Public Version

California Water Service Company

Water Supply and Facilities Master Plan

Bear Gulch District

FINAL REPORT

September 2008

Public Version

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Executive Summary

Purpose of Master Plan

California Water Service Company (Cal Water) is the largest investor-owned water utility in the western United States serving over 1.7 million people in 75 communities, with 28 operating systems throughout California. Cal Water has provided water service to the Bear Gulch area since 1933. The Bear Gulch District serves Atherton, portions of Menlo Park, Portola Valley, Woodside, and areas of unincorporated San Mateo County (North Fair Oaks, Menlo Oaks, Sequoia Tract, West Menlo Park, Weekend Acres, Ladera, Los Trancos Woods, and Vista Verde). The study area includes the former Los Trancos County Water District system acquired by Cal Water in 2005, which is now part of the Bear Gulch District.

Cal Water undertook this Master Plan to develop a comprehensive 20-year prioritized CIP that will provide a sound basis for the near term California Public Utilities Commission (CPUC) rate case, meet supply and reliability goals, and cost effectively and collaboratively optimize water supply and system reliability in coordination with other peninsula districts, in order to ensure safe and reliable, high quality water service including fire protection for both existing and future customers in the Bear Gulch District. The planning timeframe for this study extends to 2030.

The master plan study integrated several elements, as shown in Figure ES-1, in formulating plan recommendations.

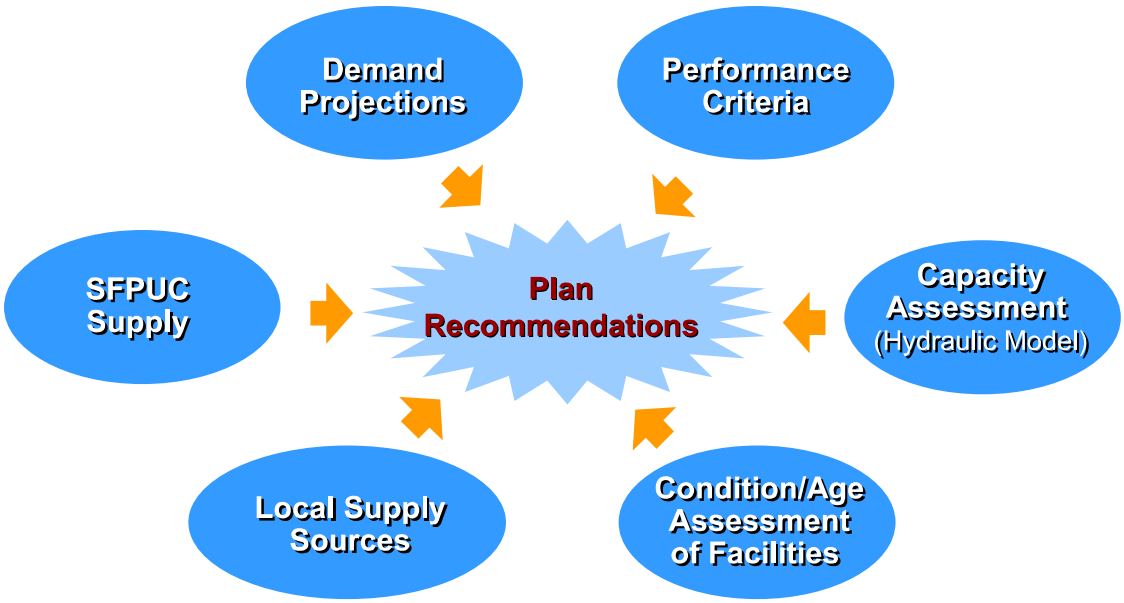


Figure ES-1
Master Plan Elements

Water Demands

Current average day water demand in the Bear Gulch District is about 13 mgd. Table ES-1 summarizes projected buildout (year 2030) demands in the Bear Gulch District. A range of demand projections was developed based on various scenarios of growth rates and unit demand rates.

See Section 3 for more detailed information.

Table ES-1
Buildout (Year 2030) Demand Projections for Bear gulch District

Demand Scenario	***Key Assumptions***	***Buildout Average Day Demand***	
		(mgd)	***(acre-feet per year)***
High End – Planning Level Demand	Highest rates of service growth and unit demands over past 20 years.	14.5	16,242
Mid Range	5-year average growth rates and 10-year unit demands.	13.7	15,347
Low End	Equivalent to 10% conservation savings as reduction from high end estimate.	13.0	14,562

The planning-level demand for this master plan is conservatively based on the high end of the demand range. The low end estimate is equivalent to achieving planned conservation savings of 10 percent as a reduction from the high end estimate. If planned conservation savings are achieved, demands would remain at current levels.

The demand projections are based on land use and development projections obtained from local planning agencies including the Cities/Towns of Atherton, Menlo Park, Portola Valley and Woodside, as well as San Mateo County.

Current Water System Facilities

The existing Bear Gulch water system consists of 44 pressure zones. The lowest and largest zone is located closest to San Francisco Bay, with many smaller zones extending westerly and southerly into the hills. The three largest zones comprise 80 percent of the total system demand; the remaining 41 zones are much smaller and account for the remaining 20 percent of total system demand.

See Section 4 for more detailed information.

The Bear Gulch District is supplied from San Francisco Public Utilities Commission (SFPUC) turnouts. In addition, the District has a local surface water supply from Bear Gulch Creek that is stored in the Bear Gulch Reservoir and treated at its Bear Gulch Water Treatment Plant.

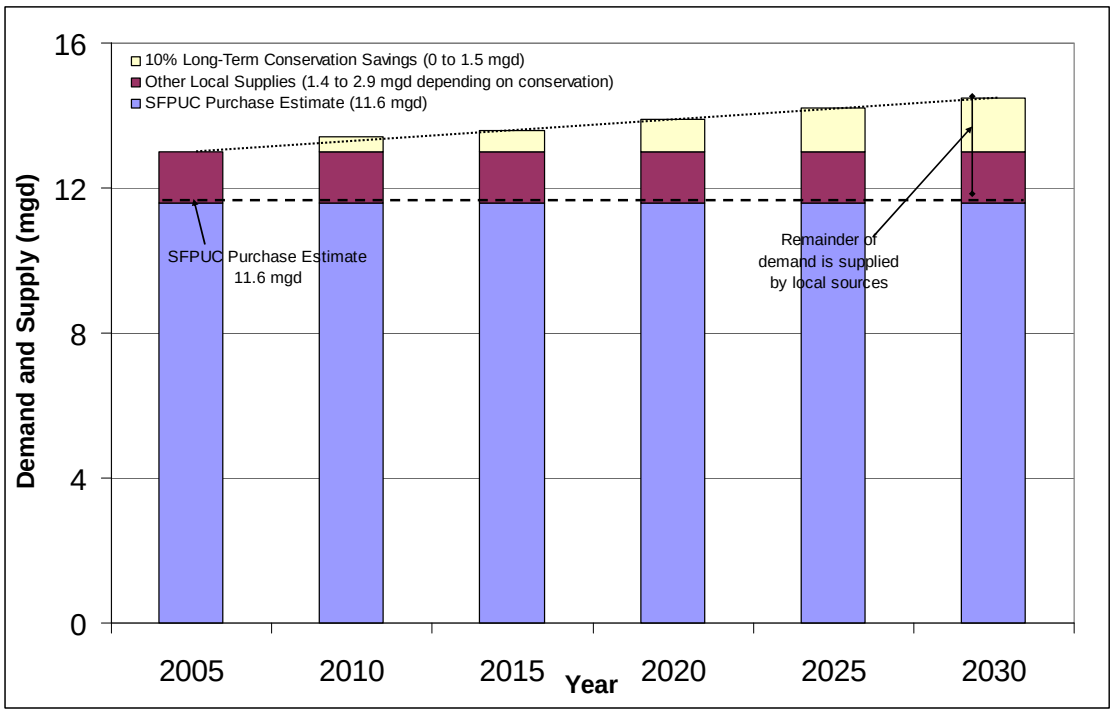
A transmission grid of larger diameter pipelines moves water through the system from the supply sources. System facilities also include reservoirs and pump stations.

Water Supply Strategy

See Section 7 for more detailed information.

It is recommended that Cal Water pursue a supply strategy for the Bear Gulch District that includes an array of supply components for flexibility and reliability. SFPUC surface water will continue to be the primary supply. In addition, the Bear Gulch District has Cal Water-owned local surface supply that currently provides about 10 percent of the total supply. Other local supply sources will supplement SFPUC surface water supply. Water savings from long-term conservation measures and temporary demand reductions during droughts/emergencies are key local supply components for this plan, due to high costs of implementing other local sources.

Figure ES-2 illustrates the projected growth in demands over time to 2030 under normal demand conditions, and the supplies to meet these demands. As indicated on the figure, local supply will be needed to augment SFPUC surface supply of 11.6 mgd under normal conditions (year 2030 SFPUC purchase estimate), which could be reduced to 8.7 mgd during droughts and emergencies.



(1) Local supply could consist of local surface water, groundwater, recycled water, or desalination. The figure indicates the amount of local supply needed so that the year 2030 SFPUC purchase estimate is not exceeded.
(2) SFPUC supply is at SFPUC's year 2030 purchase estimate amount. In the near-term until additional local supplies are developed, SFPUC surface water supply may provide a larger amount of the total supply.

Figure ES-2
Water Demand & Supply Projections – Normal Conditions
Bear Gulch District

Local supplies needed to supplement SFPUC will be up to 2.9 mgd by year 2030 under normal conditions, and up to 5.8 mgd during droughts and emergencies when SFPUC supplies are reduced. These local supplies would consist of a mix of local surface water, long-term conservation savings, temporary demand reductions, groundwater, recycled water, and desalination supply. As discussed below, water conservation savings under normal conditions and temporary reductions during emergencies and droughts are cost-effective ways of providing additional local supply, compared with the high costs of developing other local supplies.

It is recommended that Cal Water target development of a minimum of 2.9 mgd of local supplies by year 2030 from a combination of local surface water, groundwater, desalination, and/or recycled water. With this level of local supply, Cal water could meet normal demands without relying on permanent long-term conservation savings, which may not be achieved.

Assuming no long-term conservation savings, 2.9 mgd of local supplies plus temporary demand reductions of 20 percent (which would provide an additional 2.9 mgd) would meet demands during droughts/emergencies. It is reasonable to plan on requiring temporary demand reductions during droughts and emergencies, especially when local supply options are limited. During droughts/dry years, no local surface water supply will be available, so there must be a greater contribution from other sources. If long-term conservation savings of 1.5 mgd (10 percent savings) by year 2030 are achieved, then temporary demand reductions during droughts/emergencies could be reduced to 10 percent rather than 20 percent; or alternatively, if temporary demand reductions remained at 20 percent, then additional supply needed from other sources, such as groundwater or desalination, could be reduced to 1.4 mgd.

In developing water supply recommendations, the Bear Gulch District has been analyzed to determine a reasonable water supply approach for this area independent of other Cal Water service areas in San Mateo County. The recommended strategy includes:

- SFPUC surface supply will continue to be the primary supply, and will be supplemented by a mix of other local supply sources. Under normal conditions, the recommended strategy assumes normal supply equal to the planned SFPUC purchase amount of 11.6 mgd, and provides for up to a 25% reduction in SFPUC surface supply to 8.7 mgd under drought/emergency conditions.

- Water conservation savings under normal conditions and temporary demand reductions during emergencies and critical droughts are cost-effective ways of providing local supply to supplement SFPUC supply. These measures are a key component of the water supply strategy.

- Planned long-term conservation savings are permanent reductions in demand due to implementation of planned conservation measures as described in the Urban Water Management Plan (UWMP). It is recommended that Cal Water continue with ongoing implementation, which may result in a maximum reduction in demand of up to about 1.5 mgd of local supply by year 2030. This reduction is considered as a future local supply component to offset demand. If the planned reduction is not achieved, then supply from other local sources must be increased to make up the difference, e.g., a higher level of temporary demand reductions during droughts/emergencies.

- Additional temporary emergency demand reductions during SFPUC shortages assumes more stringent demand reduction measures could be implemented on a temporary basis during droughts or emergencies that reduce SFPUC supply. Assuming a minimum level of 10 percent additional temporary demand reductions by customers, this would be equivalent to about 1.5 mgd of local supply by year 2030. In general, a 10 percent level of temporary conservation has been readily achieved by other agencies during past droughts and emergencies, if customers are informed of the need through public education efforts. If the planned long-term conservation savings of 1.5 mgd are not achieved, then requiring 20 percent additional temporary demand reductions would be equivalent to about 3 mgd of local supply by year 2030, and could essentially take the place of the planned long-term conservation savings.

- The District's local surface water production under historic operating conditions has averaged 1.2 mgd annually over a 27-year period encompassing a range of dry, normal, wet and very wet years. With the proposed Operations Conservation Measures for creek diversions, the anticipated median supply will be 0.6 mgd; up to 2.2 mgd as a mean average over time. There will be no local surface water supply during dry years.

  - With recommended raw water and distribution system improvements, it is anticipated that the available local surface supply could be more effectively utilized in the future. This will require effectively capturing and utilizing peak creek flows, which will require adequate raw water storage capacity, raw water conveyance improvements, and some distribution system improvements. However, the amount of this supply will vary annually based on hydrologic conditions, and no local surface supply will be available during drier years and droughts unless drought storage is provided. Bear Gulch Reservoir storage is limited due to operational restrictions and would require significant improvement to expand its storage capability.

- Groundwater resources in the Bear Gulch District are better than in Mid-Peninsula area, although not as good as in the South San Francisco area. Preliminary estimates suggest there may be an opportunity to supplement the Bear Gulch District water supply with 2 to 4 production wells at an average production rate of about 120 gpm per well. At this production rate, it is anticipated that 2 to 4 wells would provide 0.35 to 0.7 mgd on an average annual basis (about 400 to 800 AF per year). However, preliminary analyses indicate that pumping may potentially impact groundwater levels and other users in the basin even at these extraction rates. Subsequent to the master plan, a comprehensive data collection effort should be done to better quantify sustainable basin yield.

- Recycled Water supply involves longer-term measures that require regional implementation and participation by other agencies. Potential benefits are to reduce the potable supply requirements by utilizing recycled water for appropriate uses (e.g., irrigation) now served by potable water. In the Bear Gulch District, the total theoretical demand that might be met by recycled water (assuming customers were willing) is small, less than 0.7 mgd on an average annual basis, and implementation costs are very high. Extensive public education and outreach efforts will be needed to promote recycled water use. This would be a long-term supply option that will require additional feasibility studies to determine its potential long-term cost-effectiveness.

- Desalination (reverse osmosis [RO] treatment) of Bay water would be a longer-term measure that could be implemented in the future if determined to be cost-effective relative to the cost of other components. Implementing this component will require feasibility investigations and considerable lead time. This component may be more cost-effective at a regional level for the three Cal Water San Mateo County peninsula service areas. For example, the San Mateo system, in particular, has some features that may be more suitable for implementation of RO supply, e.g., proximity of the Bay, potential use of existing outfall for brine disposal.

Cal Water intends to undertake a subsequent planning effort to develop an integrated water supply approach for all of its San Mateo County systems as a whole: Bear Gulch, Mid-Peninsula, and South San Francisco. The best locations for each source of supply and the appropriate mix of supply sources will then be determined at a regional level to determine the most cost-effective approach. Potential sources of supplemental surface water supply will also be addressed as part of the integrated water supply planning effort.

Water System Analysis

An analysis of the Bear Gulch water system was conducted to determine required improvements. The analysis used a computerized hydraulic model of the water system that was developed and calibrated as part of this master plan study. In addition, reliability evaluations of each system were conducted, and replacement needs for aging facilities were identified.

See Section 8 for more detailed information.

The water system analyses were based on performance criteria as prescribed by California Public Utilities Commission (CPUC) General Order 103 that specifies rules governing water service for private water companies, and Cal Water's established criteria.

Key findings from the water system analysis are summarized below for the Bear Gulch system:

- **Future Demands** (Section 8.2)**.** There is little difference in the requirements for the existing and buildout demand scenarios due to the small future increase in demands. The average day demand at buildout for the entire Bear Gulch system is projected to increase by about 1.1 mgd over existing, which is an 8% increase. About 65 percent of the future growth will occur in Zone 220, which is the largest and lowest zone.

- **SFPUC Turnout Capacity** (Section 8.4). There is adequate existing SFPUC turnout capacity for buildout conditions for maximum day demand, which is the performance criterion, but not peak hour demand. Per Cal Water performance criteria, storage would be used to meet the difference between maximum day and peak hour demand.

- **Pumping Capacity** (Section 8.5). There are only small capacity deficiencies under normal operating conditions. There is a 0.49 mgd shortage of existing firm pumping capacity for buildout demands at booster pump station 13. Hydropneumatic pump stations have adequate capacity for normal operating conditions i.e., peak hour demands; except for zone 640 which can be supplied by zone 805 via PRV; however, none are able to meet the current criteria for fire flow. Pump station improvement recommendations consider capacity, reliability, and replacement needs.

- **Storage Capacity** (Section 8.6). A total of 18 MG additional storage in the Bear Gulch system is required for buildout demands to fully meet the performance criteria established in Section 5. The largest zone, 220, requires about 13 MG of the additional storage by buildout. The storage sub area including zones 400, 319-A and 319-B requires 2.4 MG of additional storage. There are also a few smaller zones that require a small amount of additional storage, which could be met by upsizing

the tanks when they are replaced due to age/condition. Reservoir improvement recommendations consider capacity, reliability, and replacement needs.

- **PRV Capacity** (Section 8.7). Zones served solely by PRVs were evaluated. All 25 of the zones have adequate capacity for peak hour on maximum demand day. Fifteen of the 25 zones do not have adequate capacity for fire flow on average hour of maximum day. PRV improvements to address these deficiencies are contained in the Section 9 plan recommendations.

- **Pipeline System** (Section 8.8). The major issue identified in the hydraulic analysis is that some pipelines which supply Woodside Hills in the northwest part of zone 400 have high headlosses that cause low pressures in the Woodside Hills area. Otherwise, the pipeline system has adequate hydraulic capacity for buildout peak hour demands under normal conditions. However, some pipeline improvements are recommended to increase system reliability, e.g., being able to serve large portions of the service area from more than one critical delivery location. Pipeline improvement recommendations consider capacity, reliability and replacement needs.

- **Reliability Evaluation** (Section 8.9). There are potential opportunities for relatively simple system modifications that would enhance supply reliability, consisting of a PRV bypass and an emergency pump at two key locations. At some key pump station locations, either on-site generators or hook-ups for portable generators are recommended.

- **Ability to Accommodate Local Supply Options** (Section 8.10). Improvements to fully utilize Bear Gulch water treatment plant capacity to deliver local surface water to the distribution system during low demand periods are recommended. Potential future groundwater and desalination supply could be accommodated in the low zone and conveyed to the rest of the system with minimal improvements.

- **Replacement Guidelines** (Section 8.11). In general, the Bear Gulch system facilities are very well maintained, although some are old with respect to typical useful life expectancies. A number of facilities are near or over their expected useful life. Replacement recommendations for pump stations and reservoirs are discussed in conjunction with capacity and reliability considerations.

Plan Recommendations

See Section 9 for more detailed information.

Pipeline improvements are recommended in some parts of the existing Bear Gulch distribution system, particularly in the largest zones, in order to strengthen the overall system transmission grid and improve system reliability. Additional storage capacity will be needed; the majority in the three largest storage service areas. Recommendations are included to improve the reliability of water supply to the service area, and the ability to move

water throughout the system. The Bear Gulch District contains aging facilities that will need replacement over time.

SFPUC surface water will continue as the primary supply. In addition, a mix of other local supply sources will be utilized. The local sources include local surface water supply, long-term conservation savings as targeted in the Urban Water Management Plan, and use of temporary demand reductions if needed during droughts and emergencies. Development of future groundwater supply is recommended if appropriate opportunities can be identified, in particular to provide a local drought supply since local surface water which is not available in dry years. In the long-term, recycled water and desalination may be potential future options, but should be further evaluated as part of the integrated water supply plan with respect to the most effective implementation at a regional level.

Three timeframes were used to phase the recommendations:

- Near-term (2008 to 2012)
- Intermediate (2013 to 2017)
- Long-Term (2018 to 2030 Buildout)

Within each timeframe, the projects are listed in priority order according to the following types of improvements (listed in highest to lowest priority):

- Enhancing system reliability to move water throughout the system in the event of outages of SFPUC supply turnouts, and to more effectively utilize the District's local surface water treatment plant supply.

- Additional storage capacity to meet the established performance criteria, particularly to increase emergency storage to improve system reliability.

- Additional pumping capacity to meet the established performance criteria, and to provide additional system reliability.

- Additional PRV capacity for fire flows.

- Near-term implementation of local supply sources to improve supply reliability in the event of short-term reductions in SFPUC surface supply during emergencies or critical droughts: including more effective utilization of local surface supply, implementing Urban Water Management Plan measures for long-term conservation savings, utilizing temporary demand reductions as needed during droughts/emergencies, and installation of groundwater wells if appropriate sites can be identified.

- Long-term implementation of other local supply measures, such as recycled water and desalination, if feasibility is confirmed by subsequent studies. Implementation

of these long-term measures would also be based on the outcome of integrated water supply planning for all Cal Water's San Mateo County systems.

- Replacement of other aging facilities over time including small diameter pipelines, pump stations, reservoirs, and SCADA facilities.

Table ES-2 and Figure ES-3 summarize the recommended improvements.

More detailed information is provided on recommendations over the next 5 to 10 years through 2018. These near-term and intermediate actions focus on improving the reliability of the existing supply and distribution system, and providing required capacity in the distribution system to meet the established performance criteria.

The recommended plan provides flexibility for implementation of various long-term steps depending on the outcome of near-term actions. Over the next 5 to 10 years, some uncertainties regarding local supply components should be resolved that will help better identify long-term implementation steps. Then, based on actual conditions in the future, the appropriate long-term pieces can be implemented.

Table ES-2
Summary of Recommendations for Bear Gulch District

Item	*Description*	*Estimated Total Capital Cost in 2008 $ Million*		*Long - Term Actions (2019 - 2030 Buildout)*
		Near-Term (2009 - 2013)	*Intermediate (2014 - 2017)*	
Distribution System Capacity and Reliability (improve system capacity and reliability)				
Improvements to Enhance Supply Reliability and Effectively Utilize Local Surface Supply				
Permanent PRV and pipeline connection from Station 04 discharge to zone 220	Placeholder for improvements to be able to effectively utilize the full capacity of the local surface water treatment plant. Provides emergency supply from either the treatment plant or SFPUC Bay Division pipelines 3 and 4 to zone 220 if SFPUC Bay Division pipelines 1 and 2 and Palo Alto pipelines go out of service.	$0.2	$0.0	
SCADA controls for PRVs at SFPUC turnouts	Automatically control flows from SFPUC turnouts in order to fully utilize treatment plant water. Add PRV setting control and downstream pressure readings at each SFPUC turnout (7 locations).	$1.0	$0.0	
Bypass PRV at Santa Cruz and Sand Hill	Reliability improvement to provide suction pressure from zone 400 to pump station 20 if SFPUC turnout at Alpine Road is out of service.	$0.2	$0.0	
Booster pump tie-in at Oak and Oak Knoll	Reliability improvement to provide suction pressure from zone 220 to pump station 20 if SFPUC turnout at Alpine Road is out of service.	$0.2	$0.0	
Storage Capacity and Reliability Improvements				
Storage in Zones Deficient in Fire Reserve Capacity	Additional storage is needed to meet fire reserve requirements according to the master plan criteria in the following tanks: 7 Woodside Highland, 22 Canada, 25 Woodside Oaks, 31 Summit, 32 Wayside, 36 Bonita, and 38 Vista Verde. These zones have small demand relative to the fire requirements. Costs are based on replacement with larger tank; however, dual tanks could be considered if site space is adequate.	$2.3	$3.8	
Storage for zones 440, 560, and 680 (fire reserve)	At station 28, the 0.2 MG Ladera tank is 60 years old although reported in good condition. It is undersized by 0.48 MG at buildout demand conditions primarily due to fire reserve requirements according to the master plan criteria. Cost assumes replacement with 0.7 MG tank (or dual .35 MG tanks).	$2.0	$0.0	
Storage for zone 715 (fire and emergency reserve)	Alpine Hills tank T-017-T1 is undersized by almost 1 MG due to both fire flow and emergency capacity at buildout. Though reported in good condition, the tank is 53 years old and should be evaluated for replacement/rehabilitation. Additional storage may be located either at Alpine Hills or elsewhere in zone 715 with similar elevation. Replace existing old tank with new larger 0.75 MG tank. Install bypass at Pump Station 26 to backfeed surplus Portola tank storage of 0.6 MG from zone 960 into zone 715.	$2.0	$0.0	
Storage for zone 220 (no existing supply; served from SFPUC turnouts)	Construct 13.7 MG storage for this zone which is served directly from SFPUC and has no existing storage. This storage could be located either at the Bear Gulch yard if there is sufficient space, at station 5, or at other appropriate/available sites for gravity flow based on ground elevation or pumped flow from ground-level tanks in zone 220. Cost assumes 3 tanks (2 @ 5 MG, 1 @ 4 MG).	$4.0	$25.0	
Storage for zone 400 (emergency storage)	Zone 400 requires 1.8 MG of additional storage at buildout. The 62 year old 0.1 MG redwood tank and the 57 year old 0.25 MG steel tank at Intermediate station 05 exceed Cal Water's expected service life. The tanks should be evaluated for replacement/upsizing to meet the required additional storage.	$1.2	$5.0	
Storage for zone 590 (emergency storage)	For buildout conditions, 1.6 MG additional storage is needed for zone 590. Storage facilities in zone 590 have exceeded Cal Water's expected service life; station 6 Coombsville, and station 19 Ridgeway. Station 16 Woodside was to be replaced in 2007. Tanks should be evaluated for replacement/rehabilitation for increased capacity to meet storage requirements.	$2.0	$8.0	
Storage for zone 815 (emergency storage)	Zone 815 and related zones require an additional 0.23 MG of storage, primarily due to low emergency reserves. Cost assumes replacement with a single 1 MG tank or dual 0.5 MG tanks.	$0.0	$2.5	
Pump Station Capacity and Reliability Improvements				
Portable Backup Generators	Provide portable generator connections for 4 pump stations that meet two of the four criteria for critical pump station: Stations 6,23, 24, and 26. Cost includes purchase of an additional 4 portable generators.	$1.6	$0.0	
Pump Stations 8 and 13	Recommendation to consolidate Stations 8 and 13 at one location (assumed to be the existing Station 13 site). Station 8 is in very poor condition and additional pumping capacity will improve reliability of supply to the southern portion of the system. Station 13 requires additional capacity, and also has an old pump that exceeds the useful life criterion. Cost assumes a combined facility with two sets of pumps - one set for 660 (station 8) and one set for 715 (station 13). Placeholder budget assumes station capacity sized for maximum day demand for entire southern area without station 20, for improved reliability. At a minimum, the station should be sized for the buildout maximum day demand for its current service area plus a standby pump. Required transmission improvements are included below under Pipeline Capacity & Reliability Improvements; these improvements are needed even if the station is sized for its current service area.	$2.2	$0.0	
Pump Station 20	Placeholder budget included to expand pump station for improved reliability of service to the southern portion of the Bear Gulch District - expand station to be able to provide all supply to the area without Station 8, which will require 3.8 mgd firm capacity (2 existing 500 gpm pumps, 4 additional 550 gpm pumps including one as standby). At a minimum, a standby pump should be added at station 20 for its current service area.	$3.4	$0.0	
Hydropneumatic Stations - pump capacity upgrades at stations 11, 17, and 19.	Replace existing old pumps and motors at these stations with larger pumps to provide both peak hour and maximum day plus fire flow. Implement associated electrical and telemetry upgrades as needed. Evaluate hydropneumatic tank condition and size as part of the upgrades.	$0.0	$2.0	
PRV Capacity and Reliability Improvements				
PRV Capacity Upgrades	Install an additional large PRV (4" or 6") to provide fire flow capacity during average hour of maximum day in zones 265, 395, 440, 475-A, 475-B, 500, 510, 525, 655, 680, 795-2, 850, 1265-2A, 1265-2C, and 1435. The existing PRVs in these small zones can meet peak hour demands, but cannot provide the required fire flow per the master plan criteria. In addition, a 6" PRV from zone 805 to 640 would be needed if station 15 is eliminated.	$6.4	$0.0	
Pipeline Capacity and Reliability Improvements				
Major Transmission Improvements in 220 Zone	29,500 LF of 12-inch pipeline replacements	$2.6	$4.5	
Major Transmission Improvements in 590 Zone	11,500 LF of 16-inch pipeline replacements; 5,000 LF of 12-inch pipeline replacements; 1,000 LF of new 12-inch pipeline for second highway crossing	$2.4	$4.0	
Additional Transmission Improvements in 590 Zone for Combined PS 8 & 13	2,500 LF of 24-inch pipeline replacement in Moore Road from Station 5 to Woodside; 5,900 LF of 16-inch pipeline extension in Portola Road from Station 8 to 13.	$3.0	$0.0	
Transmission Improvements in Alpine Road and Westridge for PS 20 Expansion	4600 LF of 24-inch replacement pipeline in Alpine Road from Station 20 to Westridge; and 4100 LF of 18-inch replacement pipeline in Westridge from Alpine Road to Cervantes	$0.0	$3.6	
Reinforcement of Fault & Slide Crossings	Total of 25 Locations: High Importance - 7 locations; Medium Importance - 14 locations; Lower Importance - 4 locations.	$2.0	$5.0	
Bypasses at Creek Crossings	Total of 47 Locations: High Importance - 10 locations; Medium Importance - 19 locations; Lower Importance - 18 locations.	$2.0	$5.0	

Table ES-2
Summary of Recommendations for Bear Gulch District

Item	Description	Estimated Total Capital Cost in 2008 $ Million		Long - Term Actions (2019 - 2030 Buildout)
		Near-Term (2009 - 2013)	Intermediate (2014 - 2017)	
Local Supply Measures (enhance supply capacity, improve supply reliability)				
Water Conservation Measures				
Long term permanent conservation savings	Continue implementation of planned long-term conservation measures per Urban Water Management Plan. Evaluate implementation and effectiveness of planned conservation measures; modify as needed as part of Urban Water Management Plan update process.	Costs for these measures are not facility capital costs.	Costs for these measures are not facility capital costs.	Conservation program implementation costs as determined in Urban Water Management Plan.
Temporary demand reductions	Implement temporary demand reductions during emergencies and droughts as outlined in Urban Water Management Plan (Water Shortage Contingency Plan), as needed to address temporary reductions in total supply.			
Local Surface Supply - raw water improvements (Note: Distribution system improvements are addressed in above section of table.)	Near-Term: Conduct detailed studies, using new operation conservation measures for flow diversions and historic creek flow data, to confirm raw water storage capacity needed to fully utilize allowable diversions in normal/wet years. Conduct feasibility/predesign studies to confirm available storage volume in existing Bear Gulch reservoir, and storage improvements that may be needed to increase withdrawal rate and/or drawdown level.	$1.1	$0.0	Re-assess long-term needs and costs in future master plan updates.
	Near-Term and Intermediate: Implement raw water pumping and pipeline improvements to increase conveyance capacity from diversion locations to the reservoir and WTP. Placeholders are included for: 1) Station 3 pumping capacity upgrades to double its firm capacity to 9 cfs (5.8 mgd or 4000 gpm); and 2) replacing the existing raw water pipeline (9500 LF of 24-inch and 7800 LF of 30-inch).	$2.0	$8.0	
	Long-Term: Re-evaluate potential supplemental sources of surface water supply and potential drought storage options, as part of regional water supply planning efforts.			
Groundwater	Design and implement an ongoing groundwater monitoring program to develop additional information regarding groundwater resources in the Bear Gulch District using appropriate existing wells in the area identified as favorable for groundwater development. Periodically evaluate the data with respect to overall trends.	$0.5	$0.8	Re-assess long-term needs and costs based on monitoring findings.
	Near-Term: Conduct detailed groundwater studies/investigations to confirm the feasibility of implementing wells at specific sites. The studies should confirm expected yield, identify specific locations for wells, evaluate groundwater quality at the sites, and determine treatment requirements. For selected sites, conduct field investigations, including test hole and monitoring well, develop predesign information, and provide preliminary drinking water source assessment information to DPH. Complete an initial study checklist to determine the required environmental documentation.	$1.0	$6.4	Re-assess long-term costs in future master plan updates. Conceptual cost of $6.4 million for 4 additional emergency/drought wells (additional 0.7 mgd emergency/drought supply).
	Intermediate: Based on the results of the near-term studies and site investigations, implement up to 4 wells if appropriate locations can be identified, which would provide an annual sustainable supply of up to 0.7 mgd. Costs assume that extensive treatment may be needed to effectively utilize the well supply during emergencies/droughts (if blending with surface water is reduced or not possible).			
	Long-Term: Re-evaluate status of groundwater supply in future master plan updates and determine appropriate long-term actions. Consider implementing additional wells that would function only as emergency/drought supply, if appropriate sites can be identified. Placeholder costs are included for implementation of up to 4 additional wells, which could provide an additional 0.7 mgd supply, based on the same cost assumptions as for the intermediate wells.			
Recycled Water	Near-Term: Continue discussions with Redwood City to determine the conditions and cost for obtaining recycled water supply through the Redwood City system; initiate discussions with Palo Alto regarding their future plans for expansion of their recycled water system and potential partnership with Cal Water.	$0.5	$0.8	Conceptual capital cost estimate of about $14 million for recycled water distribution system to serve a "theoretical" average day demand of 0.7 mgd. Capital cost estimate does not include cost for purchase of recycled water supply from Redwood City (which is an operating cost, not a capital cost). Re-assess long-term costs in future master plan updates.
	Intermediate: If near-term discussions indicate that recycled water may potentially be cost-effective, conduct feasibility studies to identify specific customers and refine facility requirements.			
	Long-Term: Re-evaluate implementation of recycled water supply system in future master plan updates.			
Desalination	Near-Term: As part of regional supply planning for all San Mateo County service areas, scope and conduct a conceptual feasibility study to explore siting, technology, and potential partnering options.	$0.5	$0.8	$15 million to $30 million for 1 to 2 mgd facility
	Intermediate: If feasible options are identified in the near-term feasibility study, evaluate implementing a pilot study as part of regional supply planning for all the San Mateo County service areas.			
	Long-Term: If confirmed by previous studies and if future conditions indicate it is a cost competitive supply source, an RO treatment facility of either 1 mgd or 2 mgd could be constructed for the Bear Gulch District. The capital cost range is for a 1 to 2 mgd facility that includes ancillary intake, raw water conveyance, treated water conveyance, and disposal facilities.			
Replacement/Rehabilitation Projects				
Reservoir Replacement: Station 02 Lake Tanks	Tanks T-002-T1 and T-002-T2 are 71 and 68 years old, well past expected service life of 48 years. These tanks are used for chlorine disinfection of local treatment plant water during the winter, and as flow through tanks from SFPUC supply during summer when the plant in not operating. Evaluate for major rehabilitation or replacement (cost based on replacement with steel tanks).	$0.0	$1.5	Re-assess long-term replacement needs in future master plan updated.
Reservoir Replacement: Arrowhead tanks	Arrowhead tanks 1 and 2 (zone 660)should be evaluated for major rehabilitation/replacement. Cost included for replacement.	$0.0	$4.0	
Pump Station Replacement (listed in priority order) - Replacement costs include pumps and motors, electrical and telemetry.				
Pump Station 4	Pump 04-C and 04-D are over Cal Water's expected service life and should be replaced. Pump 04-D is an emergency backup.	$0.0	$0.7	Re-assess long-term replacement needs in future master plan updated.
Pump Station 16	Pump station 16 is 52 years old, in poor condition.	$0.0	$0.2	
Pump Station 14	Pump station 14 draws suction pressure from Ormondale tanks and is necessary to turn over the tanks. It exceeds expected service life and should be evaluated for replacement/rehabilitation.	$0.0	$0.2	
Pump Station 21	This pump becomes the lead station into zone 815 during winter to maximize treatment plant water usage. It exceeds Cal Water's expected service life and should be evaluated for replacement/rehabilitation.	$0.0	$0.4	
Pump Station 17-A	Pump 17-A is 52 years old and exceeds the expected useful life. It is one of four stations that feed zone 815.	$0.0	$0.2	
Pump Stations 24 and 25	These pump stations have exceeded expected service life and serve relatively small zones, 835A and 1090; and should be evaluated for rehabilitation/replacement.	$0.0	$0.6	
Pump Station 06	This pump station is 39 years old and should be evaluated for rehabilitation/replacement.	$0.0	$0.3	
Pump Station 07	One of two pumps at this station is 39 years old and should be evaluated for rehabilitation/replacement.	$0.0	$0.2	
Pipeline Replacement per Company-wide Program	Cal Water has a company-wide program for pipeline replacement of pipes less than 6-inch diameter and bare steel pipes. Specific budget amounts for replacement are determined each year based on leak history and system needs. An estimated amount is shown assuming replacement of 5,200 LF per year with minimum 6-inch diameter pipe.	$3.0	$3.0	$0.6 annually for 15 years to 2030 = $9 million during Long Term timeframe
SCADA System	Cal Water to provide information for inclusion in plan regarding planned SCADA upgrades/budget amounts for Bear Gulch District.			
TOTALS		$49	$96	To be re-assessed in future master plan updates.

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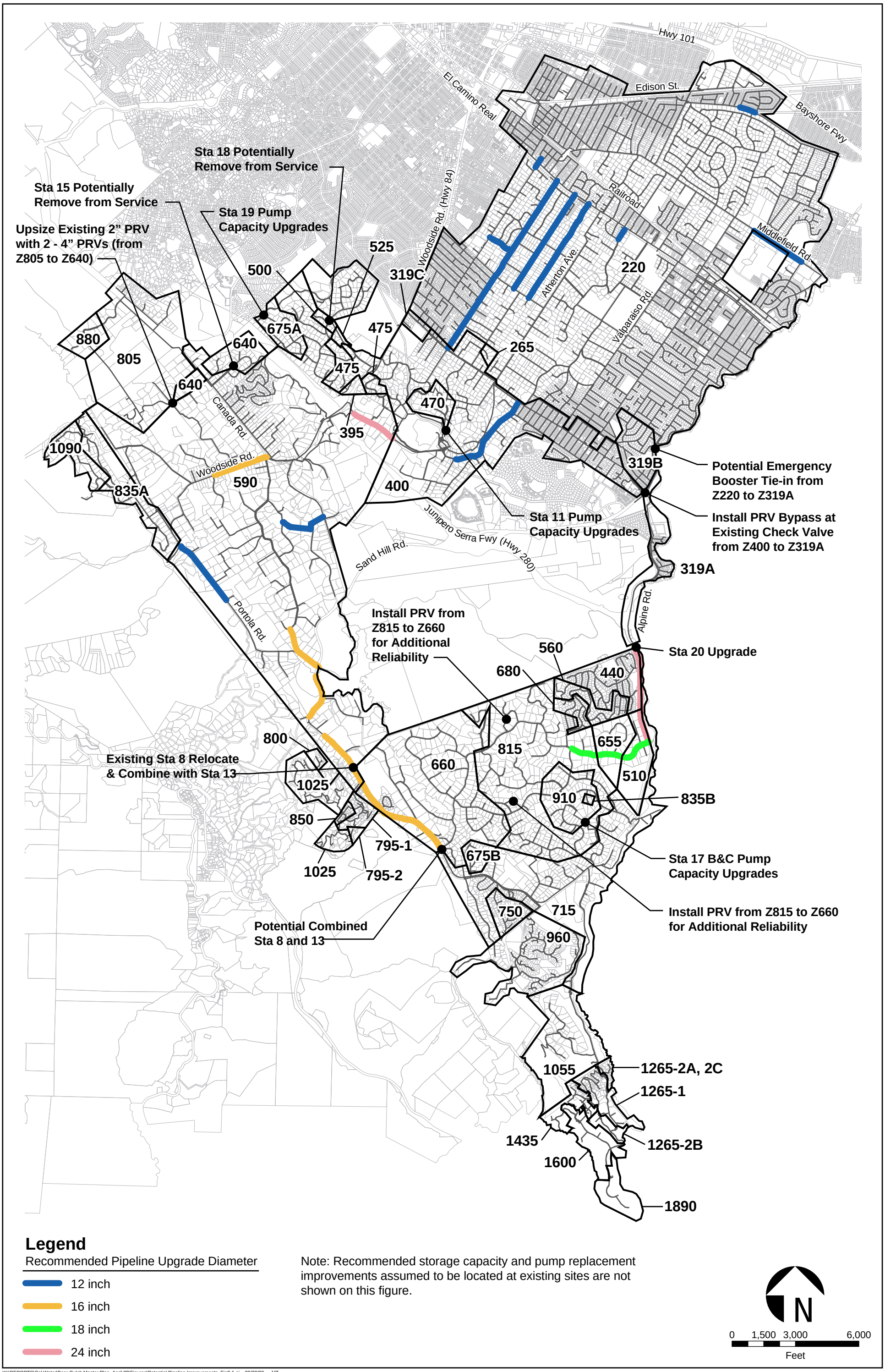

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CDM

Figure ES-3
Bear Gulch
Recommended Pipeline Improvements & Major Pump Station Improvements

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Section 1
Introduction

This section describes the purpose, organization and scope of the master plan; identifies acronyms and abbreviations used in the report; and lists acknowledgments.

1.1 Purpose of Master Plan

California Water Service Company (Cal Water) is the largest investor-owned water utility in the western United States serving over 1.7 million people in 75 communities, with 28 operating systems throughout California. Cal Water has provided water service to the Bear Gulch area since 1933. The Bear Gulch District serves Atherton, portions of Menlo Park, Portola Valley, Woodside, and areas of unincorporated San Mateo County (North Fair Oaks, Menlo Oaks, Sequoia Tract, West Menlo Park, Weekend Acres, Ladera, Los Trancos Woods, and Vista Verde). The study area includes the former Los Trancos County Water District system acquired by Cal Water in 2005, which is now part of the Bear Gulch District.

Cal Water undertook this Bear Gulch Water Supply & Facilities Master Plan to develop a comprehensive 20-year prioritized CIP that will provide a sound basis for the near term CPUC rate case, meet supply and reliability goals, and cost effectively and collaboratively optimize water supply and system reliability in coordination with other peninsula districts, in order to ensure safe and reliable, high quality water service including fire protection for both existing and future customers in the Bear Gulch District.

The planning timeframe for this study extends to 2030, consistent with the Bay Area Water Supply and Conservation Agency (BAWSCA) regional demand study.

1.2 Organization of Master Plan Report

The master plan report highlights the key findings for the master plan. Detailed technical information is provided in the appendices to the report. Table 1-1 summarizes the report organization.

Table 1-1
Bear Gulch District Supply and Facilities Master Plan Report Organization

Section	Description	Related Appendices
1 – Introduction	Overview of the purpose, organization and scope of the Master Plan.	None
2 - Study Area	Pertinent information on the study area.	Appendix A – Proposed Development Projects
3 - Water Demands	Historical water use and water demand projections used in the Master Plan.	Appendix B – Sensitivity Analyses of Service and Demand Projections
4 - Existing Water System	Overview of the water system and key facilities	None
5 - Performance Criteria	Performance criteria used for the Master Plan evaluation	Appendix C – District Information on Main Replacement Projects and Critical Pipelines

Table 1-1 Bear Gulch District Supply and Facilities Master Plan Report Organization		
Section	**Description**	**Related Appendices**
6 - Water Supply Requirements	Information on existing water supplies, comparison of water supply with projected demand, key issues affecting SFPUC surface water reliability, and future water quality regulations and potential issues.	Appendix D – SFPUC Surface Water Supply Reliability Analysis Appendix E – Water Quality Standards
7- Water Supply Strategy	Recommended water supply strategy, and description of supply components included in strategy.	Appendix F – Groundwater Supply Evaluation Appendix G – Recycled Water System Details
8 – Water System Analysis	Results of the water system evaluations conducted to determine required supply, pipeline, pumping, storage and pressure reducing valve capacities for existing and future demands.	Appendix H - Hydraulic Model Development & Calibration Appendix I - Fire Flow Simulation Results Appendix J – Property Condition Report prepared by Bear Gulch District Appendix K – Analyses of Individual Areas
9 – Plan Recommendations	Integrated plan of supply and system capacity recommendations to meet current and future water system needs, including estimated costs and phasing.	None

1.3 Scope of Services

Cal Water retained Camp Dresser & McKee Inc. (CDM) to prepare the Water Supply and Facilities Master Plan for the Bear Gulch District. HydroFocus Inc., a subconsultant to CDM, conducted the groundwater investigations.

As an initial project, CDM developed a hydraulic model of the Bear Gulch water system, and calibrated and verified the model. The model was used for development of the master plan. Information developed in the initial model work is incorporated as part of this master plan report.

The scope of work for the subsequent master plan portion of the work included the following major elements, which are described in this report:

- Prepare development and demand projections for the 20-year planning period for use in the supply and facilities evaluation.
- Develop alternative water supply sources to meet the recommended water demand projections over the planning period.
- Prepare overall water supply and facilities master plan recommendations for the district.

1.4 Acknowledgments

This report would not have been possible without the valuable assistance of Cal Water staff. In particular, the staff noted below provided comprehensive information, significant input and important insights throughout the master plan development:

Bear Gulch District Staff

- Darin Duncan, District Manager
- Paul Molder, District Superintendent
- Cary Brown, John Gomez, Marty Roberts

Engineering Staff

- Tom Salzano, Water Resources Planning Supervisor
- Michael Bolzowski, Water Resources Engineer and Project Manager
- Jim Simunovich, Engineering Operations Manager
- Jeff Yarne, Cal Water Consultant

The CDM team included:

- Phillippe Daniel, Client Officer
- Lisa House, Project Manager
- Polly Boissevain, Project Engineer
- Youssif Hussein, Task Leader, Hydraulic Modeling
- Andria Loutsch, Planner
- James Kim, Hydraulic Modeler

HydroFocus Inc. (John Fio), a subconsultant to CDM, conducted the groundwater investigations.

1.5 Acronyms and Abbreviations

The following abbreviations and acronyms are used in this report.

ABAG	Association of Bay Area Governments
AC	asbestos cement
AF	acre-feet
AF/year	acre-feet per year
ARC	American Red Cross
ASR	aquifer storage recovery
AWWA	American Water Works Association
BAWSCA	Bay Area Water Supply and Conservation Agency
Cal Water	California Water Service Company
CCP	concrete cylinder pipe
CDM	Camp Dresser & McKee Inc.
CDPH	California Department of Public Health
CI	cast iron
CIP	Capital Improvement Program, Cast Iron Pipe
CPUC	California Public Utilities Commission
DI	ductile iron
DU/acre	dwelling units per acre
EBMUD	East Bay Municipal Utility District
EPA	Environmental Protection Agency
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
fps	feet per second
ft	foot
GIS	geographic information system
gpd	gallons per day
gpm	gallons per minute
HDPE	high density polyethylene
HGL	hydraulic gradeline
HP	horsepower
HTWTP	Harry Tracy Water Treatment Plant
in	inches
LF	linear feet
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCLs	Maximum Contamination Levels
MG	million gallons
mg/l	milligrams per liter
mgd	million gallons per day
MPN	most probable number
NTU	nephelometric turbidity units

O&M	operation and maintenance
OES	Office of Emergency Services
PRV	pressure reducing valve
psi	pounds per square inch
PUC	California Public Utilities Commission
PVC	polyvinyl chloride
RO	reverse osmosis
SCADA	Supervisory Control And Data Acquisition
SFPUC	San Francisco Public Utilities Commission
SS	stainless steel
UV	ultraviolet
UWMP	Urban Water Management Plan
WSIP	Water Supply Improvements Program
WTP	water treatment plant

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Section 2
Study Area

This section describes the study area location and characteristics, and future land uses and development within the study area.

2.1 Location and Characteristics

Figure 2-1 shows the study area for this master plan. Cal Water's Bear Gulch service area is located in eastern San Mateo County approximately 30 miles south of San Francisco. The district serves Atherton, portions of Menlo Park, Portola Valley, Woodside, and areas of unincorporated San Mateo County (North Fair Oaks, Menlo Oaks, Sequoia Tract, West Menlo Park, Weekend Acres, Ladera, Los Trancos Woods, and Vista Verde). The study area includes the former Los Trancos County Water District system acquired by Cal Water in 2005, which is now part of the Bear Gulch District. The Bear Gulch District currently serves over 55,000 people.

The entire service area encompasses about 15,840 acres. The district is bordered by Redwood City on the north and west, unincorporated San Mateo County lands on the west and south, and Palo Alto, Stanford University and unincorporated Santa Clara County on the east. The service area is located on the Bay Plain and foothills of the Coastal Range. The San Andreas Fault rift zone forms the major geologic features of the area as it passes along the western boundary of the service area. Elevations in the service area range from just above sea level on the eastern boundary near Highway 101 to over 1,000 feet above sea level along western Woodside.

The climate within the study area characteristically has mild winters and dry summers, with the hills to the west shielding the area from much fog. The Woodside weather station is representative of the upper elevations in the western part of the study area, with an average annual temperature of 59.1°F and average annually rainfall of 30.0 inches. The Palo Alto weather station located closer to sea level is representative of the eastern part of the study area, with an average annual temperature of 58.0°F and average annual rainfall of 15.3 inches.

2.2 Future Land Uses and Development

Information regarding future land uses and future growth due to development or redevelopment is needed to estimate future demands. General plan and zoning land uses for the study area were obtained from the following local planning agencies: City of Menlo Park, Towns of Atherton, Portola Valley, and Woodside, and San Mateo County.

Figure 2-2 shows the ultimate land uses within the Bear Gulch service area based on the information obtained from the local planning agencies. For this master plan, it is assumed that buildout (ultimate development) of the study area will occur at or near year 2030, consistent with the 25-year planning horizon.

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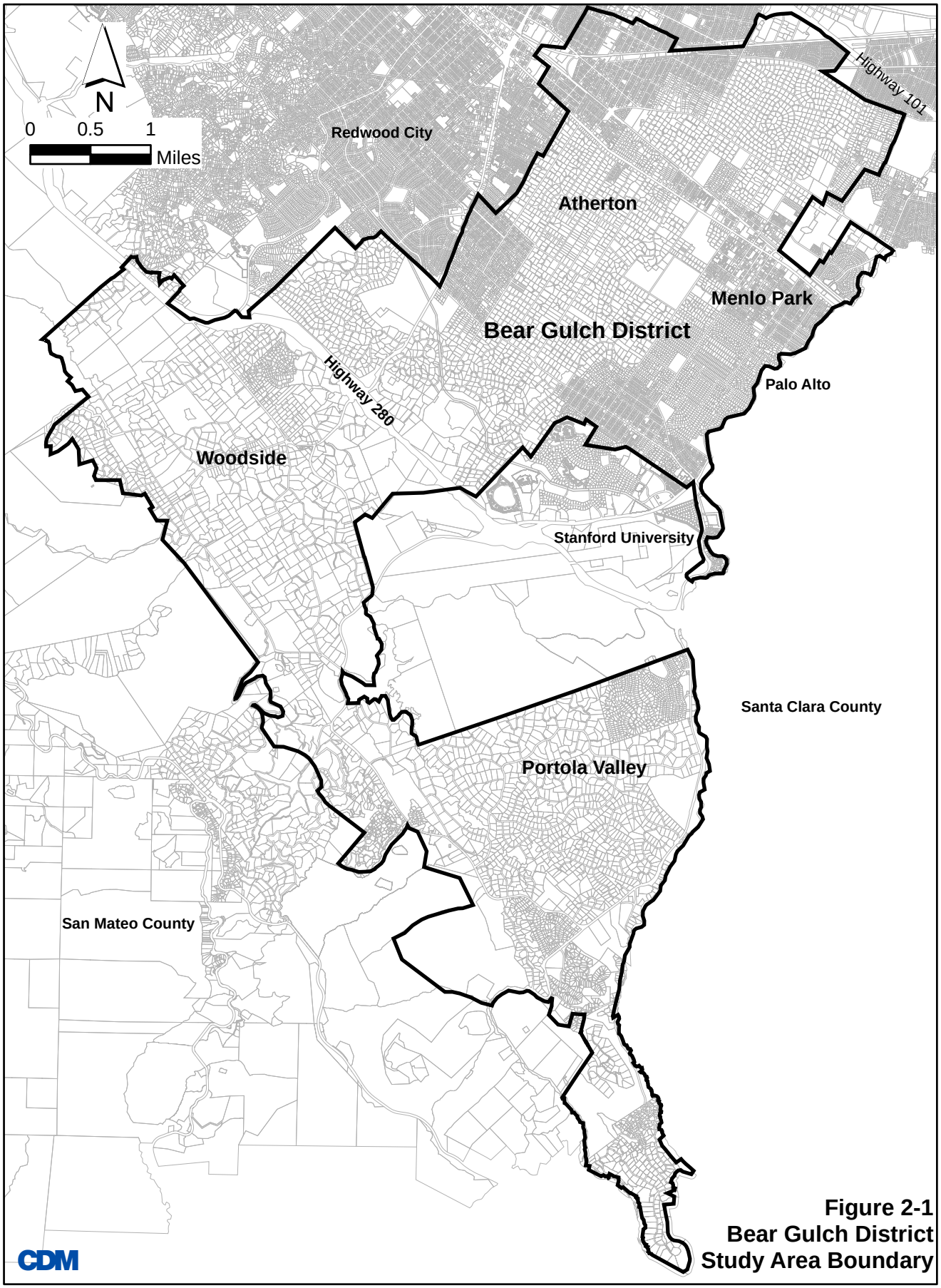

Figure 2-1
Bear Gulch District
Study Area Boundary

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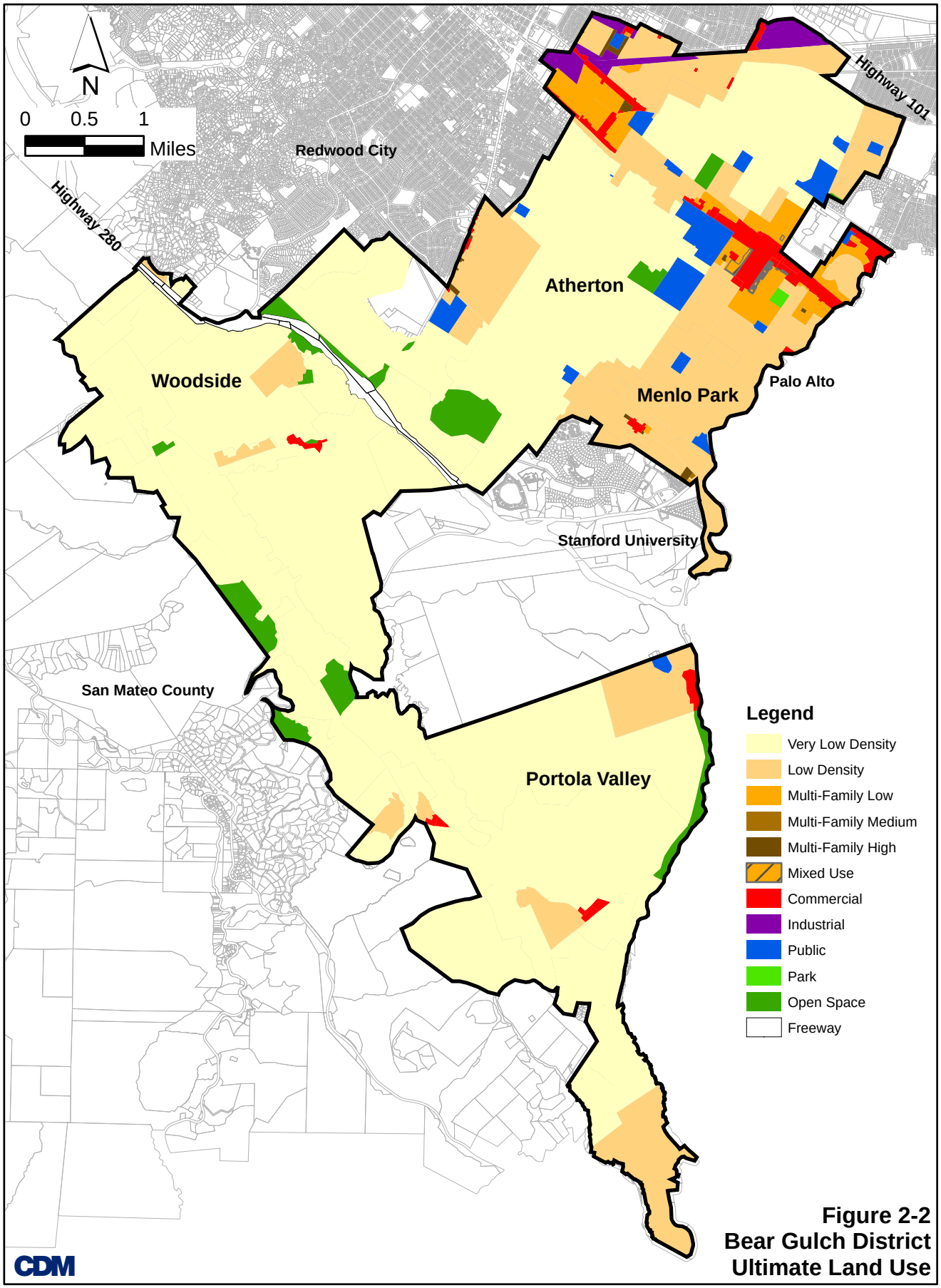

Figure 2-2
Bear Gulch District
Ultimate Land Use

The zoning and general plan land use categories used by the local planning agencies were grouped into simplified land use types to facilitate the master plan analysis. Table 2-1 shows the simplified land use types and the corresponding zoning and general plan categories. The simplified master plan land use types are used for Figure 2-2.

The study area has few remaining vacant parcels for development. Much of the future growth will consist of infill development and redevelopment of existing uses. Examples of redevelopment include intensification of residential uses when an area is redeveloped with higher density housing (for the more urban portions of the service area), and replacing existing single-family homes with larger homes, perhaps with secondary "in-law" units.

Appendix A provides a detailed list of specific development projects in Menlo Park, obtained from the Menlo Park Community Development Department, which are in various stages of approval and completion. The majority of these projects are in the El Camino Real corridor. Discussions with the other local planning agencies indicated little development, besides conversions to larger homes, is expected. The Appendix A list of specific development projects in Menlo Park indicates that all 211 future housing units are expected to be multiple family units, consistent with future redevelopment occurring at higher densities.

The development projects listed in Appendix A have progressed to the point of development applications, tentative maps, improvements plans, and/or approval for construction. Typically these are relatively near-term projects that would be implemented over the next 5 to 15 years. In addition to these projects, future development will also include other projects not yet proposed by developers but that would be allowable by the local General Plans.

Table 2-2 summarizes acreages of the ultimate land use types within the study area. Residential uses comprise about 91 percent of the lands within the service area; commercial uses about 2 percent; industrial uses about 1 percent; public/institutional (governmental) about 2 percent; open space and park uses about 3 percent; and freeways use the remaining 1 percent of land within the service area.

The Association of Bay Area Governments (ABAG) provides demographic data by census tract in their "Projections 2005" document. The ABAG projections assume a buildout timeframe of year 2030, consistent with the planning timeframe for this study. After determining which census tracts, or portions of census tracts, were within the boundaries of the Bear Gulch District, CDM used the ABAG census tract data to estimate the ultimate number of housing units, population, and people per household in the study area. According to the ABAG Projections 2005 data, the Bear Gulch service area is ultimately projected to have a total of about 23,350 housing units and a total population of about 64,000 in 2030. The number of people per household estimated from the ABAG data is 2.75.

Table 2-1
Land Use Types Within Study Area

Master Plan Land Use Type	Corresponding Atherton General Plan Categories	Corresponding Menlo Park General Plan Categories	Corresponding Portola Valley General Plan Categories	Corresponding Woodside Zoning Districts	Corresponding San Mateo County General Plan Categories
Very Low Density Residential	• Single Family Residential (up to 1.0 units/acre)	--	• Open Residential (up to 0.25 units/acre) • Conservation Residential (0.26 to 0.5 units/acre) • Low Density Residential (0.6 to 1.0 units/acre)	• Special Conservation Planning District (SPC) -10 [acres] (up to 0.1 units/acre) • SPC-7.5 [acres] (0.11 to 0.13 units/acre) • SPC-5 [acres] (0.14 to 0.2 units/acre) • Rural Residential (0.2 to 0.3 units/acre) • Suburban Residential (0.3 to 1.0 units/acre)	--
Low Density Residential	• Low Density Residential (1.1 to 3.0 units/acre)	• Very Low Density Residential (up to 3.5 units/acre) • Low Density Residential (3.6 to 5.0 units/acre)	• Low-Medium Density Residential (1.1 to 3.0 units/acre)	• R-1 Residential (1.1 to 2.2 units/acre)	• Low Density Residential (0.3 to 2.3 units/acre) • Medium Low Density Residential (2.4 to 6 units/acre) • Medium Density Residential (6.1 to 8.7 units/acre)
Multi-Family Low Density Residential	--	• Medium Density Residential (5.1 to 18.5 units/acre) • Mixed Use - Professional/ Administrative Offices (allows up to 18.5 units/acre)	--	--	• Medium High Density Residential (8.8 to 17.4 units/acre)
Multi-Family Medium Density Residential	--	• High Density Residential (18.6 to 40 units/acre)	--	--	--
Multi-Family High Density Residential	--	• High Density Residential - Senior Facilities (54 to 97 units/acre)	--	--	• High Density Residential (17.5 to 87.1 units/acre)

Table 2-1 (Continued)
Land Use Types Within Study Area

Master Plan Land Use Type	***Corresponding Atherton General Plan Categories***	***Corresponding Menlo Park General Plan Categories***	***Corresponding Portola Valley General Plan Categories***	***Corresponding Woodside Zoning Districts***	***Corresponding San Mateo County General Plan Categories***
Non-Residential					
Commercial/Office	--	• Retail/Commercial • Professional/ Administrative Offices (Mixed Use) • Art Preservation District	• Community Commercial • Administrative-Professional	• Community Commercial	• General Commercial • Neighborhood Commercial • Office Commercial
Industrial	--	• Limited Industry	--	--	• General Industrial
Public Facility, School	• Public and Quasi-Public	• Public	--	--	• Institutional
Park/Recreation/Open Space	• Public	• Parks & Recreation	• Open Area	• Open Space for Health & Safety • Open Space for Low-Intensity Recreation • Open Space for Preservation of Natural Resources	• Private Recreation • Open Space • Institutional/General Open Space/Future Study

Table 2-2
Summary of Ultimate Land Uses

Land Uses	Acres					
	Atherton	Menlo Park	Portola Valley	Woodside	San Mateo County	Total
Residential						
Single Family						
Very Low Density Residential	2,698	0	3,167	4,942	0	10,807
Low Density Residential	146	984	143	113	1,700	3,086
Subtotal - Single Family	2,844	984	3,310	5,054	1,700	13,892
Multi-Family						
Multi-Family Low Density Residential	0	274	0	0	150	424
Multi-Family Medium Density Residential	0	1	0	0	0	1
Multi-Family High Density Residential	0	7	0	0	22	29
Subtotal - Multiple Family	0	282	0	0	172	454
Total Residential	2,844	1,265	3,310	5,054	1,872	14,346
Non-Residential						
Commercial/Office	0	199	21	12	97	329
Industrial	0	67	0	0	100	168
Public Facility/School	228	29	0	0	78	336
Park/Recreation/Open Space	167	10	63	247	2	489
Freeway						177
Total Non-Residential	395	305	84	259	277	1,497
Total Acreage in Study Area	3,239	1,571	3,395	5,314	2,149	15,844

ABAG serves as the regional Census Data Center and publishes its own forecasts. ABAG and the Bay Area's other regional agencies are working with local governments and stakeholder groups to develop an alternative "smart growth" scenario that encourages construction of higher density and more affordable housing, particularly near transit centers and as infill and redevelopment in urban/suburban areas. Frequently the ABAG projections are higher than local growth projections, particularly for cities at or close to buildout and/or those cities that are “slow growth” oriented.

The ABAG projections can typically be considered as an upper limit of the ultimate growth that may occur, and may be used as a sensitivity analysis to bracket the potential uncertainty of higher future growth than has historically occurred. For example, the ABAG five-year population growth rates (on average) for the study area are shown below in Table 2-3. The ABAG population growth rates are much higher than Cal Water’s projected growth, which is based upon historic growth in residential services within the study area, as shown in Table 2-3.

Table 2-3
Comparison of Cal Water and ABAG Five-Year Population Growth Rates (1)

Years	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030
ABAG Population Growth Rate (2)	1.4%	3.2%	4.1%	2.9%	1.9%
Cal Water – Growth Rate for Residential Services (3)	1.9% population growth for each five-year period (based on the 10-year historic average growth in residential services)				

(1) Total growth over the 5-year period (not annual growth).
(2) Data obtained from ABAG's "Projections 2005".
(3) Data obtained from updated Urban Water Management Plan (UWMP) tables provided by Cal Water in January 2007.

CDM also estimated the number of ultimate housing units and population from the ultimate land uses and allowable range of densities obtained from the local planning agencies. Table 2-4 summarizes the estimated ultimate housing units and population and the assumptions about housing densities for these estimates.

As discussed above, CDM overlaid ABAG's "Projections 2005" data by census tract with the Bear Gulch district boundary to develop the estimate of 2.75 people per household. Cal Water developed its estimate of people per household (3.15) using the same method but with the 2000 US Census data. ABAG promotes urban densification and assumes conversion to higher density housing will occur in the future, resulting in a higher number of units and a lower average number of people per unit. Cal Water assumes continuation of historic local planning patterns with lower density residential, resulting in a lower number of units and a higher number of people per unit. In general, ABAG makes county-wide assumptions for all incorporated areas, rather than developing specific localized estimates. Cal Water has more specific local information within its service area.

As indicated on Table 2-4, the ultimate projections assuming the minimum to average allowable residential densities are consistent with Cal Water's updated UWMP projections (provided in early 2007), which include the recently acquired Los Trancos system. This assumption regarding residential densities reflects historic and existing growth patterns in the area. In order to get projections similar to ABAG, it is necessary to use average to maximum densities, which would require redevelopment and/or infill at significantly higher densities than existing development. The impact of more intensive development as projected by ABAG on the future demand projections is addressed as sensitivity analysis later in this report.

Table 2-4
Estimated Ultimate Residential Units and Population

Residential Land Uses from Ultimate Land Use Figure (Figure 2-2)	Acreage	Estimated Units at Minimum to Average Densities		Estimated Units at Average to Maximum Densities	
		Density (DU/ac) [1]	Number of Units	Density (DU/ac) [1]	Number of Units
Low Density Residential *(assumed these will be single family services and considered single family units)*					
Key Assumptions for Densities:		At average to minimum densities:		At average densities:	
Very Low Density Residential - Single Family	10,807	0.5	5,404	0.5	5,404
Low Density Residential - Single Family	3,086	3.5	10,801	3.5	10,801
Low Density Residential - Multiple Family [2]	290	6.0	1,740		
	133			12.0	1,596
Subtotal for Low Density Units			***17,945***		***17,801***
Higher Density Residential *(assumed these will be multiple family services and considered multiple family units)*					
Key Assumptions for Densities:		At minimum densities:		At average to maximum densities:	
Low Density Residential - Multiple Family [2]	290			12.0	3,480
	133	6.0	798		
Medium Density Residential - Multiple Family	1	19.0	19	34.0	34
High Density Residential - Multiple Family	29	26.0	754	70.0	2,030
Subtotal for Higher Density Units			***1,571***		***5,544***
Estimated Total Residential Acres and Units	**14,346**		**19,516**		**23,345**
Estimated Total Ultimate Population [3]		**61,500 at 3.15 persons per unit**		**64,200 at 2.75 persons per unit**	
Comparison with Cal Water Projections for Year 2030 including Los Trancos System (from UWMP worksheets updated in 2006)					
Dwelling Units = 19,500 Population = 61,425 at 3.15 persons per unit	The Cal Water projections appear to be based on ultimate development occurring at the minimum to average allowable densities. This is consistent with existing development and historic growth in the district.				
Comparison with ABAG 2005 Projections for Year 2030					
Dwelling Units = 23,350 Population = 64,200 at 2.75 persons per unit	The ABAG projections appear to be based on ultimate development occurring at the average to maximum allowable densities. This would require significantly higher densities than currently existing development, i.e., redevelopment and infill at higher multiple family densities.				

(1) DU/acre = dwelling units per acre.
Densities were obtained from the allowable range of minimum to maximum densities according to the local General Plans.

(2) Low density multiple family residential may sometimes be served as single family services (units) and sometimes as multiple family services (units) depending on the type of development. This land use category was split between single family and multiple family services based on the assumed density. For minimum density, about two-thirds were considered single family services and one-third was considered multiple family services, and vice versa for the higher density assumption.

(3) Persons per unit is an average for both single family and multiple family according to the assumptions used by ABAG (2.75 persons per unit) and Cal Water (3.15 persons per unit).

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Section 3
Water Demands

This section describes existing services and demands in the Bear Gulch District and provides future service and demand projections through year 2030. The information in this section is on a system-wide basis, by customer category.

3.1 Existing Services and Water Demand

Table 3-1 summarizes the existing customer service and demand estimates. The existing services are estimated at the end of 2005, which includes the Los Trancos system. The existing demand of 13.4 million gallons per day (mgd) is estimated from the highest recent demand year (2004), and includes the small 0.12 mgd Los Trancos system demand which is less than one percent of the total demand. The 13.4 mgd existing demand is consistent with the hydraulic model demand for the existing scenario.

Table 3-1
Summary of Existing Services and Demand by Customer Type for the Bear Gulch Service Area

Customer Type	*Number of Services (1)*	*Percent of Total Services*	*Total Annual Demand (2) (MG)*	*Average Day Demand (2) (mgd)*	*Percent of Total Demand*	*Average Daily Demand per Service (gpd)*
Residential	16,250	91.7%	4,051	11.10	82.8%	683
Multi-Family Residential	65	0.4%	81	0.22	1.7%	3,412
Commercial	1,284	7.2%	458	1.25	9.4%	977
Industrial	1	0.01%	2	0.01	0.0%	5,169
Government	95	0.5%	96	0.26	2.0%	2,758
Other	30	0.2%	17	0.05	0.3%	1,556
Subtotal	17,725	100.0%	4,704	12.89	96.2%	727
Unaccounted-for Water	0	0.0%	187	0.51	3.8%	29
Total	17,725	100.0%	4,891	13.40	100.0%	756

(1) The existing number of services is estimated at the end of 2005, which includes the Los Trancos system.

(2) The existing demand is estimated based 2004, which is the highest demand year to date (2004) and is assumed to include the Los Trancos demand of 0.12 mgd which is less than one percent of the total demand.

Million Gallons = MG; gallons per day = gpd

As of the end of 2005, Cal Water had a total of about 17,725 customers (services), which includes Los Trancos. About 92 percent of the services are for single family residential customers, less than 1 percent for multi-family residential customers, about 7 percent for commercial, and less than 1 percent for industrial, government and other customers. The "other" customer category includes sales to other water utilities and temporary services, such as construction sites.

Figure 3-1 shows the distribution of existing services by customer type, as percentage of total services. Existing services are estimated as of the end of 2005, including Los Trancos.

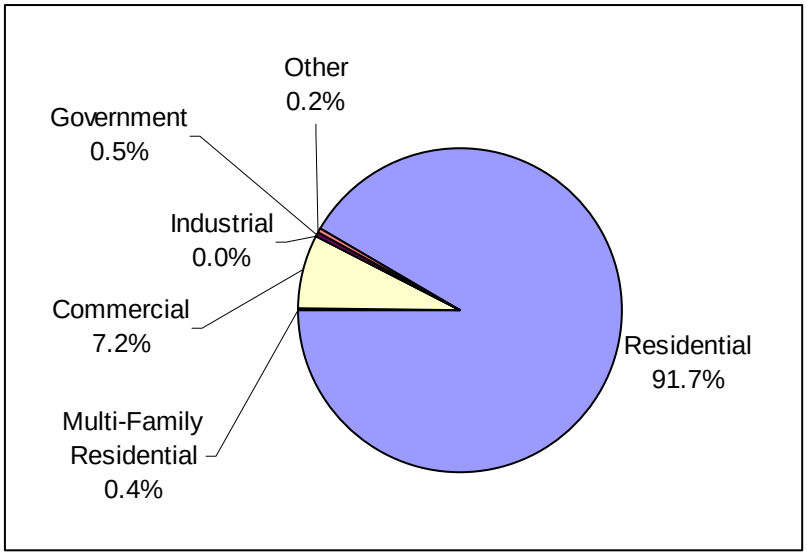

Figure 3-1
Existing Services by Customer Type
(% of Total)

Table 3-1 shows the existing water usage (consumption) on a system-wide basis by customer type. It also shows the unaccounted-for water and total demand. Total demand equals customer usage plus unaccounted-for water. The total average day demand of 13.4 mgd is consistent with the hydraulic model existing demands, and includes Los Trancos.

Figure 3-2 shows the distribution of existing demands by customer type, as percentage of total demand. The existing demand consists of about 85 percent residential uses, about 12 percent non-residential uses, and 3.8 percent unaccounted-for water. For non-residential uses, commercial comprised about 9 percent of total demand, government 2 percent, and industrial much less than 1 percent.

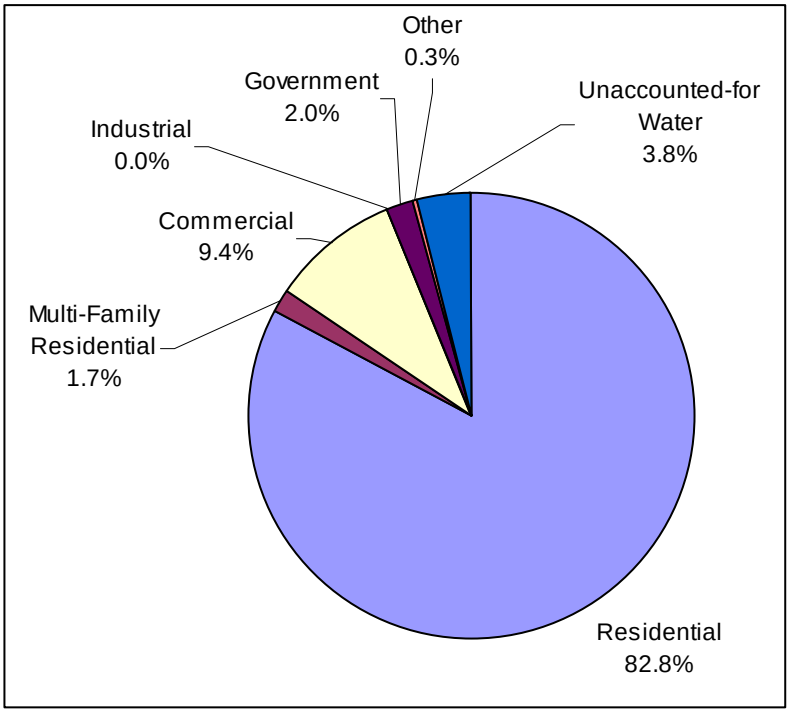

Figure 3-2
Existing Demand by Customer Type
(% of Total)

For an existing average day demand of about 13.4 mgd and an estimated current service population of about 55,000, the current per

capita water demand for all uses is 244 gpd per capita, and for residential uses only is 206 gpd per capita. Over the past 5 years, the total per capita demand has averaged about 230 gpd per capita; and the residential only per capita demand has averaged about 196 gpd per capita.

Table 3-2 shows the top twenty water users in the Bear Gulch system in gpd and gallons per minute (gpm). These top twenty users accounted for about 3 percent of the total average day water demand in the system. Based on customer class data included in the billing records, the large users include a mix of multi-family residential, single family residential, schools, retirement home/nursing home facilities, commercial, and public facilities.

The largest single user had less than half a percent of total average day system demand. The top five users made up just over 1 percent, and the top 10 users about 2 percent of the total average day system demand. This data indicates that individual large users are not a significant factor for system-wide facilities planning, although may impact localized areas.

Table 3-2
Top Twenty Largest Users [(1)]

	Customer Type	City	Meter Size	Average Day Usage in 2004	
				gpd	gpm
1	Multi-Family Residential	Portola Valley	4"	50,340	35
2	Residential	Woodside	6"	34,351	24
3	Public	Menlo Park	4"	28,873	20
4	Commercial	Portola Valley	6"	24,513	17
5	Commercial	Menlo Park	1"	23,240	16
6	Commercial	San Mateo County	3"	21,560	15
7	Multi-Family Residential	Menlo Park	3"	21,447	15
8	Other	Woodside	1.5"	21,414	15
9	Commercial	Menlo Park	4"	18,953	13
10	Public	Menlo Park	6"	18,299	13
11	Public	Woodside	6"	17,971	12
12	Commercial	Menlo Park	3"	17,713	12
13	Residential	Woodside	3"	14,665	10
14	Commercial	San Mateo County	2"	14,187	10
15	Commercial	Atherton	3"	14,181	10
16	Multi-Family Residential	Menlo Park	4"	13,617	9
17	Public	Woodside	3"	12,802	9
18	Residential	Woodside	2"	12,576	9
19	Commercial	Menlo Park	2"	12,113	8
20	Residential	Atherton	4"	12,105	8
Total				404,919	281

[(1)] Demand data obtained from customer billing records.

3.2 Historic Service Growth and Demand per Service

Information on historical service growth and the demand per service in the Bear Gulch District was based on historical customer data from 1986 through 2005 as obtained from UWMP tables provided by Cal Water staff.

Table 3-3 summarizes the historical percentage growth in number of services in the Bear Gulch District. Several time periods are considered for growth in services, which reflect economic and demographic conditions: 20-year average growth from 1986 through 2005; 15-year average growth from 1991 through 2005; 10-year average growth from 1996 through 2005; and the recent 5-year average growth from 2001 through 2005.

Table 3-3
Historical Annual Percentage Growth in Number of Services [1]

Period	Average Annual Percent Growth By Customer Type							
	Customer Type							Total Services
	Single Family Residential Services	Multi-Family Residential		Commercial Services	Industrial Services	Government Services	Other Services	
		Services	Units					
20-Year Average (1986-2005)	0.40%	0.16%	0.57%	0.02%	-6.19%	-0.47%	2.64%	0.37%
15-Year Average (1991-2005)	0.34%	0.00%	0.72%	-0.09%	0.00%	-0.82%	0.39%	0.29%
10-Year Average (1996-2005)	0.38%	0.00%	0.87%	0.06%	0.00%	0.01%	2.60%	0.36%
5-Year Average (2001-2005)	0.40%	0.00%	1.77%	0.13%	0.00%	-0.41%	-1.84%	0.37%

[1] Data obtained from updated UWMP tables provided by Cal Water in January 2007.

As indicated in Table 3-3, the overall growth rate of total number of services has stayed relatively constant over the last 20 years despite flat growth in multi-family and industrial services. The average percent growth per year in the number of single family and multiple family residential services has remained around 0.4 percent per year over the last 20 years, except for a lower growth period from 1991-1995. However, it should be noted that the estimated number of multi-family units has increased while the number of services stayed constant indicating higher density multi-family housing, i.e., more units per service. On average, as higher density housing is built, the number of multi-family services increases more slowly than the number of units.

Commercial services increased in recent years and its growth is highest in the past 5-year period. Both the government and industrial customer types have experienced flat or declining numbers of services. The other services category fluctuates widely in growth rate, but is a very small number of services.

Table 3-4 summarizes the historical demand per service for the Bear Gulch customer classes for the 25-year period that Cal Water provided historical data. Several time periods are considered for demand per service, which reflect climate and drought conditions: 25-year average over the entire period of record from 1981 through 2005; pre-drought period from 1981 through 1987; the last major drought period from 1988-1991; post-drought period from 1992 through 2005; 10-year average from 1996 through 2005, and the recent 5-year average from 2001 through 2005.

Table 3-4
Historical Demand Per Service (gpd) [1]

Period	Single Family Residential	Multiple Family Residential	Commercial	Industrial	Government	Other	Unaccounted Per Service	Total Demand Per Service
25-Year Average (1981-2005)	565	3,525	931	4,451	2,556	2,930	27	647
Pre-Drought Average (1981-1987)	549	3,660	887	4,198	3,044	4,160	37	646
Drought Average (1988-1991)	480	3,285	871	3,603	2,066	2,588	28	564
Post-Drought Average (1992-2005)	598	3,526	971	4,819	2,453	2,412	22	672
10-Year Average (1996-2005)	633	3,555	998	5,206	2,602	2,178	22	706
5-Year Average (2001-2005)	659	3,475	979	6,003	2,639	1,279	18	723

[1] Data obtained from updated UWMP tables.

As indicated in Table 3-4, the demand per service has increased for single-family residential, commercial, and industrial services over the past 5- and 10-year periods, surpassing the pre-drought levels from 1981 to 1987. Multi-family residential and government use per service have decreased or stayed the same. The demand per service for the other category has varied widely; however, this is a very small number of services. During the 1988-1991 drought, the total demand per service decreased by about 13 percent.

The recent 5-year average in Table 3-4 shows that the total demand per service now exceeds the pre-drought level by 12 percent. For residential demand, which is the largest component of total demand, the residential demand per service now exceeds the pre-drought level by 20 percent. The District has indicated this increase may be due to remodeling projects that result in significantly larger structures on the same property. There has also been a trend in newer development to replace native, low water use landscaping with water intensive plantings and water features, e.g. fountains and pools. The highest average residential demand in any single year for the residential customer category in general is estimated at 683 gpd per service based on estimated current average day demand of 13.4 mgd.

3.3 Unaccounted-for Water

Unaccounted-for water refers to system losses between production (supply) and consumption (customer usage). These losses may occur from fire flows, construction use, hydrant flushing, leaks, main breaks, metering inaccuracies, illegal connections or usage, and other types of un-metered water use. Unaccounted-for water typically ranges from about 5 to 10 percent of production for most water systems.

Table 3-5 shows Cal Water's historical unaccounted-for water. Since 1991 (15 years), it has averaged about 3.5 percent, below industry average. During the 1990s, there were several years when the unaccounted-for water percentage was close to 5 percent. However, the percentage has decreased over the last 5 years, which is likely due to the District's leak detection and maintenance program. Unaccounted-for water has recently averaged 2.4 percent, although did reach 3.8 percent in 2004. For this master plan, a 3.5 percent allowance is recommended as a reasonable planning estimate for future demand projections.

Table 3-5
Unaccounted-For Water as a Percent of Total Demand [(1)]

Year	Unaccounted for Water (MG)	Total Demand (MG)	% of Unaccounted-For Water
1991	144	2,979	4.8%
1992	158	3,326	4.7%
1993	164	3,634	4.5%
1994	21	3,646	0.6%
1995	166	3,861	4.3%
1996	104	4,127	2.5%
1997	164	4,503	3.6%
1998	219	3,980	5.5%
1999	218	4,420	4.9%
2000	120	4,611	2.6%
2001	141	4,731	3.0%
2002	29	4,436	0.7%
2003	107	4,505	2.4%
2004	187	4,891	3.8%
2005	99	4,408	2.2%
15-year Average (1991-2005)	136	4,137	3.4%
10-year Average (1996-2005)	139	4,461	3.1%
5-year Average (2001-2005)	113	4,594	2.4%
Maximum over Past 5 Years	187	4,891	3.8%

[(1)] Data obtained from updated UWMP tables provided by Cal Water in January 2007.

3.4 Peaking Factors

Water system facilities are generally sized for peak demand periods. The peaking conditions of most concern for water facility sizing are maximum day demand with fire flow and the peak hour demand on the maximum day.

Average day demand refers to the average daily usage of water over a year. Maximum day demand is the maximum water usage for a 24-hour period during a year, which generally occurs during the maximum month of usage in summer. Peak hour demand is the peak flow during a one-hour period on the day of maximum demand.

Table 3-6 summarizes historical demand data on a system-wide basis for the past five years including total annual demand, average daily demand, and maximum day demand. Table 3-6 also shows the relationship (peaking factor) between maximum day demand and average daily demand.

Table 3-6
Summary of Historical Demand and Maximum Day Peaking Factors Over Past 10 Years [1]

Year	Annual Demand (MG)	Average Daily Demand (mgd)	Maximum Day Demand (mgd)	Maximum Day Peaking Factor
1996	4,127	11.3	20.2	1.79
1997	4,490	12.3	22.0	1.79
1998	3,979	10.9	21.5	1.97
1999	4,419	12.1	23.1	1.91
2000	4,610	12.6	25.6	2.03
2001	4,731	13.0	26.9	2.08
2002	4,444	12.2	26.1	2.14
2003	4,517	12.4	26.5	2.14
2004	4,890	13.4	29.8	2.23
2005	4,408	12.1	23.7	1.96
Average Over 10-Year Period	4,462	12.2	24.5	2.00
Average Over Past 5-Year Period	4,598	12.6	26.6	2.11
Maximum occurred in 2004	4,890	13.4	29.8	2.23

[1] Data obtained from updated UWMP tables.

The maximum day peaking factor relates the maximum day average daily demand to the annual average day system demand. Over the last 5 years, the maximum day peaking factor ranged from about 1.96 to 2.23 (average 2.11 over the 5-year period). For the master plan, a maximum day peaking factor of 2.1 is recommended as a reasonable value for master planning purposes.

The peak hour factor used for the Bear Gulch District hydraulic model is 1.7 times the maximum day demand over the 24-hour period, as derived from the diurnal pattern for the Bear Gulch District. Therefore, the peak hour demand is approximately 3.6 times the average day demand.

The Bear Gulch diurnal pattern was developed with the data representing Zones 265, 319, 400, and 470: hourly flow for pump stations 04 and 05 and water levels for the Intermediate tanks. This was the most complete data available to create a diurnal

curve, and was therefore applied to the entire system. During verification, the diurnal patterns of some zones were adjusted to better match field data.

Monthly demands are also of interest in water system planning, since the level of water use may vary significantly over the course of a year. Figure 3-3 shows the ratios of the monthly average day demand to the annual average day demand. The monthly ratios relate the monthly average daily flow to the annual average daily flow. The ratios are based on the 5-year average usage from 2001 through 2005.

As indicated on Figure 3-3, the monthly average demand ranges from about 0.4 times the annual average day demand in the winter to 1.6 times the annual average day demand in the summer.

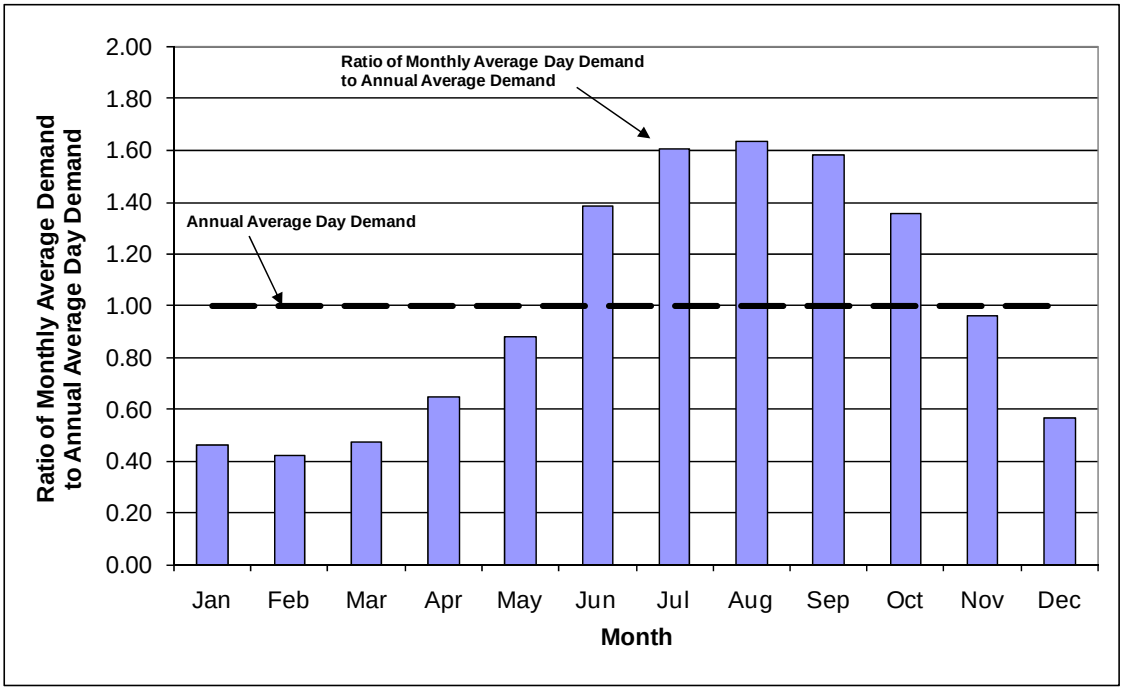

Figure 3-3
Monthly Demand Factors

3.5 Future Service and Demand Projections

The recommended planning-level demand projections are summarized first, followed by a discussion of the sensitivity analysis of low to high projection ranges.

3.5.1 Recommend Planning-Level Demands

Projections of future services and demands have been developed using the Table 3-3 historical growth rates for services and the Table 3-4 historic demands per service. Individual growth rates and unit demands were used for each customer type.

Unaccounted-for water was assumed to be 3.5 percent of total water use. These service projections include the recently acquired Los Trancos system.

Table 3-7 summarizes the recommended planning-level service and demand projections for the Bear Gulch District to year 2030, a 25-year planning horizon. The demand projections are for normal (non-drought) conditions, and assume no recycled water use. Table 3-7 summarizes the following by 5-year increments to year 2030.

- Total number of projected services based on the highest growth rate for each of the customer types. For each customer type, an individual growth rate was used to project services (single family residential, multiple family residential, commercial, industrial, governmental, and other). The projected number of services is consistent with ultimate land use plans from the local planning agencies, assuming that future development patterns are fairly similar to historic growth patterns.
- Demand projections, including average daily demands, total per service demand, and total per capita demand. Year 2030 demand of 14.5 mgd assumes no conservation savings, and is based on the highest growth and demand rates. It also assumes the number of units per multiple family service remains constant at its current level of 20 units per service.
- The recommended planning level projection of 14.5 mgd is a conservative baseline for planning purposes. It is based on the highest historic service growth and unit demand rates, not on historic average or low rates. This is due to the recent trend toward a higher average demand per service, particularly with respect to residential unit demands from redevelopment of properties and conversion of yards to more extensive landscaping and water use features. There is variability in demands from year to year, although the trend appears to be increasing.

Table 3-7
Summary of Planning-Level Demand Projections

Year	Total Projected Services	Estimated Population in Service Area [1]	Projections Assuming No Conservation Savings - Based on Highest Average Growth Rate and Highest Unit Demand Per Service			
			Average Day Demand (mgd)		Total Per Service Demand	Total Per Capita Demand
			(mgd)	(AF/ year)	(gpd)	(gpd)
2005 [2]	17,725	55,300	13.0	14,562	733	235
2010	18,072	56,700	13.4	15,010	741	236
2015	18,426	58,200	13.6	15,234	738	234
2020	18,787	59,700	13.9	15,570	740	233
2025	19,155	61,300	14.2	15,906	741	232
2030	19,531	63,000	14.5	16,242	742	230
Low End Estimate at 2030 (with 10 percent long-term conservation savings by 2030) [3]			**13.0**	**14,562**	**666**	**206**

(1) The estimated population is based on the projected residential units and Cal Water's estimate of 3.15 persons per unit.

(2) 2005 values are projections (estimates) using the planning-level growth rates and unit demands.

(3) The low end estimate with 10 percent conservation savings is similar to current conditions.

The bottom row of Table 3-7 illustrates the potential impact of a 10 percent reduction in demand due to future conservation savings from implementation of Cal Water's proposed conservation measures in the UWMP. If the full 10 percent reduction were realized, then the year 2030 demand would remain similar to current levels. Potential impacts of future water conservation and recycled water use to meet the projected demands are discussed in Section 7, Water Supply Strategy.

Figure 3-4 presents the monthly demands in 2030 for the Bear Gulch District, based on the planning-level demand projection and the 5-year average monthly distribution shown in Figure 3-3.

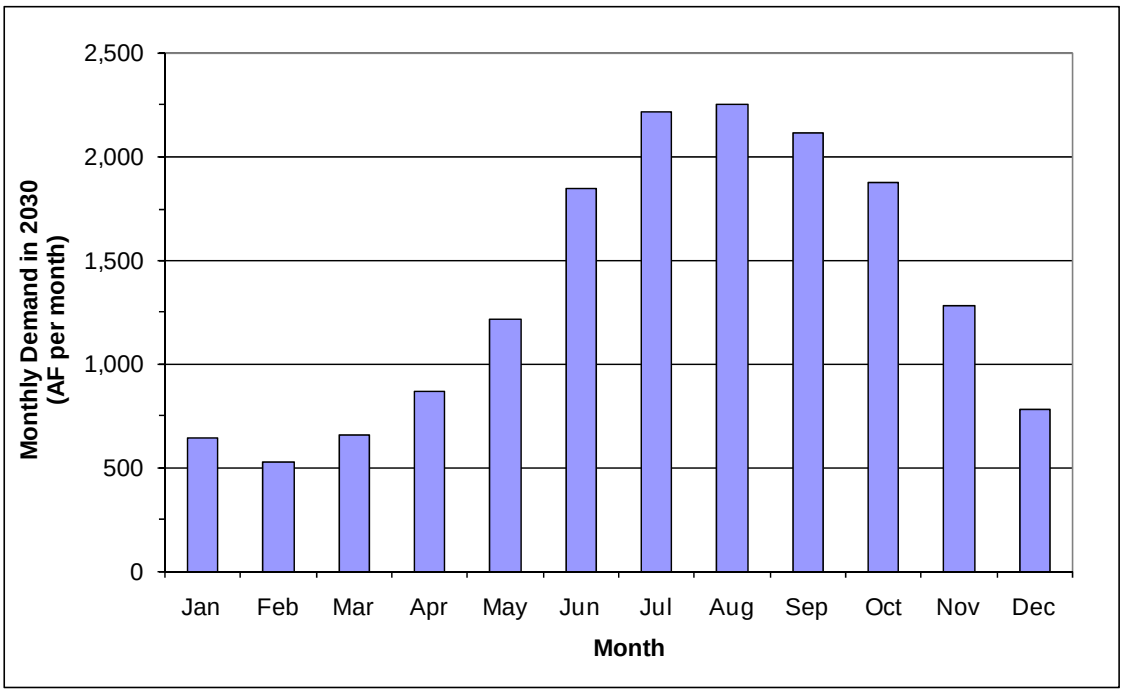

Figure 3-4
Monthly Demand in 2030

Appendix B provides a detailed breakdown of the services and demands by customer category for each 5-year increment (for the scenario using the highest growth rates and highest unit demands). The year 2030 projected services include 17,970 single family services (equivalent to housing units) and 100 multiple family services (2,015 housing units). It is assumed that the number of multiple family units per service will remain constant at about 20 units per service.

In addition, the potential impact on the recommended demand level was evaluated with respect to the higher ABAG growth projections and potential higher residential unit demands. The combined impact if both conditions were to occur is an additional

0.8 mgd of demand at year 2030, which would increase the year 2030 demand to 15.3 mgd. These conditions are discussed below:

- The ABAG projections appear to assume a significantly higher number of future multiple family units, on the order of 3,000 additional multiple family units. Assuming 30 units per multiple family services for the higher density development anticipated by ABAG, this would result in an additional 100 multiple family services which would be about 0.4 mgd at year 2030. However, the ABAG growth rates do not appear to be consistent with the information from the local planning agencies.

- The unit demands per service, which dropped during the 1987-1991 drought, now exceed pre-drought levels. The planning-level demand projection reflects this increase because it is based on the highest average residential demand (which occurred over the past 5-year period). In addition, CDM considered the potential impacts of even higher future single family residential unit demands by using the highest estimated residential unit demand in any single year (683 gpd versus 659 gpd average), which increased the projected year 2030 demand by 0.4 mgd.

CDM also evaluated the effects of single family residential demand increasing over time. The Bear Gulch District has seen this trend over the past 25 years, as shown in Table 3-4. The actual 2005 single family residential demand of 625 gpd per service was used to calculate the 2005 demand. In each successive 5-year period, the single family residential demand per service was increased by 4.1%. That percentage represents the increase in single family demand per service from its 10-year average (633 gpd) to its 5-year average (659 gpd). The growth rates and unit demands for all other categories remained the same from the planning-level demands shown above in Table 3-7. With the single family residential unit demand continuing to increase by the same rate until 2030, the year 2030 district demand was estimated to be 16.4 mgd, an increase of 13% over the planning-level demand. This demand serves as a potential upper limit for the "worst case" district demand, and highlights the importance of water conservation measures.

Economic and hydrologic conditions are factored into the service and demand estimates by looking at historical variations in water supply over various periods. As discussed below, a sensitivity analysis was conducted for various periods, such as the 20-year, 10-year and 5-year averages, which capture historic economic downturns, such as the early 1990's; and also historic economic boom periods. The historical averages also capture both dry and wet years.

3.5.2 Sensitivity Analysis of Demand Projections

A sensitivity analysis was conducted to determine the potential future range in demands for various combinations of historical growth rates and unit demands. Based on the sensitivity analysis, demands may range from a low of 13.6 mgd to a high of 14.5 mgd. This range of projections is useful to evaluate the potential impact

of uncertainties regarding how future development will actually occur, and to identify whether assumptions may significantly affect the estimates. The sensitivity results helped to identify a reasonable estimate for long-term planning purposes.

Table 3-8 summarizes the total service and demand projections for five sensitivity scenarios noted below. Appendix B contains detailed tables that show the breakdown by customer type of the service and demand projections for each scenario. The Table 3-8 demand projections represent normal (non-drought) conditions.

- Scenario A: 10-year growth rates and 10-year average unit demand per service for each customer category. This is the low end of the projection range, and includes both lower and higher parts of the historical cycle. The total demand for this scenario of 13.6 mgd is similar to Scenario C.
- Scenario B: 10-year average growth rate and 5-year average unit demand per service for each customer category. The 5-year average unit demand is the highest for the period of record, and has exceeded pre-drought levels. The total demand of 14.0 mgd for this scenario is similar to Scenario D.
- Scenario C: 5-year average growth rate and 10-year average unit demand per service for each customer category. The total demand of 13.7 mgd for this scenario is similar to Scenario A.
- Scenario D: 5-year average growth rate and 5-year average unit demand per service for each customer category. The total demand of 14.2 mgd for this scenario is similar to Scenario B.
- Scenario E: highest growth rate and highest unit demand for each customer category. In addition, this scenario assumes that the number of multiple family units per service remains constant at the current level. At 14.5 mgd, this is high end of the projection range.

Table 3-8
Summary of Sensitivity Analyses for Service and Average Day Demand Projections (1)

Year	Scenario A: 10-year Growth Rate 10-year Unit Demands		Scenario B: 10-year Growth Rate 5-year Unit Demands		Scenario C: 5-year Growth Rate 10-year Unit Demands		Scenario D: 5-year Growth Rate 5-year Unit Demands		Scenario E: (2) Highest Growth Rate Highest Unit Demands	
	Total Services	Total Estimated Average Day Demand (3) (mgd)	Total Services	Total Estimated Average Day Demand (3) (mgd)	Total Services	Total Estimated Average Day Demand (3) (mgd)	Total Services	Total Estimated Average Day Demand (3) (mgd)	Total Services	Total Estimated Average Day Demand (3) (mgd)
2005	17,725	12.5	17,725	12.9	17,725	12.5	17,725	12.9	17,725	13.1
2010	18,042	12.7	18,042	13.1	18,064	12.8	18,064	13.2	18,072	13.4
2015	18,364	13.0	18,364	13.4	18,410	13.0	18,410	13.4	18,426	13.6
2020	18,693	13.2	18,693	13.6	18,762	13.2	18,762	13.7	18,787	13.9
2025	19,028	13.4	19,028	13.8	19,121	13.5	19,121	13.9	19,155	14.2
2030	19,370	13.6	19,370	14.0	19,488	13.7	19,488	14.2	19,531	14.5

(1) See Appendix B for detailed information on service and demand projections.
(2) Scenario E uses the highest growth rates and highest unit demands over the past 20 years, and assumes that the ratio of multiple family units to services remains constant at the current level of 20 units per service.
(3) All demands are estimated using the unit demand rates for the particular scenario, including 2005 demands.

The demand projections fall within a very narrow range, regardless of the assumptions used, which increases confidence in the future projections. Buildout average day demands at year 2030 range from 13.6 to 14.5 mgd, which is a difference of only 0.9 mgd between the lowest and the highest projections. The narrow range is reasonable for an established area that is close to buildout. Cal Water's database of historical customer information provides an excellent basis for future projections.

For each customer type, individual growth rates (percent per year) and unit demands (gallons per day per service) were used. The growth rates apply to the residential and commercial categories, which are the largest customer categories. The industrial and government categories have experienced flat or declining growth. For planning purposes, an allowance for some growth in the government category is included in some of the scenarios to provide flexibility for potential future institutional needs. The industrial category is expected to remain at its current level since no industrial development is projected for the study area. The "other" category fluctuates widely year by year, and was assumed to remain at the historical average level. The "other" category is very small and has a negligible impact on the projections.

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Section 4
Existing Water System

This section provides a summary description of the Bear Gulch existing water system configuration and facilities.

4.1 System Configuration and Pressure Zones

The existing water system is supplied from San Francisco Public Utilities Commission (SFPUC) turnouts and Bear Gulch Reservoir via the Bear Gulch Water Treatment Plant (WTP). SFPUC turnouts supply the system via zone 220, the largest and lowest pressure zone. Treated water from the WTP enters the system via pump station 4 into zone 400. Zone 220 can also be supplied using a temporary pressure reducing valve (PRV) that is installed at the discharge side of station 4. The PRV is used when system demands are low and water is available from the WTP, in order to maximize the use of the WTP.

Figure 4-1 provides an overview of the modeled pressure zones; each zone is shown in a different color. Figure 4-2 shows the existing system profile schematic, with the same colors for zones as used for Figure 4-1. Figure 4-3 shows all the modeled water system facilities with the pipes color-coded by diameter and the pressure zone boundaries.

Table 4-1 summarizes the modeled pressure zones in the Bear Gulch system and the towns that each pressure zones serves. Table 4-2 summarizes the key facilities that supply water into and out of each zone, and existing storage facilities in the zones. Key features of the major facilities are described in the rest of this section. Appendix G on the hydraulic model of the water system provides more detailed information on facility settings.

Table 4-1
Pressure Zones Categorized by Town Served

Zone	Atherton	Menlo Park	Woodside	Portola Valley
220	X	X		
265	X			
319A (Santa Cruz Blvd and Sand Hill Rd)		X		
319B (Woodside Rd and Bonsen Ct)			X	
395			X	
400	X	X	X	
440		X		
470			X	
475			X	
500			X	

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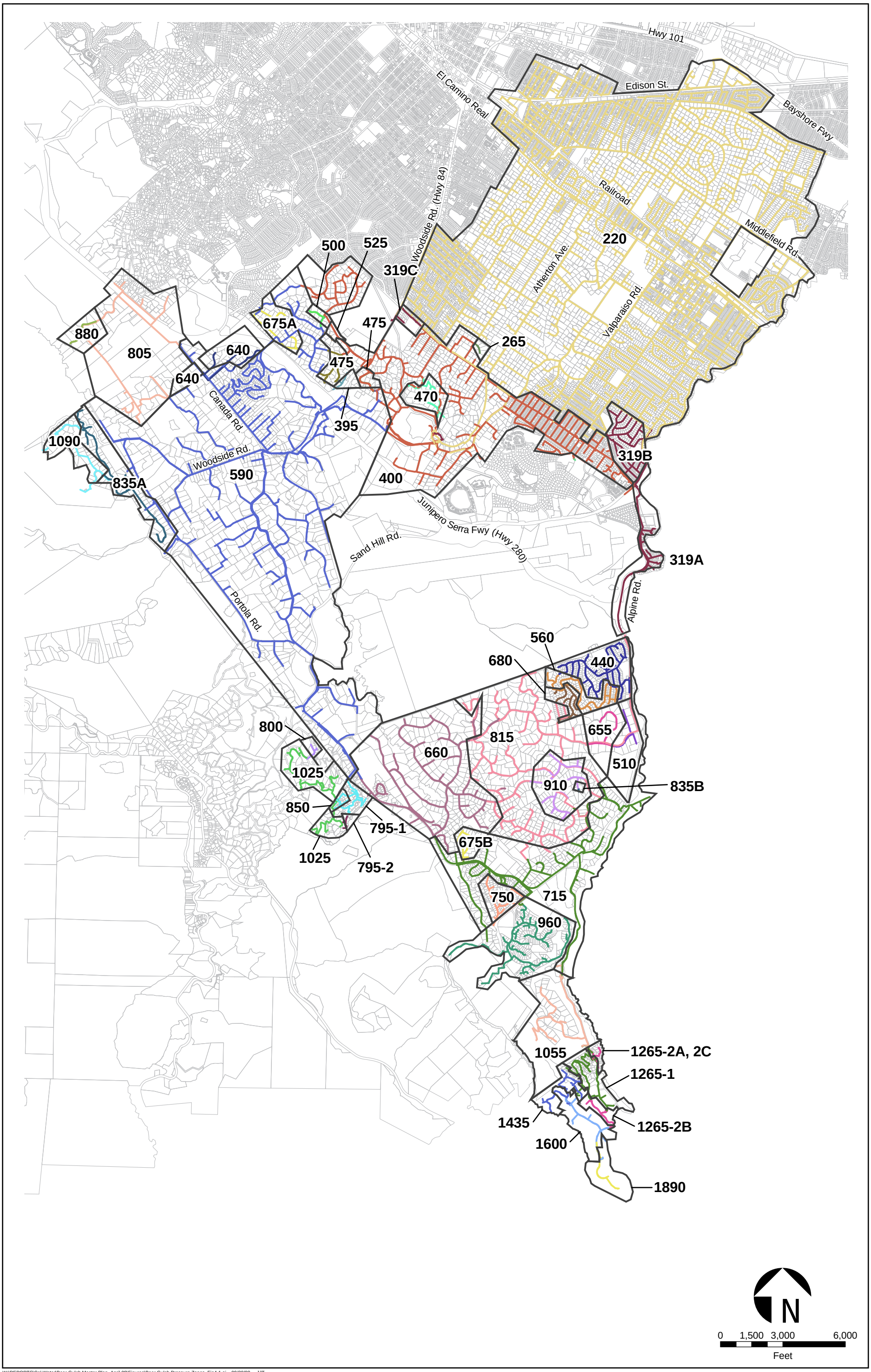

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Figure 4-1
Bear Gulch Pressure Zones

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Figure 4-2a
Bear Gulch System Schematic

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Figure 4-2b
Bear Gulch System Schematic

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Figure 4-2c
Bear Gulch System Schematic

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Figure 4-2d
Bear Gulch System Schematic

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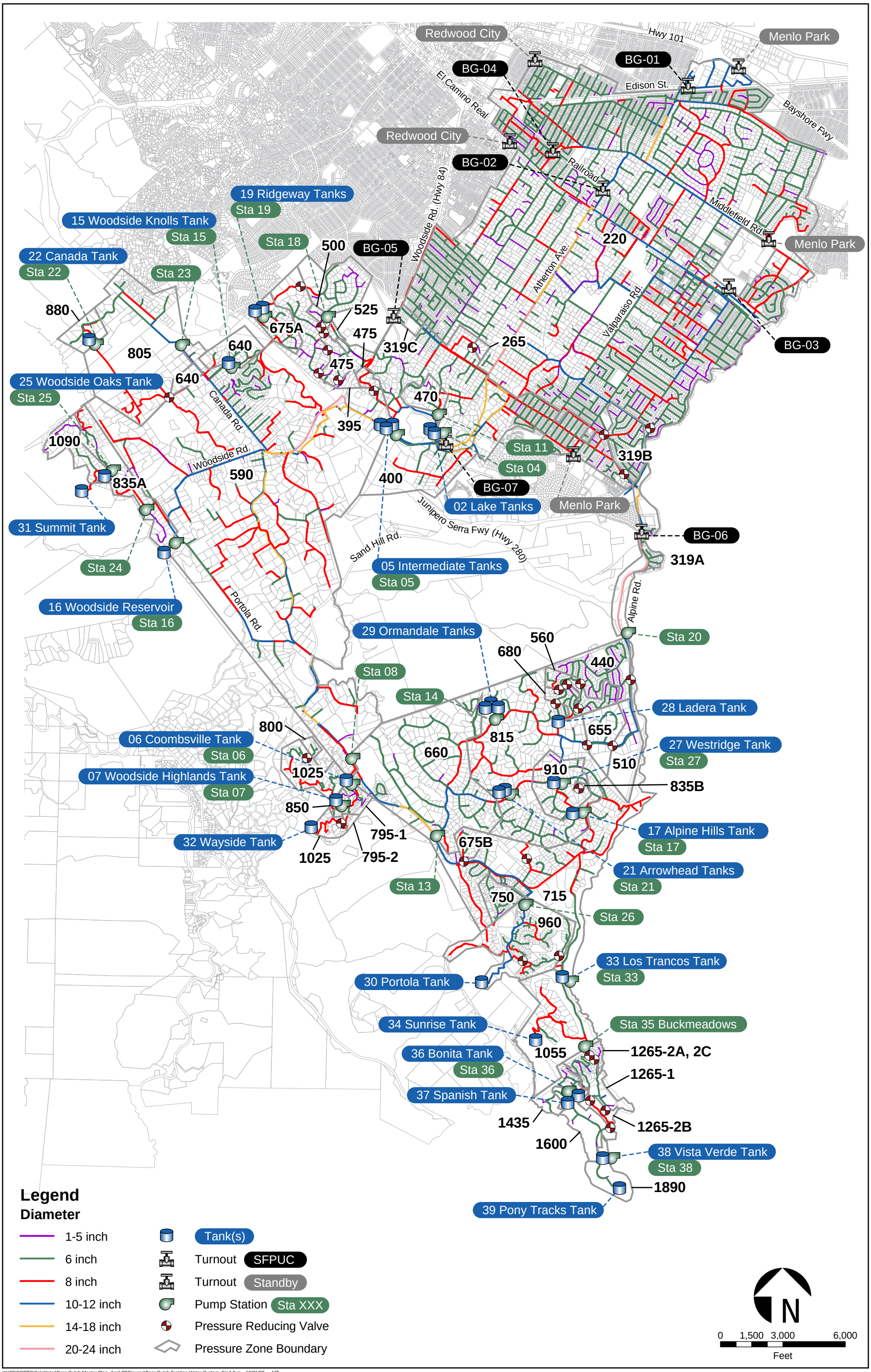

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Figure 4-3
Bear Gulch Existing Water System

Table 4-1
Pressure Zones Categorized by Town Served

Zone	Atherton	Menlo Park	Woodside	Portola Valley
510				X
525			X	
560		X		
590			X	
640			X	
655				X
660				X
675A (Crest Rd and Ridgeway Rd)			X	
675B (Grove Dr and Portola Rd)				X
680		X		
715				X
750				X
795-1				X
795-2				X
800				X
805			X	
815				X
835A (Partition Rd and Oakhill Dr)			X	
835B (Tagus Ct and Golden Oak Dr)				X
850				X
880			X	
910				X
960				X
1025				X
1055				X
1090			X	
1265-1				X
1265-2A (Caramel Way and Ramona Rd)				X
1265-2B (Vista Verde and Ramona Rd)				X
1435				X
1600				X
1890				X

Table 4-2
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	Sources of Supply	Deliveries out of Zone	Storage
Menlo Park/Atherton			
220			--
265			--
319A (Alpine Rd)			--
319B (Santa Cruz Rd)			--
319C (Woodside Rd)			--
400			Intermediate
470			hydro (5000 gal)
Woodside			
395			--
475			--
500			--

Table 4-2
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	Sources of Supply	Deliveries out of Zone	Storage
525			--
590			Coombsville
			Ridgeway
			Woodside Res
640			Woodside Knolls on suction side and hydro (3000 gal)
675A			hydro (3000 gal)
805			Canada
835A			Woodside Oaks
880			hydro (2000 gal)
1090			Summit
Portola Vall			
440			--
510			--
560			--
655			--
660			Arrowhead
			Ormondale
675B			--

Table 4-2
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	Sources of Supply	Deliveries out of Zone	Storage
680			Ladera
715			Alpine Hills Los Trancos
750			--
795-1			Woodside Highlands
795-2			--
800			--
815			Westridge
835B			--
850			--
910			hydro @ 17(5000) hydro @ 27 (2500)
960			Portola
1025			Wayside
Los Tranco			
1055			Sunrise
1265-1			Bonita
1265-2A			--

Table 4-2
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	Sources of Supply	Deliveries out of Zone	Storage
1265-2B			--
1435			--
1600			Vista Verde
1890			Pony Tracks

4.2 SFPUC Turnouts

Table 4-3 summarizes the SFPUC turnouts that supply treated water to the Bear Gulch system, and shows the location and delivery zone. Turnouts BG-01, -02, -03, -04, -05, -06, and -07 feed zone 220. Turnouts BG-05 and -06 feed zone 319 as well.

Table 4-3
SFPUC Turnouts

Connection Number	Valve Number and Size (inches) [1]	Location	Approximate SFPUC HGL (feet)	Downstream Facility	Delivers to Zone
BG-01	1-6", 1-8"		319		220
BG-02	1-4", 1-6" per schematic		319		220
BG-03	2 - 4" per schematic		319		220
BG-04	1 – 6"		319		220
BG-05	2-6"		319		220
BG-06	2-8"		319		220, 319A, Sta. 20
BG-07	1-8", 2-6"		319		220, Sta. 04

[1] Meter assumed to be capable of conveyacities at turnout.

4.3 Bear Gulch Water Treatment Plant

The Bear Gulch Water Treatment Plant (WTP) facilities and operation are described in Section 7.3.1, which addresses local surface water supply. The finished water treated at the WTP is stored in the Lake tanks at the WTP site, which acts as the plant clearwell. Pump station 04 pumps out of the Lake tanks into zone 400. At the discharge of station 04, a portable PRV can be used to supply the low zone 220 from zone 400. This PRV is used during low demand days in the winter when water produced by the treatment plant needs to be distributed to a larger area.

4.4 Pump Stations

The Bear Gulch system, including the former Los Trancos system, has 26 pump stations, which supply 20 of the 41 pressure zones in the system. The other zones are supplied by either PRV stations or by SFPUC turnouts. There are five hydropneumatic zones including zones 470, 640, 675, 880, and 910.

Table 4-4 summarizes key features of the existing pump stations, including the source zone and the service zone (zone where water is delivered).

Table 4-4
Pump Stations

Pump Station Number	Pump ID	Source Zone	Service Zone	Design Flow (gpm)	Design Head (ft)
02	PMP-002-B	Bear Gulch WTP clearwell (Lake tanks)	220	1200	45
	PMP-002-C		220	1200	45
	PMP-002-D		220	1200	45
04	PMP-004-C	220	400	1900	220
	PMP-004-I	220	400	2000	233
	PMP-004-F	220	400	2200	225
	PMP-004-G	220	400	1500	115
	PMP-004-H	220	400	2600	126
05	PMP-005-J	400	590	1920	280
	PMP-005-K	400	590	1950	270
	PMP-005-L	400	590	1950	270
	PMP-005-M	400	590	1950	270
	PMP-005-N	400	590	1950	270
06	PMP-006-A	590	795-1	155	239
	PMP-006-B	590	795-1	250	260
07	PMP-007-B	795-1	1025	250	260
	PMP-007-C	795-1	1025	650	150
08	PMP-008-B	590	660	400	140
	PMP-008-C	590	660	700	160
	PMP-008-D	590	660	1200	190
	PMP-008-E	590	660	600	100
11 (Hydro-pneumatic)	PMP-011-A	400	470	200	65
	PMP-011-B	400	470	150	80
	PMP-011-C	400	470	400	94
13	PMP-013-B	660	715	800	75
	PMP-013-C	660	715	800	94
14	PMP-014-A	660	815	300	225
15 (Hydro-pneumatic)	PMP-015-A	590	640	250	175
16	PMP-016-A	Woodside Res	590	1000	50
17	PMP-017-A	715	815	200	110
	PMP-017-B	715	910	320	200
	PMP-017-C	715	910	320	200
18	PMP-018-A	400	590	400	305
19 (Hydro-pneumatic)	PMP-019-A	590	675A	450	95
	PMP-019-B	590	675A	500	94
20	PMP-020-A	319A	815	500	480
	PMP-020-B	319A	815	500	480
21	PMP-021-A	660	815	700	220

Table 4-4 Pump Stations					
Pump Station Number	**Pump ID**	**Source Zone**	**Service Zone**	**Design Flow (gpm)**	**Design Head (ft)**
22 (Hydro-pneumatic)	PMP-022-A	805	880	100	90
	PMP-022-B	805	880	100	90
23	PMP-023-A	590	805	300	250
	PMP-023-B	590	805	300	360
24	PMP-024-A	590	835A	200	240
	PMP-024-B	590	835A	200	240
25	PMP-025-A	835	1090	200	240
	PMP-025-B	835	1090	200	240
26	PMP-026-A	715	960	250	375
	PMP-026-B	715	960	250	375
27 (Hydro-pneumatic)	PMP-027-A	815	910	350	100
33	PMP-033-A	715	1055	180	465
	PMP-033-B	715	1055	165	465
35	PMP-035-A	1055	1265-1	136	224
	PMP-035-B	1055	1265-1	137	224
36	PMP-036-A	1265-1	1600	135	347
	PMP-036-B	1265-1	1600	140	347
38	PMP-038-A	1600	1890	75	268
	PMP-038-B	1600	1890	75	249

4.5 Reservoirs

The Bear Gulch system has 30 distribution system reservoirs with a total storage capacity of over 11 MG. This treated water storage does not include the Bear Gulch Surface Water Reservoir for storage raw water that is treated at the WTP. Table 4-5 summarizes the key information for the distribution system reservoirs.

Table 4-5 Distribution Storage Reservoirs						
Tank/ Reservoir Number	**Description**	**Volume (MG)**	**Bottom Elevation (ft)**	**Overflow Elevation (ft)**	**Diameter (ft)**	**Service Zone**
T-002-T1	Lake (Bear Gulch WTP)	0.26	194	219	42	220
T-002-T2	Lake (Bear Gulch WTP)	0.51	194	218	60	220
T-005-T6	Intermediate	0.11	381	399	32	400
T-005-T8	Intermediate	0.26	381	402	46	400
T-005-T9	Intermediate	1.07	373	400	82	400
T-006-T1	Coombsville	0.20	560	584	38	590
T-007-T1	Woodside Highlands	0.11	780	798	32	795-1
T-015-T1	Woodside Knolls	0.03	453	467	20	640
T-016-T1	Woodside Res.1	1.09	567	590	90	590
T-017-T1	Alpine Hills	0.26	692	719	41	715
T-019-T1	Ridgeway	0.52	565	593	56	590
T-019-T2	Ridgeway	0.53	563	594	54	590
T-021-T1	Arrowhead	1.03	628	660	74	660
T-021-T2	Arrowhead	1.03	628	660	74	660

Table 4-5 Distribution Storage Reservoirs						
Tank/ Reservoir Number	**Description**	**Volume (MG)**	**Bottom Elevation (ft)**	**Overflow Elevation (ft)**	**Diameter (ft)**	**Service Zone**
T-022-T1	Canada	0.47	783	802	65	805
T-025-T1	Woodside Oaks	0.11	814	834.5	30	835
T-027-T1	Westridge	0.76	790	815	72	815
T-028-T1	Ladera	0.20	650	682	33	680
T-029-T1	Ormondale	0.12	637	653	35	660
T-029-T2	Ormondale	0.12	637	653	35	660
T-029-T3	Ormondale	0.16	637	654	40	660
T-030-T1	Portola	1.02	937	964	80	960
T-031-T1	Summit	0.15	1072	1092	36	1090
T-032-T1	Wayside	0.26	995	1026	38	1025
T-033-T1	Los Trancos	0.010	575	591	10	1055
T-034-T1	Sunrise	0.075	1046	1056	25	1055
T-036-T1	Bonita	0.125	1241	1265	30	1265-1
T-037-T1	Spanish	0.055	1416	1436	22	1435
T-038-T1	Vista Verde	0.212	1575	1599	39	1600
T-039-T1	Pony Tracks	0.282	1856	1888	39	1890

4.6 Pressure Reducing Valves

There are 41 valve stations within the Bear Gulch system. Eighteen pressure zones are served exclusively by PRVs. Seven pressure zones use PRVs as a backup to the normal supply provided by either pump stations or turnouts.

Table 4-6 summarizes key features of the existing PRV stations. Most PRV discharge settings were provided by Cal Water. The others have been estimated based on the hydraulic gradeline in the zone downstream of the PRV, as noted in the table footnotes.

Table 4-6 PRV Stations					
PRV Number	**Location**	**Size (inch)**	**Supplied From**	**Delivered To**	**Outlet Pressure Setting (psi) (1)**
PRV-1025-7952-1		4	1025	7952	30
PRV-1025-850-1		2	1025	850	30
PRV-1025-800-1		12	1025	800	26 (2)
PRV-1055-1055-1		8	1055	1055	90
PRV-1055-1055-2		2	1055	1055	87
PRV-12651-1055-1		6	1265-1	1055	105
PRV-12651-12652-1		2	1265-1	1265-2A	55
PRV-12651-12652-2		2	1265-1	1265-2A	92
PRV-12651-12652-3		4	1265-1	1265-2A	45
PRV-12651-12652-4		2	1265-1	1265-2A	45
PRV-12652-12651-1		2	1265-2B	1265-1	42
PRV-12652-12651-2		4	1265-2B	1265-1	42
PRV-12652-12651-3		4	1265-2B	1265-1	27
PRV-12652-12651-4		2	1265-2B	1265-1	27
PRV-1600-12651-1		12	1600	1265-1	10

Table 4-6
PRV Stations

PRV Number	Location	Size (inch)	Supplied From	Delivered To	Outlet Pressure Setting (psi) [1]
PRV-1600-12652-1		6	1600	1265-2B	60
PRV-1600-12652-2		3	1600	1265-2B	60
PRV-1600-1435-1		12	1600	1435	12
PRV-1890-1600-1		6	1890	1600	18
PSV-PS8-T6		6	590	Coombsville Tank	80 [2]
PRV-284-220-1		6	SFPUC	220	64[2]
PRV-284-220-2		6	SFPUC	220	75
PRV-284-220-3		12	SFPUC	220	75
PRV-297-220-1		6	SFPUC	220	71
PRV-301-220-1		12	SFPUC	220	80
PRV-319-220-1		12	SFPUC	220	50
PRV-319-220-2		12	SFPUC	220	18
PRV-319-220-3		12	SFPUC	220	18
PRV-319-220-4		10	319-A	220	49
PRV-400-220-1		6	400	220	12
PRV-400-265-1		4	400	265	40
PRV-400-319-1		4	400	319A	80
PRV-400-319-3		4	400	319A	86
PRV-475-395-1		2	475	395	72
PRV-560-440-1		6	560	440	65
PRV-590-400-1		4	560	400	49
PRV-590-475-1		3	590	475	49
PRV-590-475-2		3	590	475	49
PRV-590-475-3		2	590	475	49 [2]
PRV-590-500-1		3	590	500	60
PRV-590-525-1		3	590	525	76
PRV-590-590-4		18	590	590	115
PRV-655-510-1		4	655	510	38
PRV-660-660-1		8	660	660	135
PRV-680-560-1		1.5	680	560	46
PRV-680-560-2		6	680	560	46
PRV-680-560-3		4	680	560	60
PRV-680-560-4		4	680	560	43
PRV-715-675-1		4	715	675B	60 [2]
PRV-715-675-2		4	715	675B	60 [2]
PRV-805-590-1		12	805	590	58
PRV-805-640-1		2	805	640	58
PRV-815-440-1		4	815	440	93
PRV-815-655-1		4	815	655	31
PRV-815-680-1		4	815	680	60
PSV-815-680-2		4	815	680	53 [3]
PRV-815-715-1		12	815	715	42 [2]
PRV-815-715-2		6	815	715	6
PRV-910-835-1		4	910	835B	48
PRV-910-835-2		4	910	835B	48
PRV-960-750-1		12	960	750	80
PRV-960-960-1		6	960	960	74
PRV-960-960-2		6	960	960	74
PRV-960-960-3		6	960	960	173 [2]

[1] Outlet pressure setting provided by Cal Water unless noted otherwise.
[2] Outlet pressure setting estimated to match zone grade line.
[3] Upstream pressure setting estimated to match 815 zone grade line.

4.7 Emergency Standby Connections to Other Cities

Table 4-7 summarizes the existing emergency standby connections where treated water from other cities can be delivered to the Bear Gulch District system.

Table 4-7
Emergency Standby Connections to Other Cities

Connection Number	Water Supplied From Neighboring Agency	Location	Delivers to Zone
SB-MP-1	Menlo Park		680
SB-RC-1	Redwood City		145
SB-RC-2	Redwood City		145
SB-MP-2	Menlo Park		145
SB-MP-3	Menlo Park		145

4.8 Pipelines

Table 4-8 summarizes the existing pipelines in the Bear Gulch District by diameter and material. The information was obtained from the GIS database provided by the Engineering Department. There are about 300 miles of pipe in the entire system.

As indicated in Table 4-8, about 12 percent of the existing pipelines are 4-inch or smaller; about 50 percent are 6-inch; and about 23 percent are 8-inch. About 5 percent are greater than 12-inches in diameter.

About 59 percent of the existing pipelines are asbestos cement or transite which is an older form of asbestos cement. About 26 percent are cast or wrought iron (24%) and uncoated steel (3%). About 6 percent of existing pipelines are plastic (PVC, HDPE, PE); about 3 percent are concrete lined and/coated steel; and about 5 percent are ductile iron.

Table 4-8
Bear Gulch - Pipeline Summary by Diameter and Material

Diameter (inches)	Length of Pipe (linear feet - LF)																				
	Material																			Total	
	Asbestos Cement (AC)	Concrete Cylinder Pipe (CCP)	Cast Iron (CI)	Concrete Lined (CL)	Concrete Lined and Coated (CL&C)	Copper	Ductile Iron (DI)	Galvanized Steel	High Density Poly-ethylene (HDPE)	Poly-ethylene (PE)	Polyvinyl Chloride (PVC)	Steel Cement Lined (SCL)	Stainless Steel (SS)	Standard Steel (STD STL)	Steel (STL)	Transite (TRANS)	Wrought Iron (WI)	Wrought Steel (WS)	Unknown [1]	LF	% of Total
1	129					121				179			170							599	0.04%
1.25													167							167	0.01%
1.5								146					700							847	0.05%
2	513	10	23,230	68	38	1,021	475	3,091		121	1,332		3,890	352	14				783	34,938	2.20%
3	252		5,873				27							1,690	30			490	75	8,437	0.53%
4	41,833		78,482		35		1,575	63			4,799	2,154	30		3,161	10,169		192	184	142,676	8.99%
6	447,622		194,046		2,852		30,429	157			52,089	6,877	40	286	6,405	55,766	1,498		480	798,548	50.34%
8	241,754		34,616		7,717		20,940	10	1,555		41,062	934		453	9,847	11,989			9	370,885	23.38%
10	13,063		29,185		22		171							42	154					42,638	2.69%
12	83,826		13,366		588		12,374				136	126	191	53	386				1,127	112,174	7.07%
14	3,505														2,948				13	6,465	0.41%
15															5,122					5,122	0.32%
16	12,730	2,500	1,078				4,496			4,253				76	1,268				7,798	34,199	2.16%
18	6,705	32	587		201		2,065													9,590	0.60%
20	917														7,170					8,087	0.51%
24		5,502	1,090				4,444													11,035	0.70%
Total LF	852,850	8,044	381,552	68	11,453	1,142	76,995	3,468	1,555	4,552	99,418	10,092	5,188	2,951	36,504	77,923	1,498	682	10,469	1,586,405	100.00%
% of Total	54%	1%	24%	0%	1%	0%	5%	0%	0%	0%	6%	1%	0%	0%	2%	5%	0%	0%	1%	100%	

[1] Unknown indicates that material information was not in the database.

Section 5
Performance Criteria

As a private water company, Cal Water is regulated by the Public Utilities Commission (PUC) of the State of California. PUC General Order 103 specifies rules governing water service including minimum standards for design and construction. The performance criteria are based on the PUC requirements, Cal Water's established water system criteria, and recently adopted revisions to the California Health and Safety Code Waterworks Standards (Chapter 16 of Title 22, California Code of Regulations). In addition, information is provided on current American Water Works Association guidelines, current practices of similar water utilities, and CDM engineering experience.

5.1 Summary of Performance Criteria

Table 5-1 summarizes the performance criteria used for the analysis of the Bear Gulch distribution system. The remainder of the section provides a more detailed discussion of each criterion including relevant standards and Cal Water's established criteria, criteria used by other agencies, and the recommended values for the master plan.

Table 5-1
Summary of Performance Criteria for Bear Gulch District

Element	***Description***
Supply to Distribution System	• Supply capacity sufficient to meet maximum day demand with fire flow and peak hour flow. Storage may be used to provide fire flow and peak hour flow in excess of the average maximum day demand. Per the recently adopted Waterworks standards, systems with 1000 or more service connections must be able to meet four hours of peak hourly demand with source capacity, storage capacity, and/or emergency source connections.
Water Transmission Main Sizing (pipelines 18-inch or greater in diameter)	• Minimum pressures: – 50 psi for average day demand condition – 40 psi during maximum day and peak hour demand conditions • Maximum pressure: 125 psi for average day demand condition • Maximum velocities: – 3 fps for average day demand condition – 5 fps for maximum day and peak hour demand condition • Maximum headloss: – 3 ft per 1000 ft for maximum day and peak hour demand conditions • Hazen-Williams "C" Factor = 130 • Allowable pipeline materials: ductile iron, concrete cylinder or steel Note: Sizing criteria are requirements for new development. Existing transmission mains are evaluated on a case-by-case basis considering age, material, velocity, headloss, and pressure.
Water Distribution Main Sizing (pipelines less than 18-inch in diameter)	• Minimum pressures: – 40 psi during peak hour demand condition – 20 psi residual at fire node during maximum day plus fire flow • Maximum velocities: – 7 fps for peak hour demand condition – 10 fps for maximum day demand plus fire flow • Maximum headloss: – 10 ft per 1000 ft for maximum day plus fire and peak hour demand conditions • Hazen-Williams "C" Factor = 120 for ductile iron or steel; 130 for PVC • Allowable pipeline materials: PVC, ductile iron, or steel Note: Sizing criteria are requirements for new development. Existing distribution mains are evaluated on a case-by-case basis considering age, material, velocity, headloss, and pressure.

Table 5-1
Summary of Performance Criteria for Bear Gulch District

Element	Description
Minimum Distribution Pipeline Sizes	Pipes are sized to meet the minimum pressure requirements noted above or the following minimum pipe diameters, whichever is greater. • Low density residential: 12-inch on square mile grid, 8-inch on quarter mile grid, 6-inch for all other • Commercial: 12-inch on square mile grid; 8-inch for all other • Industrial: 12-inch • Cul-de-sac or dead-end street: 8-inch • Distribution to fire hydrants: 8-inch The maximum number of residential lots that can be served by a non-looped pipeline = 25 lots. If a non-looped line goes out-of-service, all associated residences lose water.
Fire Flows	• 2001 California Fire Code (Appendix III-A) flow rates and durations are: – Single family (SF) residential < 3600 SF = 1,000 gpm for 2 hours – SF residential > 3600 SF and up to 11,300 SF = ranges from 1,500 gpm to 2,750 gpm for 2 hours (Fire Dept may require higher flows for larger buildings) – Medium density multiple family (MF) residential = 2,000 gpm for 2 hours – High density MF residential = 2,500 gpm for 2 hours – Commercial = 3,000 gpm for 3 hours – Industrial = 3,500 gpm for 3 hours Note: Flows may be reduced by up to 50% if buildings are sprinklered. • One fire at a time in zone (no simultaneous fires in the same pressure zone).
Reservoir Storage	• Storage provides the following three functions: – Operational (or balancing storage) to meet daily fluctuations in demand in excess of the water supply production capacity on the maximum day. For the Bear Gulch District, this component is estimated as 25 percent of the maximum day demand. – Fire storage to provide a reserve for fire fighting. The amount varies and is estimated as the most critical (highest) fire flow required in a zone times the required duration. – Emergency storage to provide an emergency reserve in case of planned or unplanned outages of equipment or facilities, including power or supply outages. For the Bear Gulch District, this component is estimated as one average demand day. • The total required storage is the sum of the above three components. For the Bear Gulch District, the total required storage is about 1.9 average days demand (equivalent to about 90% of the maximum demand day).
Pumping Facilities	• Firm pump station capacity is with the largest pump considered to be out of service. If there are multiple pump stations serving the same service zone, only one pump is considered to be out of service for all the stations combined, i.e., not one pump at each station. • Total pump station capacity equals the firm capacity plus a standby (out-of-service) pump equal in size to the largest pump. • Pump stations pumping into zones with gravity reservoir storage are sized to have firm capacity equal to the maximum day zone demand (average rate over 24-hours). Fire flows are provided by gravity from the zone storage. • Hydropneumatic pump stations are sized for firm capacity for domestic flows equal to the peak hour flow into the zone (or into the portion of the zone served by the pump station). Hydropneumatic stations must also have a fire flow capacity to provide required fire flows in the zone. Hydropneumatic stations should have back-up capabilities. • For all zones, pump stations must also have the ability to pump any flow that must be lifted through to subsequent higher zones. • Backup power should be provided equal to the firm capacity of the pump station by means of an on-site generator for critical stations or a plug-in portable generator for less critical stations. • Critical pumping facilities – a pumping facility is defined as critical if it meets any of the following criteria: – Largest facility that provides water to a particular pressure zone and/or service area. – Facility that provides sole source of water to multiple pressure zones and/or service areas. – Facility that provides water from a supply turnout into pressure zones and/or service areas. – Facility that provides water from key groundwater supply wells into a pressure zone and/or service area. Key depends on capacity, quality and location of the well.

5.2 Supply to Distribution System

PUC General Order 103 requires that the quantity of water delivered to the distribution system from all source facilities be sufficient to supply adequately, dependably and safely the total requirements of all customers under maximum consumption, while meeting the pressure requirements described below. The combined flow from sources of supply and storage capacity should be adequate for four consecutive days of maximum use.

Many water agencies, particularly those with surface water supply such as the Bear Gulch District, provide supply capacity equal to the maximum day demand, and then meet peak hour needs from storage. In some cases, it may be appropriate to meet some peaking needs from the supply source, e.g., if there is available peaking capacity from the surface water source, or from wells in systems with groundwater supply.

The recently adopted revisions to the Waterworks Standards require that a system's water sources must have the capacity to meet the maximum day demand at all times. For systems with 1,000 or more service connections, the system must be able to meet four hours of peak hourly demand with source capacity, storage capacity, and/or emergency source connections. Both the maximum day and peak hour requirements must be met in the system as a whole and in each individual pressure zone.

For the Bear Gulch District, the criterion will be to meet maximum day demand from supply sources and peak hour demands in excess of the average maximum daily demand from storage.

5.3 Distribution System Pressures

Per PUC General Order 103, the utility must maintain the following operating pressures at the service connection:

- Normal operating pressures of not less than 40 psi or more than 125 psi at the service connection;
- Minimum pressures under peak hourly seasonal demands of at least 30 psi;
- Maximum pressures under minimum hourly demand conditions of not more than 150 psi; and
- Residual pressure of 20 psi in the distribution system under fire flow conditions.

Per PUC General Order 103, under normal operating conditions, variations in pressure are not to exceed 50 percent of the average operating pressure, determined as the arithmetical average of at least 24 hourly pressure readings.

Cal Water has established the following pressure requirements, which are used for the master plan analysis:

- Transmission Pipelines (18-inch or greater in diameter)
  - Minimum pressures:
    - 50 psi for average day demand condition
    - 40 psi during maximum day and peak hour demand conditions
  - Maximum pressures: 125 psi for average day demand condition
- Distribution Pipelines (less than 18-inch diameter)
  - Minimum pressures:
    - 40 psi during peak hour demand condition
    - 20 psi residual at fire node during maximum day plus fire flow

The recently adopted revisions to the Waterworks Standards require that each distribution system be operated in a manner to assure that the minimum operating pressure in the water main at the user service line connection is not less than 20 psi at all times throughout the distribution system. This minimum pressure criterion applies for fire flow and other emergency conditions, such as temporary outages of pumping facilities.

The new Waterworks Standards also require that each new distribution system that expands existing service connections by 20 percent or more, or that may otherwise adversely affect distribution system pressure, must be designed to provide a minimum normal operating pressure throughout the new distribution system of not less than 40 psi at all times (excluding fire flow or other emergency conditions).

The Uniform Plumbing Code requires individual pressure reducing valves if pressures exceed 80 psi for new installations.

5.4 Water Main Sizing

PUC General Order 103 requires new and replacement mains be sized to accommodate the pressure requirements in the order as described above, or minimum of 6-inch diameter, whichever is larger. The transmission pipelines from sources of supply must be designed to deliver, in combination with related storage facilities and to the limits of the capacity of those sources of supply, the maximum requirements of that portion of the system dependent upon those transmission pipelines.

Cal Water requires that new pipelines be sized to meet its pressure criteria as discussed above. In addition, Cal Water has established the following additional requirements for sizing new pipelines, which are used for the master plan analysis:

- Transmission Pipelines (18-inch or greater in diameter)
  - Maximum velocities:
    - 3 feet per second (fps) for average day demand condition
    - 5 fps for maximum day and peak hour demand condition
  - Maximum headloss:
    - 3 ft per 1000 ft for maximum day and peak hour demand conditions
  - Hazen Williams "C" factor: 130
  - Allowable pipe materials: ductile iron, concrete cylinder, steel

- Distribution Pipelines (less than 18-inch in diameter)
  - Maximum velocities:
    - 7 fps for peak hour demand condition
    - 10 fps for maximum day demand plus fire flow
  - Maximum headloss:
    - 10 ft per 1000 ft for maximum day plus fire and peak hour demand conditions
  - Hazen Williams "C" factor: 120 for ductile iron or steel, 130 for PVC
  - Allowable pipe materials: PVC, ductile iron, steel
  - Minimum pipe sizes:
    - Low density residential: 12-inch on square mile grid, 8-inch on quarter mile grid, 6-inch for all other
    - Commercial: 12-inch on square mile grid
    - Industrial: 12-inch
    - Cul-de-sac or dead-end street: 8-inch
    - Distribution to fire hydrant: 8-inch
  - The maximum number of residential lots served by a non-looped pipeline is 25 lots, since all associated residences would lose water service due to a break.

The sizing criteria are requirements for new pipeline improvements and new development. Existing transmission mains are evaluated for improvement on a case-by-case basis considering age, material, velocity, headloss, and pressure. New and/or replacement pipelines should be looped to the greatest extent possible to improve hydraulics and water quality in the system.

Velocity and headloss information from the modeling analysis is used to identify hydraulic bottlenecks in the existing system and determine the best locations for hydraulic improvements. Existing pipelines that exceed the established criteria are identified, and are evaluated on a case-by-case basis. If existing pipelines must be improved, then improvements would be designed to meet the established criteria.

Many water agencies have main sizing criteria that include system pressures, as discussed above, as well as pipe velocities and headlosses. Typical velocity ranges used by other agencies are from a desirable level of 5 fps up to a maximum of 12 fps under peak hour or maximum day plus fire flow. The typical range for headlosses is from 5 feet per 1,000 feet under maximum day demand up to a maximum of 10 feet per 1,000 feet for peak hour demand. A maximum of 10 feet per 1,000 feet under any non-fire demand condition is a typically used head loss criterion, and is equivalent to 4.3 psi pressure loss per 1,000 feet.

Typically, high velocities and/or high headlosses may manifest as a reduction in pressure. However, high velocities and corresponding high headlosses are also a concern for water hammer. According to the American Water Works Association's Manual M32 – "Distribution Network Analysis for Water Utilities" (AWWA, 1989), velocities are acceptable up to a maximum of about 10 fps to minimize such problems, while velocities of about 5 fps are desirable. Under fire flow conditions, the most likely cause of water hammer would be from rapid closure of a hydrant following use. This infrequent scenario may not warrant applying the same velocity and headloss criteria for fire flow conditions.

5.5 Fire Flows

PUC General Order 103 provides fire flow standards considered appropriate on an average statewide basis, but acknowledges that there are widely varying conditions for the urban, suburban and rural areas in the state. The order states that the standards prescribed by the local fire protection agency or other prevailing local governmental agency govern. Such local flow standards are to be provided whether greater or lesser than those set forth in the order, except that mains designed for and capable of providing flows in excess of the requirements set forth are to be considered mains providing excess flow for the purpose of the application of the utility's main extension rule.

The PUC statewide fire flows are shown below for the types of land uses in the Bear Gulch District. The flows shown must be provided for up to 2 hours, in addition to the average daily demand in the area served.

PUC Statewide Average Fire Flows	
Type of Land Use	***Flow (gallons per minute)***
Single family residential with lot density of three or more units per acre, including mobile home parks	1,000
Duplex residential units, neighborhood business of one story	1,500
Multiple residential, one and two stories; light commercial or light industrial	2,000
Multiple residential, three stories or higher; heavy commercial or heavy industrial	2,500

The Menlo Park Fire District serves the communities of Atherton, Menlo Park, East Palo Alto, and some unincorporated areas of San Mateo County in Redwood City. The Menlo Park Fire District has adopted the 2001 California Fire Code. Appendix III-

A of the Fire Code contains information on required fire flows for new installations, as shown below (all flows to be provided with minimum 20 psi residual pressure):

- Single family residential and duplexes
  - Building area not exceeding 3,600 square feet (SF): 1,000 gpm for 2 hours
  - Building area greater than 3,600 SF and up to 11,300 SF: ranges from 1,500 gpm to 2,750 gpm for 2 hours. Building area from 11,301 to 20,600 SF: ranges from 3,000 to 3,750 gpm for 3 hours. Buildings larger than 20,600 SF: 4,000 gpm and higher for 4 hours. This is based on a general type of building construction using any type of allowed construction material, including wood. [Note: Requirements are lower for other building types utilizing non-combustible materials or constructed to provide a minimum of 1-hour fire resistivity. hat provide higher fire resistivity. For these other building types, the minimum fire flow is 1,500 gpm for 2 hours for buildings up to 12,700 SF. Higher flows are required for larger buildings.]
- Medium density multiple family residential – 2,000 gpm for 2 hours
- High density multiple family residential and schools – 2,500 gpm for 2 hours
- Commercial – 3,000 gpm for 3 hours
- Industrial – 3,500 gpm for 3 hours

If the buildings have approved automatic sprinkler systems, the Menlo Park Fire District may reduce the required flow amount by up to 50 percent on a case-by-case basis.

The Woodside Fire Protection District serves the remainder of the Bear Gulch District, including the Town of Woodside, the Town of Portola Valley and several unincorporated areas such as Ladera, Los Trancos Woods, Vista Verde, Emerald Lake, and the Skyline Area. The current fire flow requirements of the Woodside Fire Protection District are an amended version of the California Fire Code, as shown below (flows to be provided with minimum 20 psi residual pressure):

- One and Two Family Dwellings: 1,000 gpm minimum. This flow may be reduced by 50% if the building has an approved automatic sprinkler system. A water supply for fire protection means a fire hydrant within 500 feet from the building capable of the required fire flow; or an approved storage facility at the structure with a minimum of 18,000 gallons of water for fire protection with a hydrant capable of delivering 1,000 gpm from storage.
- Land Divisions and Subdivisions: 1,000 gpm minimum flow. This flow may be reduced by 50% if the building has an approved automatic sprinkler system. Hydrants must be 500 feet apart within 500 feet from structures. Hydrants must meet required flow for a minimum 120,000 gallons in storage for fire protection.

The Woodside Fire Protection serves the very hilly western portion of the District at a wildland/urban interface that is subject to urban wildfire threats. Their service area includes rural areas with private (individual) water system, i.e., not served by Cal Water or municipal water agencies. The current fire protection requirements are not as stringent as the California Fire Code, since the Fire Code was not considered practical due to the lack of existing municipal water systems and the rural nature of the area.

The Town Woodside has conducted recent studies regarding the need for improved fire protection, and prepared a Fire Management Plan. The Town does not agree with the reduced requirements adopted by the Fire District, or allowing small individual storage facilities to function as the fire protection supply.

The California Fire Code was used as the baseline for evaluating the distribution system for fire flows, which in some cases are more stringent than current Fire Department criteria, e.g., Woodside Fire Protection area. Under PUC rules, facilities to meet fire flow requirements for individual customers are the responsibility of those they are designed to serve. Cal Water's understanding is that the local supply system is only charged with meeting 3,500 gpm for insurance rating purposes. If fire flow exceeds 3,500 gpm and cannot be met by the local water system, the property owner either provides additional on-site fire protection or pays a higher premium.

Water system planning analyses typically assume that only one fire will occur at a time within a pressure zone or service subarea. If the pressure zone or service subarea is very large, two simultaneous fires may be simulated. For the Bear Gulch District, it is assumed that only one fire would occur at a time in a zone.

5.6 Reservoir Storage

PUC General Order 103 does not contain any specific requirements regarding storage amounts. The combined flow from sources of supply and storage capacity must be adequate for four consecutive days of maximum use.

Water system storage is typically sized based on the following three components:

- operational storage (also called equalizing or balancing storage);
- fire reserve storage; and,
- emergency storage.

Water storage capacity may also be provided in equivalent ways, other than tanks. For example, some agencies provide backup generators at pump stations to provide some of the reliable emergency supply. In some cases, a water system may be able to peak off the supply source, which can reduce the in-system operational storage requirement. Water systems with groundwater supply may use wells with backup power to provide some or all of these components.

Operational (equalizing or balancing) storage is the volume of water required to meet daily fluctuations in demand in excess of the water supply production capacity on the maximum day. This storage volume is determined by the variation in the hourly demand during the day of maximum demand. When supply capacity is provided to meet the maximum day demand, operational storage requirements typically range from 25 to 50 percent of the maximum day demand. If peaking capacity is available from the supply system, then the operational storage requirement may be lower. For the Bear Gulch District, operational storage at 25 percent of the maximum day demand is recommended, which is a typical industry standard. This criterion is based on the Bear Gulch diurnal curve pattern that was developed for the hydraulic model from system-specific information and complies with the new Waterworks Standard requirement to be able to meet 4 hours of peak hourly demand from a combination of supply sources and storage (maximum day is provided from supply sources and the peak hourly demand in excess of the average hourly on the maximum day is met from storage).

Fire reserve storage is the amount of storage volume necessary to supply fire flow for the most critical land use within a pressure zone. The fire reserve storage is typically computed for each pressure zone or service area, based on the most restrictive (highest) fire flow requirement times the duration for which it must be supplied. The fire reserve storage should always be available for fire protection to every part of the distribution system.

Emergency storage is the volume of water required to supply the service area during planned or unplanned equipment outages, power outages, or well shutdowns for unexpected mechanical difficulties or quality issues. This storage needs to be sufficient to provide a reasonable level of uninterrupted service under such circumstances. The minimum recommended emergency storage generally represents a 6-hour power outage on the maximum demand day (25 percent of maximum day demand). A typical assumption for emergency storage in the Bay Area is that there may be a supply outage and/or power outage for 8 to 12 hours on the maximum demand day, which would represent about 35 to 50 percent of the maximum day demand. An outage of this duration on the maximum demand day would be equivalent to requiring emergency storage equal to about 0.7 to 1.0 average demand day. For the Bear Gulch District, one average day demand of emergency storage has been used, which is consistent with the criteria for other Cal Water service areas on the San Mateo Peninsula.

The storage criteria for the Bear Gulch District are summarized below. Total storage equals the sum of the operational storage, emergency storage, and fire reserve.

Reservoir Storage Criteria for Bear Gulch District	
Storage Component	***Criterion***
Operational Storage (also called equalizing or balancing storage)	25 percent of maximum day demand
Emergency Storage	One average day demand
Fire Reserve	For each zone, based on most critical land use within zone and required fire flow amount and duration.
TOTAL REQUIRED STORAGE	Sum of all three components

The storage criteria identified above do not include additional storage capacity that may be required to allow time-of-use pumping. With time-of-use pumping, reservoir storage is needed to store the water for use during the "pumps off" period. This is discussed further below under pumping facilities.

If standby power is provided at pump stations that supply a zone that would avoid potential service interruptions, this could also be considered as an alternative to emergency storage. This option is sometimes more feasible than storage tanks, particularly for small zones.

The storage analysis also considers minimizing water quality impacts, such as potential for nitrification, at storage reservoirs due to low turnover during low demand periods. Water age is a general indicator for other water quality problems, such as loss of disinfectant residual, or potential for nitrification. Water age in reservoirs is often used to identify reservoirs with potential problems, i.e., higher water age typically means lower turnover and potential for water quality problems. The recently adopted revisions to the Waterworks Standards require that tanks must be constructed with a separate inlet and outlet (internal or external) to improve turnover for water quality purposes.

5.7 Pumping Facilities

PUC General Order 103 does not contain any specific requirements regarding pumping capacities. The transmission system from sources of supply must be designed to deliver, in combination with related storage facilities and to the limits of the capacity of those sources of supply, the maximum requirements of that portion of the system dependent upon those transmission pipelines.

Cal Water has established the following criteria for pumping capacities:

- Zones with reservoir storage should provide firm pumping capacity or gravity supply capacity that is sufficient to meet maximum day demand. For zones with storage, fire reserves are provided from storage.

- Zones without storage in the zone should have firm pumping capacity or gravity supply capacity to meet the peak hour demand on the maximum day, plus a fire pump or other means of providing fire flows to the zone.

- For all zones, the pump station must also have the ability to pump any flow that would be lifted through to supply subsequent higher zones.

- Firm capacity is defined as the capacity with the largest pumping unit at the pump station out of service.

Some agencies size pumps to allow time of use pumping to reduce energy costs. For example, pump stations may be sized for 150 percent of the maximum day demand. This sizing allows for operating the pump station during a 16-hour period, and keeping the pumps off for 8 hours during the day (6-hour peak energy cost period plus an hour on either end as an operational cushion). With time-of-use pumping, reservoir storage is needed to store the water for use during the "pumps off" period. Depending on the amount of capital improvements needed to provide the additional booster capacity, additional storage capacity, and/or additional supply peaking capacity needed to allow off-peak pumping, it may not be cost effective relative to the annual savings that might be realized from lower pumping costs.

Backup power should be provided equal to the firm capacity of the pump station by means of an on-site generator for critical stations or a plug-in portable generator for less critical stations. Critical pumping facilities are those that meet any one or more of the following criteria: 1) largest facility that provides water to a particular pressure zone and/or service area; 2) facility that provides the sole source of water to multiple pressure zones and/or service areas; 3) facility that provides water from a supply turnout into pressure zones and/or service areas; and/or 4) facility that provides water from key (depend on capacity, quality, location) groundwater supply wells into a pressure zone and/or service area.

5.8 Main Replacement Program

This section discusses both the company-wide program objectives, and specific main replacement objectives established by the District.

5.8.1 Company-Wide Program

Cal Water, as a company, has an established Main Replacement Program for all its districts to replace all undersized mains and bare steel mains (uncoated, unlined or both). The goal of the program is to replace all mains of these categories within a 25 to 50 year period. The specific length of the replacement period for a given district is determined by:

1) The total footage of mains that fall within the following replacement program categories:

    - Undersized mains that are smaller than 6-inch diameter

- Steel mains (bare) that are 6-inches or larger in diameter

2) The severity of the leak or fire protection problems in the district.

Undersized mains with a diameter smaller than 6 inches are replaced to improve fire protection, distribution within the system, and service pressure to customers. Under PUC General Order 103, the current policy is to install mains with a minimum 6-inch diameter, in order to provide adequate system pressure and flows to all services. The highest priorities for replacement are the smallest diameter mains which provide the weakest pressure and flow conditions and those mains with the greatest history of leaks. While not required by the PUC General Order, mains that are 6-inch diameter or larger are also evaluated as the need arises to determine if such mains should be considered for replacement with larger diameter mains.

Steel mains that are 6-inch and larger diameter are included in the targeted mains as needed to reduce and control leaks. Many steel mains were originally installed over forty years ago and these mains can routinely, yet randomly, develop leaks. The objective in any one-year is to replace those mains which have generated the greatest leak problems during recent years.

The soils in some regions are more corrosive than in other regions. These soils can accelerate leak occurrence in certain main materials. For example the bay mud found in the Peninsula districts is highly corrosive to cast iron mains. Where appropriate, these affected main types are included in the replacement program.

Cal Water has implemented a leak tracking system that uses leak repair report cards submitted by repair crews following any leak repair action. Using these cards, a leak history is generated for individual mains. Cal Water annually determines the number of leak for each district on the basis of leaks per one hundred miles of main. This information along with the actual length of targeted mains in a district is used to set the annual target main replacement length.

5.8.2 District Long-Term Main Replacement Objectives

The District has developed and provided a detailed list of specific main replacement projects that address the following objectives:

- Improving flow in the Woodside Zone
- Repairing leaky pipes
- Improving reliability of pipes in slide-prone areas
- Improving fire flows
- Improving pressures in the Intermediate zones
- Addressing operational issues

- Improving circulation, i.e., reducing water quality issues

In addition, the District provided a listing of identified locations of critical pipelines crossing faults, creeks and known slide areas.

The information provided by the District is included as Appendix C. This information is considered as part of the water system analysis discussed in Section 8 and the plan recommendations in Section 9.

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Section 6
Water Supply Requirements

This section discusses the existing water supply sources and key issues, and compares demand and supply projections to identify the requirements for future supply. Key issues discussed in this section include the reliability of SFPUC surface supply and the local surface supply, and future water quality regulations and potential water quality issues that may affect the Bear Gulch supply.

Section 7 describes the recommended water supply strategy to address the supply requirements identified in this section. Section 8 discusses the water system analysis that incorporates these supply requirements. Section 9 combines the supply and distribution system recommendations into an integrated plan.

6.1 Existing Water Supply Sources

The Bear Gulch District has historically received about 90 percent of its water supply from the San Francisco Public Utilities Commission (SFPUC). The remaining ten percent is local surface water supplied from Cal Water's Bear Gulch Reservoir.

6.1.1 SFPUC Supply

Cal Water's SFPUC supply is delivered to the Bear Gulch District at seven turnouts distributed throughout the system, as described in Section 4. Table 6-1 summarizes Cal Water's historical purchases from SFPUC for the Bear Gulch District for the period from 1981 through 2005.

Table 6-1
Historical SFPUC Supply for Bear Gulch District

Period	Water Purchases from SFPUC	
	Million Gallons per Day (mgd)	Acre-Feet (AF)
20-year Average (1986-2005)	10.1	11,346
15-year Average (1991-2005)	10.2	11,457
10-year Average (1996-2005)	11.0	12,320
5-year Average (2001-2005)	11.6	12,940

Table 6-2 summarizes the SFPUC purchase estimates for Year 2030 for Cal Water's three San Mateo County systems. The Year 2030 SFPUC purchase estimates are the basis for implementation of the SFPUC Water System Improvements Program (WSIP), which is the capital improvement program currently underway to reinforce the SFPUC supply system. The purchase estimates are for SFPUC surface water supply

only. Total demands in the Cal Water service areas will be met by a combination of SFPUC supply and local supplies.

Cal Water's current 25-year contract with SFPUC adopted in 1984 will expire in 2009. Table 6-2 shows the current contractual Supply Assurance Amount for the three San Mateo County districts (Mid-Peninsula, South San Francisco, and Bear Gulch). The Supply Assurance Amount is a single combined amount for all three service areas. Cal Water determines how the total amount will be allocated among the service areas. It is anticipated that the small deficit between the current supply assurance amount and the projected Year 2030 purchase estimate will be addressed in Cal Water's re-negotiation of the SFPUC contract, i.e., the re-negotiated supply assurance amount will be higher to cover the deficit. If this does not occur, the deficit must be covered by additional local supply.

As an investor-owned utility, Cal Water is not permitted to purchase more than a specified maximum amount of 47,400 acre-feet per year (AFY) of SFPUC surface water due to the provisions of the Raker Act that authorized development of SFPUC's Hetch Hetchy system. The maximum amount allowable under the Raker Act is larger than the Supply Assurance Amount. The Raker Act quantity is related to the amount of local surface water that may be available to SFPUC.

Table 6-2
Year 2030 SFPUC Supply Purchase Estimates

Supply Condition	*Water Supply*	
	(mgd)	*(AFY)*
Year 2030 SFPUC Purchase Estimates [(1)]		
Bear Gulch District service area	11.60	12,995
Mid Peninsula service area	17.24	19,313
South San Francisco service area	7.97	8,928
Total for All Three Peninsula Service Areas [(1)]	*36.81*	*41,235*
Supply Assurance Amount – 1984 Supplement to Agreement/Contract (all Cal Water districts)	35.39	39,645
Difference between Current Supply Assurance Amount and Projected Purchase Estimate [(2)]	(1.42) [(2)]	(1,591) [(2)]

(1) Year 2030 SFPUC purchase estimates are for SFPUC surface water supply only. Total demands in the Cal Water service areas will be met by a combination of SFPUC supply and local supplies.

(2) It is anticipated that the difference (deficit) between the current supply assurance amount and the projected Year 2030 purchase estimate will be addressed in Cal Water's re-negotiation of the SFPUC contract, i.e., the re-negotiated supply assurance amount will be higher to cover the deficit. If this does not occur, the deficit must be covered by additional local supply.

6.1.2 Local Surface Water from Bear Gulch Creek

The Bear Gulch District has the only existing local surface water supply in Cal Water's San Mateo County districts. The local surface supply for the Bear Gulch District is runoff from rainfall in the local drainage areas of Bear Gulch Creek. The water is treated at Cal Water's Bear Gulch Water Treatment Plant, located at the outlet of the Bear Gulch Reservoir, prior to delivery to the distribution system. Table 6-3 summarizes the historical production of local surface water.

Section 7 contains a detailed discussion of the existing local surface supply system, key issues affecting the local surface supply, and potential options to increase and expand the use of the local surface supply. Cal Water's current Urban Water Management Plan (UWMP) for the Bear Gulch District has targeted an annual local surface water production of about 1,500 AF (490 MG), which is 1.34 mgd on an average annual basis. At this production level, local surface water would supply about 10 percent of the total District demand.

Table 6-3
Historical Surface Water Production from Bear Gulch WTP

Range	Annual Production from 1980 through 2006		
	(AF)	(MG)	(mgd)
Minimum Production (during dry years such as 1987-1992 drought)	320	104	0.3
Average Production (average of all years)	1,325	432	1.2
Maximum Production [1] (during wet years)	2,810	916	2.5

[1] The five highest production years included: 1983 at 2.5 mgd; 1982 at 2.1 mgd; 1995 at 2 mgd; 1984 at 1.7; and 2006 at 1.7 mgd.

6.2 Comparison of Supply and Demand

Table 6-4 summarizes the current and projected Year 2030 district-wide water demands for the Bear Gulch service area that were developed in Section 3. The demand projections in Table 6-4 are for normal conditions (non-drought and non-emergency conditions). In addition, Table 6-4 shows the demand projections developed for Cal Water's South San Francisco Water Supply & Facilities Master Plan, and Mid-Peninsula Water Supply & Facilities Master Plan. These service areas plus the Bear Gulch District comprise Cal Water's San Mateo County service areas.

A range of Year 2030 demand projections were developed based on various growth assumptions and unit demands (low, mid, and high estimates). Based on this range of demands, Year 2030 demands without accounting for future conservation savings would range from 13.6 to 14.5 mgd. If long-term conservation savings of 10 percent were realized by Year 2030, the Year 2030 demand would essentially remain at the current level of about 13 mgd.

Table 6-4
Summary of Demand Projections for Bear Gulch District and Other Cal Water San Mateo County Service Areas and Comparison to BAWSCA Demand Projections

Demand Condition	Water Demand	
	(mgd)	(AF/year)
Bear Gulch Demands (Normal Conditions)		
Current Demands	13.0	14,562
Year 2030 Projections:		
Low Estimate (10-year average unit demands)	13.6	15,232
Mid Range Estimate (5-year average unit demands)	14.0	15,680
High Estimate (highest growth rates and unit demands over past 20-year period)	14.5	16,240
With 10% Long-Term Conservation Savings at 2030 as reduction from high estimate (demand essentially would remain at current level)	13.0	14,562
Mid-Peninsula Service Area Demands (San Mateo and San Carlos Systems)		
Current Demands	17.0	19,040
Year 2030 Projections:		
Low Estimate (10-year average unit demands)	17.2	19,152
Mid Range Estimate (5-year average unit demands)	17.6	19,712
High Estimate (highest growth rates and unit demands over past 20-year period): This is the planning-level demand.	18.6	20,832
With 10% Long-Term Conservation Savings at 2030 as reduction from high estimate (demand essentially remains at current levels)	17.0	19,040
South San Francisco Service Area Demands		
Current Demands	8.6	9,634
Year 2030 Projections:		
Low Estimate (10-year average unit demands)	10.6	11,874
Mid Range Estimate (5-year average unit demands). This is the planning-level estimate.	11.0	12,322
High Estimate (highest growth rates and unit demands over past 20-year period)	11.6	12,995
With 10% Long-Term Conservation Savings at 2030 as reduction from mid range estimate	9.9	11,090
Year 2030 BAWSCA Demand Projections [1]		
Bear Gulch System	13.9	15,571
Mid Peninsula System	18.1	20,276
South San Francisco system	9.9	11,090
Total for All Three San Mateo County Peninsula Systems	*41.9*	*46,937*

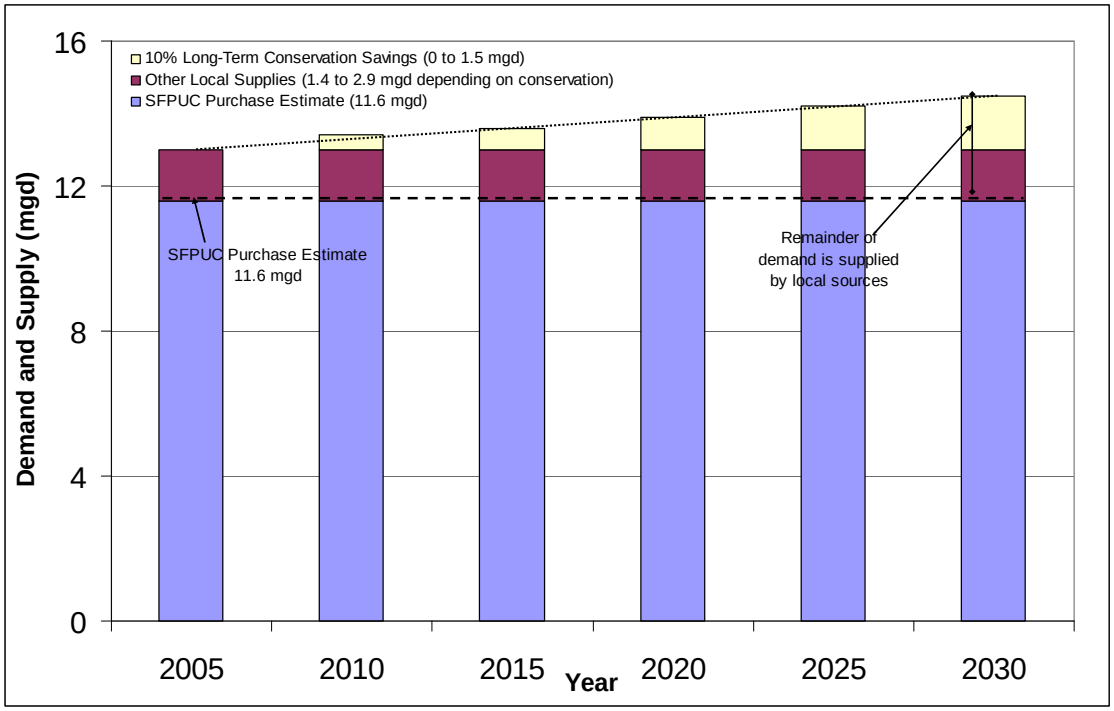
[1] BAWSCA demands are the total demands regardless of source of supply. SFPUC derived their purchase estimates, as shown in Table 6-2, based on the information provided by BAWSCA and SFPUC assumptions as to how much of the total demand would be met from SFPUC versus from local supply sources. The Year 2030 SFPUC purchase estimates are: Bear Gulch District – 11.6 mgd; Mid-Peninsula – 17.24 mgd; and South San Francisco – 7.97 mgd. The total Year 2030 SFPUC purchase estimate for all three areas equals 36.81 mgd, which is 5.1 mgd less than the combined estimated BAWSCA demand for all three. At a regional level, it is assumed that at least 5.1 mgd of local supply for all three areas combined will be provided to meet normal demands, in addition to the SFPUC supply.

Table 6-4 also compares the demand projections developed for the Cal Water master plans with those in the regional BAWSCA demand study that provided the basis for the SFPUC purchase projections. As indicated in Table 6-4, the BAWSCA projections for the Bear Gulch District and Mid-Peninsula service areas are approximately in the mid range of the Cal Water estimates, while the South San Francisco service area projection is in the low range. The BAWSCA projections assume that Cal Water's conservation program will reduce demands in the future. Cal Water's projections include high end estimates that allow consideration of the potential supply impact if planned conservation savings are not realized. The Cal Water demand projections are used for the Water Supply & Facility Master Plans, and will be used for the upcoming integrated water supply plan for all of Cal Water's San Mateo County service areas.

BAWSCA demands are the total demands regardless of source of supply. SFPUC derived their purchase estimates (shown in Table 6-2) based on the information provided by BAWSCA and SFPUC assumptions as to how much of the total demand would be met from SFPUC versus local supply. The Year 2030 SFPUC purchase estimate for the Bear Gulch District is 11.6 mgd versus BAWSCA's 13.9 mgd projected demand, which assumes that the SFPUC supply will be supplemented by 2.3 mgd local supply.

Figure 6-1 and Table 6-5 illustrate the projected growth in Bear Gulch demands over time to 2030 under normal conditions for the high demand estimate of 14.5 mgd by 2030, and the supplies to meet those demands.

The supplies include SFPUC surface supply at 11.6 mgd based on the year 2030 SFPUC purchase estimate, and local supplies to make up the remainder. If planned conservation savings of up to 10 percent by Year 2030 could be realized, this could provide up to 1.5 mgd and hold the year 2030 demand at its current level of 13 mgd. A minimum of 1.4 mgd of other local supply would be needed to supplement the 11.6 mgd of SFPUC supply assuming 10 percent conservation savings holds Year 2030 demand at about 13 mgd. Up to 2.9 mgd of local supply may be needed without conservation savings if Year 2030 demands reach the high estimate of 14.5 mgd. In the near-term until additional local supplies are developed, SFPUC surface water supply may provide a larger amount of the total supply.



(1) Local supply could consist of local surface water, groundwater, recycled water, or desalination. The figure indicates the amount of local supply needed so that the year 2030 SFPUC purchase estimate is not exceeded.
(2) SFPUC supply is at SFPUC's year 2030 purchase estimate amount. In the near-term until additional local supplies are developed, SFPUC surface water supply may provide a larger amount of the total supply.

Figure 6-1
Water Demand & Supply Projections – Normal Conditions
Bear Gulch District

Table 6-5
Bear Gulch Supply Components Required to Meet Normal Demands

	Supply Amount											
	Year 2005		***Year 2010***		***Year 2015***		***Year 2020***		***Year 2025***		***Year 2030***	
Supply Component	***(mgd)***	***%***	***(mgd)***	***%***	***(mgd)***	***%***	***(mgd)***	***%***	***(mgd)***	***%***	***(mgd)***	***%***
SFPUC Supply - assumes constant at year 2030 projected purchase amount.	11.6	89%	11.6	87%	11.6	85%	11.6	83%	11.6	82%	11.6	80%
Local Supply (1) (local surface water supply, conservation savings, temporary savings, groundwater, recycled water, desalination.)	1.4	11%	1.8	13%	2.0	15%	2.3	17%	2.6	13%	2.9	20%
Total Bear Gulch Supply/Demand (2)	*13.0*	*100%*	*13.4*	*100%*	*13.6*	*100%*	*13.9*	*100%*	*14.2*	*100%*	*14.5*	*100%*

(1) Local supply would consist of a combination of local supply sources as discussed in Section 7.
(2) Projected demand is the high estimate of 14.5 mgd by 2030. The projected demands ranged from a low of 13.6 mgd to a high of 14.5 mgd.

As discussed below, there are issues with respect to the long-term reliability of the SFPUC supply and its ability to meet demands during droughts and emergencies. These issues are considered in the formulation of the water supply strategy in Section 7. As described in Section 7, local supply sources have been identified to supplement SFPUC supply for the Bear Gulch District. Future supply will be provided from a combination of SFPUC supply, local surface water (Bear Gulch Reservoir), and other local supply sources including long-term conservation savings, temporary demand reductions during emergencies and droughts, groundwater, recycled water, and possibly desalination.

The cost of new local supply, including any costs to Cal Water for these efforts, will need to be cost competitive with SFPUC supply for Cal Water's participation to be feasible. Cal Water, as a private utility, must justify rate increases and get approval from the California Public Utilities Commission (CPUC). Currently Cal Water pays about $500 per acre-foot for wholesale SFPUC water. However, the cost of SFPUC water in the future is anticipated to increase significantly as SFPUC implements its WSIP to improve the reliability of its regional water supply system.

According to recent information from SFPUC, it is anticipated that the wholesale cost of SFPUC water will increase to about $600-650 per acre-foot by 2010, and to over $1,500 per acre-foot by 2015 due to the WSIP. The cost thresholds for justifying Cal Water development of new local supply would be based on these costs, not the current cost of SFPUC water.

For all three Cal Water districts on the San Mateo County peninsula, the combined Year 2030 SFPUC purchase estimates are 5.1 mgd less than the combined BAWSCA demand estimates for all three districts. At a regional level, SFPUC/BAWSCA are assuming that at least 5.1 mgd of local supply will be provided to meet normal demands in the three districts (combined total for all three districts), in addition to the SFPUC supply. Cal Water can allocate its total SFPUC supply among the three San Mateo County peninsula service areas as it chooses.

Subsequent to the San Mateo County peninsula master plan studies, Cal Water anticipates developing a regional water supply strategy for the peninsula as a whole that will focus on cost-effective use of total supplies among all San Mateo County peninsula service areas, including both SFPUC and local supplies. This regional supply planning for all areas combined will consider both normal and drought/emergency supply planning. To enhance supply reliability, Cal Water may decide to provide a larger amount of local supply that could replace a portion of SFPUC supply if needed.

6.3 SFPUC Surface Water Supply Reliability

SFPUC surface water supply is the main supply source for the Bear Gulch service area. The Year 2030 SFPUC purchase estimate projection for the Bear Gulch service area essentially assumes that the SFPUC supply will not increase over current levels under normal conditions. In addition, normal SFPUC surface supply may be reduced during emergency or drought conditions. The evaluation of SFPUC surface water reliability initially developed for the South San Francisco Water Supply & Facilities Master Plan was reviewed and updated for the Bear Gulch District, as presented in Appendix D. Key findings of the evaluation with respect to the Bear Gulch District are summarized below.

Table 6-6 summarizes the amounts of local supply that will be needed to replace reduced SFPUC supplies during droughts and emergencies. A large amount of local supply will be needed to make up for temporary SFPUC supply reductions during droughts and emergencies. During temporary emergencies of relatively short-term durations, it will be necessary for Cal Water to take actions to temporarily reduce customer demand, as described in the UWMP. For longer-term reductions, such as during extended droughts, Cal Water could develop other local supplies to mitigate the SFPUC cutbacks. This is considered in the development of the local supply requirements discussed in Section 7.

SFPUC findings indicate that it will take two days to initiate some water service after a major earthquake, and 90 days to restore all facilities. Until all facilities are restored, the existing SFPUC supply system will be able to deliver 50% of the current average summer day demand, which is equivalent to 50% of the Year 2030 average day demand of 300 mgd.

SFPUC's current planning goals include drought cutbacks of up to 20%, based on Year 2030 demands. For planning purposes, SFPUC used an 8.5-year "design drought," similar to a combination of the extended drought that occurred during 1987 through 1992, followed immediately by a critically dry conditions similar to 1976-1977. SFPUC's cutbacks would increase throughout the drought period, beginning with smaller cutbacks in the early years, and larger cutbacks in later years.

SFPUC has identified proposed Capital Improvement Program (CIP) projects as part of the WSIP to improve the reliability of the water supply system in the event of a major earthquake/disaster, and is investigating some potential additional supplies to improve drought reliability. However, as discussed in Appendix D, there are significant uncertainties regarding the timeframe for implementation due to institutional constraints over which Cal Water and the other SFPUC suburban customers have no control.

Table 6-6 ***Emergency/Drought Reductions of SFPUC Supply***	
Emergency/Drought Supply Cutbacks [(1)]	***Additional Local Supply Needed to Replace SFPUC Supply in the Bear Gulch District*** [(2)]
Emergency Reductions (critical scenario is major earthquake)	
With existing SFPUC supply system – up to 50% reduction for up to 90 days of existing average summer deliveries, which is equivalent to a 50% reduction in Year 2030 average day deliveries. Full service restored after 90 days. (Bear Gulch average day demand is equivalent to about 60% of the average summer day demand.)	Existing 3.5 mgd for 90 days Year 2030 5.8 mgd for 90 days
After implementation of proposed SFPUC WSIP projects to improve reliability – 30% reduction in Year 2030 average day deliveries for up to 30 days; Year 2030 average day deliveries restored after 30 days. Full service restored after 90 days.	Year 2030 3.5 mgd for 30 days
Drought Reductions (for 8.5 year design drought)	
With existing SFPUC supply sources – At existing demands, about 13% average reduction over entire 8.5-year design drought period, up to a maximum of 20% during the last 2.5 years. By Year 2030, would be 25% average over the entire 8.5-year period, up to 40% maximum during last 2.5 years.	Existing: 1.5 mgd on average; Up to 2.3 mgd maximum. (13% on average over entire drought period; up to 20% maximum during last years of an extended drought) Year 2030: 2.9 mgd on average; Up to 4.6 mgd maximum. (25% on average over entire drought period; up to 40% maximum during last years of an extended drought)
With additional SFPUC supply sources – By Year 2030, up to 20% maximum reduction in SFPUC surface supply during last 2.5 years of the 8.5-year design drought (average of 12% reduction over the entire drought period). Assumes SFPUC obtains additional supply, such as restored Calaveras Dam, desalination, groundwater conjunctive use, recycled water.	Year 2030: 1.4 mgd on average; Up to 2.3 mgd maximum. (12% on average over entire drought period; up to 20% maximum during last years of an extended drought)

(1) Under the current contract, the percent reduction would be made with respect to the allocation basis. The allocation basis is the average of the following three components: 1) average of the supply assurance amount, 2) average of FY 96-97 thru 98-99 purchase amount, and 3) average of last 3-years purchase just prior to drought.

(2) The additional local supply amount is calculated based on the SFPUC Supply Assurance Amount for the Bear Gulch District of 11.6 mgd (average day).

The local supply will also provide for critical health and safety needs during emergencies that cause a temporary complete outage of SFPUC supplies. These critical emergency conditions are expected to be of short duration, perhaps a week or two at the most.

The American Red Cross (ARC), Federal Emergency Management Agency (FEMA), and California Office of Emergency Services (OES) recommend a minimum amount of 1 gallon per person per day. This recommended critical water supply of 1 gallon per

person per day includes drinking water, food preparation, and essential hygiene related to potential health & safety issues such as hand washing for food preparation, essential dish washing, and first aid-related washing. This amount is typically used by state and federal emergency agencies, and also by some other utilities.

To include some water for basic sanitation, such as toilet flushing and washing, a minimum of 5 gallons per person per day should be planned. The critical water supply and basic sanitation does not include any water for indoor or outdoor irrigation of vegetation of any type or other non-critical uses. It is assumed that Cal Water will institute emergency restrictions prohibiting non-critical uses.

For a buildout population of about 60,000 within the Bear Gulch District, the critical water supply would be about 0.06 mgd at 1 gallon per person per day, and 0.3 mgd at 5 gallons per person per day. This critical supply is well within the planned future local supply. The local supply could also provide basic fire protection during emergencies.

The local supply would be conveyed in the distribution system. It is assumed that only potable supply would be conveyed in the distribution system. For major fires, water from the Bay or other non-potable sources may need to be conveyed by helicopters and other emergency vehicles.

6.4 Future Water Quality Regulations and Potential Issues

Future water quality regulations that may affect SFPUC and potential SFPUC future treatment changes were reviewed to identify water quality issues that could potentially affect Cal Water. The following treatment/water quality issues are discussed:

- Drinking Water Standards
- Cal Water Local Surface Water Quality
- SFPUC Surface Water Quality
- Long-Term 2 Enhanced Surface Water Treatment Rule
- Fluoridation
- Lead and Copper Rule
- Nitrification in Distribution System
- Potential Blending of Surface Water with Future Groundwater Supply

Table 6-7 summarizes each of these topics and potential impacts for Cal Water. As noted in Table 6-7, the issues with the most potential impact for Cal Water are potential nitrification in the distribution system, and potential blending of future groundwater supply with surface water supply.

Table 6-7 Summary of Potential Water Quality Issues		
Water Quality Issue	***Overview***	***Implications for Cal Water***
Long Term 2 Enhanced Surface Water Treatment Rule	Regulation will require higher treatment standards for inactivation of the protozoan parasite *Cryptosporidium.* SFPUC is considering implementing ozone or UV for Hetch Hetchy / Sunol Valley sources. Likely no treatment changes or implementation of UV at HTWTP. Ozone affects potential for re-growth in customer systems. UV has no discernible effect on water quality.	Not expected to significantly impact water quality for Cal Water. Cal Water has already implemented UV treatment at the Bear Gulch WTP. Potential for re-growth if SFPUC implements ozone instead of UV at Hetch Hetchy.
Fluoridation	SFPUC currently fluoridates at the Polhemus Fluoride station and the HTWTP. All Cal Water turnouts receive fluoridated water from SFPUC.	No significant water quality implications anticipated. If local supply becomes a large enough proportion of the total supply relative to SFPUC, Cal Water may need to consider fluoride addition to maintain levels.
Lead and Copper Rule	The Lead and Copper Rule minimizes lead and copper in drinking water through corrosion control practices. SFPUC currently provides corrosion control for its supply by lime addition at the Rock River Lime Plant.	Although considered unlikely, Cal Water may need to provide caustic trim in the future in zones that receive a Hetch Hetchy/Sunol blend.
Nitrification	Nitrification occurs as chloraminated water decays and liberated ammonia is converted to nitrite, then to nitrate, which is a public health concern. A significant factor contributing to nitrification is long detention times (high water age).	Cal Water actively manages reservoirs to minimize detention times, and will need to continue this practice.
Groundwater/Surface Water Blending	Customers receiving changing source water, either intermittently, seasonally, or longer-term, may experience water quality changes, as the system re-equilibrates to changing water chemistry. Water quality changes are primarily aesthetic, but lead release is also a possible issue.	In the future, Cal Water may need to evaluate potential blend areas and options to reduce water quality changes as part of implementation of groundwater supplies.

6.4.1 Drinking Water Standards

The U.S. Environmental Protection Agency (EPA) under the authorization of the Federal Safe Drinking Water Act of 1974 sets drinking water standards. The California Department of Public Health (CDPH), which can either adopt the USEPA standard or establish state standards that are more stringent, enforces the EPA mandated drinking water regulations.

There are two types of drinking water standards: Primary and Secondary. Primary standards are designed to protect public health by establishing Maximum Contamination Levels (MCLs) for substances in water that are determined to be harmful to human health. Secondary standards are based on the aesthetic qualities of the water, such as taste, odor, color, and mineral content. These standards, established by the State of California, specify limits for substances that may affect the aesthetics and consumer acceptance of the water.

Appendix E contains tables summarizing the current primary and secondary MCLs. Appendix E also has a table listing "constituents of concern" in water supplies that

are being monitored by CDPH, but do not currently have MCLs. CDHS has set action levels for these constituents, which are not actually MCLs. Some of the constituents have MCLs pending approval, such as copper & lead, chromium 6, and perchlorate.

6.4.2 Cal Water Local Surface Water Quality

The treated surface water from the Bear Gulch Water Treatment Plant (WTP) meets all federal and state drinking water regulations. The local surface water is chloraminated. After treatment, water is blended in the distribution system with the chloraminated SFPUC supply.

The District monitors treated water quality very closely and makes improvements as needed. The District recently added an ultraviolet (UV) disinfection process to ensure effective deactivation of cryptosporidium. Final permitting of the UV treatment process is expected by the end of the year. The District also recently switched to a different coagulant product (a polyaluminum coagulant) to reduce soluble aluminum in the finished water and proactively avoid potential compliance issues.

The primary water quality concern for the Bear Gulch plant production is that algal blooms in the Bear Gulch Reservoir can impact treatment operations and finished water quality. The District treats the reservoir several times a year with a copper sulfate based product to minimize algal blooms.

6.4.3 SFPUC Surface Water Supply Quality

Cal Water purchases treated surface water from SFPUC. The SFPUC supply meets all drinking water standards. SFPUC supply is chloraminated, as is Cal Water's local surface supply, so there are no blending issues.

As discussed in Appendix D, the Bear Gulch District receives SFPUC water from seven active turnouts from the Bay Division Pipelines in the Lower Gradient Pressure Zone. These turnouts receive a Hetch Hetchy/Sunol Valley WTP blend.

Future water quality regulations that may affect SFPUC and potential SFPUC future treatment changes were reviewed to identify water quality issues that could potentially affect Cal Water, as discussed further below.

6.4.4 Long Term 2 Enhanced Surface Water Treatment Rule

EPA promulgated the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) in January 2006 to reduce disease incidence associated with the protozoan parasite *Cryptosporidium*. Under the LT2ESWTR, systems conduct source monitoring to determine what treatment requirements need to be implemented. Accepted treatment practices for *Cryptosporidium* inactivation include chlorine dioxide, ozone or UV treatment. Cal Water has already implemented UV treatment at its Bear Gulch WTP.

For SFPUC's unfiltered Hetch Hetchy supply, SFPUC will be required to provide 2-log or 3-log inactivation of *Cryptosporidium*, depending on results of the monitoring. Current regulations do not require treatment for *Cryptosporidium*, except through watershed control. The regulations call for monitoring in the first 2 years, followed by treatment improvements to be implemented 6 to 8 years following promulgation of the rule.

At the Harry Tracy WTP, SFPUC's current treatment includes direct filtration. The facility uses both ozone and chloramines for disinfection. SFPUC will either rely on its existing ozone treatment or add UV to meet LT2EWSR. Implementation of UV is not expected to significant impact delivered water quality.

SFPUC's Hetch Hetchy supply is currently unfiltered and disinfected. SFPUC is currently considering implementing either ozone or UV for its Hetch Hetchy supply to meet LT2EWSTR. Implementing ozone could potentially increase the potential for bacterial re-growth in customers systems. However, water quality with ozone treatment is not expected to significantly differ from water quality of the currently ozonated Harry Tracy supply. Implementation of UV is not expected to significantly impact delivered water quality.

Sunol Valley WTP includes conventional filtration to treat source water from San Antonio and Calaveras Reservoirs. SFPUC's Hetch Hetchy and Sunol Valley supplies are blended at the Alameda Siphons in the Sunol Valley, and chloraminated at the Sunol Valley Chloramination Facility.

In general, treatment changes to meet LT2EWSTR are not expected to significantly impact SFPUC water served to Cal Water or other customers.

6.4.5 Fluoridation

SFPUC fluoridates its Hetch Hetchy/Sunol blend at the Sunol Valley Chloramination & Fluoridation Facility in the East Bay, and at the Polhemus Fluoride Station located on the Crystal Springs Bypass Tunnel. SFPUC fluoridates supply from Harry Tracy WTP at the plant.

All Cal Water turnouts currently receive fluoridated water from the SFPUC, so there will be no impact to Cal Water from fluoridation changes in the SFPUC system. The required fluoride residual is provided in the distribution system.

6.4.6 Lead and Copper Rule

The Lead and Copper Rule was promulgated in 1991 to minimize lead and copper in drinking water, primarily by reducing water corrosiveness. It has been suggested that chloramines can accelerate corrosion, so corrosion issues have received more attention as more systems convert to chloramines for residual disinfection. SFPUC converted to chloramines in February 2004 with no apparent change in lead levels. The Lead & Copper Rule sets Action Levels (not MCLs) for lead and copper.

SFPUC provides corrosion control by adjusting the pH of its Hetch Hetchy supply through lime addition at the Rock River Lime Plant, located along the Foothill Tunnel, upstream of the pipelines that cross the San Joaquin Valley. Current practice is to increase the pH to 9.5 or so before the water reaches the Bay Area.

Because of the low alkalinity of Hetch Hetchy water, customers who receive a Hetch Hetchy/Sunol Valley WTP supply blend see more fluctuations in pH. SFPUC has made provisions for caustic trim at the Sunol Valley Chloramination Facility, if needed, to maintain a more constant pH. There is a caustic tank and feed system trim in the Sunol area for increasing pH if it should become necessary; it is not currently used. Harry Tracy WTP source water has a higher alkalinity, with more buffering capacity, and therefore has less fluctuation in pH.

Although considered unlikely, especially if Cal Water does not currently experience corrosion problems, Cal Water may need to provide caustic trim in the future, for zones served from the Crystal Springs Pipeline, which receive a Hetch Hetchy/Sunol Valley WTP blend. This would not be needed if SFPUC provides caustic trim at the Sunol Valley Chloramination Facility. However, SFPUC makes no guarantee of water quality in their supply contracts.

6.4.7 Nitrification in Distribution System

With chloraminated supply, there is increased potential for nitrification to occur in SFPUC and customer systems. Chloramine disinfection includes the addition of chlorine and ammonia to form monochloramine. Over time, as monochloramine decays, ammonia is liberated. Ammonia can provide a food source for nitrifying bacteria that convert the ammonia to nitrite, which accelerates the depletion of the disinfectant residual.

Although many factors contribute to nitrification, a key factor is water age. Nitrification is principally of concern when detention times in the system are very long, typically at reservoirs where demand is low relative to the overall storage volume, or where hydraulic performance limits turnover in the reservoir.

Cal Water currently actively manages it distribution reservoirs to maintain adequate turnover and limit potential for nitrification to occur. There have been no nitrification events in the distribution system. Potential improvements to increase reservoir turnover typically include either structural changes to provide more flexibility to more rapidly drain storage, or modifying operational practices to reduce detention time. Potential improvements are discussed in more detail in Section 8. The proposed upgrades to tanks will mitigate potential for low turnover.

6.4.8 Potential Blending of Surface Water with Future Groundwater Supply

Groundwater may be a potential future source of supply for the Bear Gulch District. There are potential water quality issues for customers with changing source water, either intermittently, seasonally, or longer-term (e.g. drought years), such as by blending groundwater with surface water.

Key concerns include antagonistic effects (e.g. a ground water containing iron being introduced into a high pH system resulting in iron staining) and re-equilibration issues as the system responds to water with a different chemistry (i.e., lower pH and higher hardness). Distribution system re-equilibration impacts are typically aesthetic (e.g., dirty/colored/red water). However, there is also potential for lead release, which would be a public health concern (as discussed above for the Lead and Copper Rule).

Another concern with potential blending of groundwater with surface water is potential loss of disinfectant residual in the combined water. This may occur if the groundwater supply is chlorinated rather than chloraminated prior to blending with the chloraminated surface water. Blending operations must be carefully designed and controlled to maintain the required level of disinfectant residual in the blended water.

Potential items that should be considered if using groundwater as part of the supply mix include:

- Review of planned operating scenarios and how these will affect customers in the area receiving groundwater and surface water. The system hydraulic model developed for the Master Plan could be used to perform source tracing calculations to identify water quality sources for various operating scenarios. This is not part of the Master Plan scope of work, but could be done later in subsequent detailed studies.

- Possible blending of surface water and well water prior to introduction to the distribution system to minimize water quality changes.

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Section 7
Water Supply Strategy

This section describes the water supply strategy for the Bear Gulch District, and describes each of the supply components. This strategy is based on the water supply requirements identified in Section 6. Section 8 discusses the water system analysis that considers these supply components. Section 9 combines the supply and distribution system recommendations into an integrated plan.

7.1 Water Supply Strategy

It is recommended that Cal Water pursue a supply strategy for the Bear Gulch District that includes an array of supply components for flexibility and reliability. SFPUC surface water will continue to be the primary supply. In addition, the Bear Gulch District has Cal Water-owned local surface supply that currently provides about 10 percent of the total supply. Other local supply sources will supplement SFPUC surface water supply (on average). Table 7-1 provides a summary comparison of the potential alternative supply sources. Water savings from long-term conservation measures and temporary demand reductions during droughts/emergencies are key local supplies for this plan, due to high costs of implementing other local sources.

As summarized below in Table 7-2, local supplies needed to supplement SFPUC will be up to 2.9 mgd by year 2030 under normal conditions, and up to 5.8 mgd during droughts and emergencies when SFPUC supplies are reduced. These local supplies would be a mix of local surface water, long-term conservation savings, temporary demand reductions, groundwater, recycled water, and desalination supply.

It is recommended that Cal Water target development of a minimum of 2.9 mgd of local supplies by year 2030 from a combination of local surface water, groundwater, desalination, and/or recycled water. With this level of local supply, Cal Water could meet normal demands without relying on permanent long-term conservation savings, which may not be achieved.

Assuming no long-term conservation savings, 2.9 mgd of local supplies plus temporary demand reductions of 20 percent (which would provide an additional 2.9 mgd) would meet demands during droughts/emergencies. It is reasonable to plan on requiring temporary demand reductions during droughts and emergencies, especially when local supply options are limited. During droughts/dry years, no local surface water supply will be available, so there must be a greater contribution from other sources. If long-term conservation savings of 1.5 mgd (10 percent savings) by year 2030 are achieved, then temporary demand reductions during droughts/emergencies could be reduced to 10 percent rather than 20 percent; or alternatively, if temporary demand reductions remained at 20 percent, then additional supply needed from other sources, such as groundwater or desalination, could be reduced to 1.4 mgd.

Table 7-1
Summary Comparison of Alternative Supply Sources for Bear Gulch District

Source	Potential Average Day Supply Amount (Year 2030)	Supply Reliability	Relative Cost	Flexibility	Ease of Implementation
SFPUC	11.6 mgd Year 2030 purchase estimate for normal supply; 8.7 mgd with 25% reduction during droughts & emergencies.	Low to Moderate for full amount. Moderate to High for reduced amount.	Moderate Increasing to $1,500 + per AF by 2015.	Moderate within contract terms. Not Cal Water controlled.	Good - Already implemented
Local Surface Water from Bear Gulch Creek	1.2 mgd historical average; essentially 0 during dry years and up to 2.5 mgd in very wet years. Future potential for 0.6 mgd on a median basis; up to 2.2 mgd as a mean over time if high peak creek flows are effectively captured and used.	Supply depends on hydrology. Low drought reliability during dry years unless a significant amount of additional raw water storage capacity could be provided. Moderate during normal to wet conditions.	Low to Moderate (if adequate raw water storage available): minimal improvements needed to expand treated water service area; raw water conveyance improvements needed to increase supply from diversion locations to plant. If major raw water storage improvements needed, relative cost would be Moderate to High.	Moderate to High – Cal Water owned and operated, but subject to significant regulatory oversight.	Good - Already implemented. Service area for delivery of treated local surface water can be expanded with minimal improvements. More difficult if major raw water storage improvements needed.
Long-Term Conservation Savings	Up to 1.5 mgd by Year 2030 with 10% conservation savings.	Low for behavioral measures Moderate for structural measures	Low (part of UWMP)	Low to Moderate – reliant on long-term public participation.	Good - Partially implemented. Requires extensive public outreach and participation.
Temporary Demand Reductions during Droughts / Emergencies	Up to 1.5 mgd by Year 2030 if 10% temporary reductions by customers (up to 3.0 mgd by Year 2030 with 20% temporary reductions)	Moderate with extensive public outreach during periods when needed	Low (part of UWMP)	Moderate – Cal Water can activate only when needed; reliant on short-term public participation.	Good - Already part of Cal Water's Urban Water Plan. Requires extensive public outreach and participation to be effective.
Potential Groundwater Supply	0.35 to 0.7 of annual supply; however more detailed subsequent study needed to better define sustainable yield without impacting other users. Perhaps higher for short-term emergency use depending on identification of usable sites.	High	Low to Moderate (assuming no land cost with wells on Cal Water or public properties) $1,000 -$1,200 per AF with disinfection only before blending with surface water; $1,600 - 2,100 per AF if more extensive treatment required.	High – can be implemented solely by Cal Water	Good with suitable sites - Will require field investigation and procurement of suitable sites, but infrastructure is straightforward.
Potential Recycled Water Supply	About 0.35 mgd for the largest irrigators to a maximum of 0.7 mgd if all potential "theoretical" recycled water customers were served.	High	Very High $3,300 to $6,500 per AF	Low to Moderate – will require participation by several types of other entities, e.g., potential customers, wastewater agencies	Complex - Requires extensive new infrastructure, regulatory and permit approvals, agreements with other agencies, public acceptance
Potential Desalination Supply	Modular RO units of 0.5, 1.0 or 2.0 mgd each that can be combined for any desired capacity. Bay water is unlimited source.	High	High $2,000 to $4,000 per AF depending on method of brine disposal	High – could be implemented solely by Cal Water	Complex - Requires new infrastructure, brine disposal, regulatory & permit approvals

Table 7-2
Supply Components to Meet Year 2030 Demands

Component	***Supply Amounts (mgd)***							
	Normal Conditions		Temporary Drought/Emergency Conditions with Long-Term Conservation Savings			Temporary Drought/Emergency Conditions without Long-Term Conservation Savings		
SFPUC Supply	11.6 mgd		8.7 mgd			8.7 mgd		
Local Supplies:								
Permanent Long-Term Conservation Savings (10% reduction of normal demand)	No Savings 0	10% Savings 1.5 mgd	1.5 mgd			0		
Temporary Demand Reductions During Droughts/Emergencies	0		No Reduction 0	10% Reduction 1.4 mgd	20% Reduction 2.6mgd	No Reduction 0	10% Reduction 1.5 mgd	20% Reduction 2.9 mgd
Other Local Supplies: Local Surface Water, Groundwater, Recycled Water, Desalination (see Note 1 below)	2.9 mgd	1.4 mgd	4.3 mgd	2.9 mgd	1.7 mgd	5.8 mgd	4.3 mgd	2.9 mgd
Total to Meet Year 2030 Demand	**14.5 mgd**		**14.5 mgd**			**14.5 mgd**		

Note 1 to Table 7-2: Below is a more detailed breakdown of the other local supplies needed to meet the target amount of 2.9 mgd:

Detailed Breakdown of Other Local Supplies in Table 7-2		
Source	**Normal Conditions or Non-Drought Emergency Conditions**	**Drought Conditions with up to 25% Reduction in SFPUC Supply**
Local Surface Water	1.2 mgd (historic average) – potentially up to 2.2 mgd (potential future mean amount with improvements for raw water storage and conveyance, distribution system)	0 (unless raw water supply storage improvements implemented to provide supply for extended dry period)
Groundwater	0.35 – 0.7 mgd annual sustainable yield for up to 4 wells	Up to 0.7 mgd from 4 wells Plus potential additional wells for drought year use only if confirmed by subsequent studies (see row below).
Long-Term Options for Recycled Water and Desalination	0 assuming 10% long-term conservation savings are realized 1.35 mgd without long-term conservation savings	1.0 mgd assuming 10% long-term conservation savings are realized 2.2 mgd without long-term conservation savings Some of this capacity could be provided by emergency wells, see row above, if confirmed by subsequent studies).
Target Total	*2.9 mgd*	*2.9 mgd from other local supplies* *Plus 2.9 mgd from 20% temporary demand reductions = total 5.8 mgd*

In developing water supply recommendations, the Bear Gulch District has been analyzed to determine a reasonable water supply approach for this area independent of other Cal Water service areas in the San Mateo County. The recommended strategy includes:

- SFPUC surface supply will continue to be the primary supply, and will be supplemented by a mix of other local supply sources. Under normal conditions, the recommended strategy assumes normal supply equal to the planned SFPUC purchase amount of 11.6 mgd, and provides for up to a 25% reduction in SFPUC surface supply to 8.7 mgd under drought/emergency conditions.

- Water conservation savings under normal conditions and temporary demand reductions during emergencies and critical droughts are cost-effective ways of providing local supply to supplement SFPUC supply. These measures are key components of the water supply strategy.

  - Planned long-term conservation savings are permanent reductions in demand due to implementation of planned conservation measures as described in the Urban Water Management Plan (UWMP). It is recommended that Cal Water continue with ongoing implementation, which may result in a maximum reduction in demand of up to about 1.5 mgd of local supply by year 2030. This reduction is considered as a future local supply component to offset demand. However, actual reductions are subject to many uncertainties since they are contingent upon actions of the general public that are beyond Cal Water's control. Therefore, flexibility for alternate local supply is addressed if the anticipated reductions cannot be fully achieved within the planned timeframe.

  - Additional temporary emergency demand reductions during SFPUC shortages assumes more stringent demand reduction measures could be implemented on a temporary basis during droughts or emergencies that reduce SFPUC supply. These temporary demand reduction measures are outlined in the Water Shortage Contingency Plan that is part of the UWMP. These temporary reductions are considered as a future local supply component to offset demand. It is reasonable to plan on requiring temporary demand reductions during droughts and emergencies, especially when local supply options are limited.

    - Assuming a minimum level of 10 percent additional temporary demand reductions by customers, this would be equivalent to about 1.5 mgd of local supply by year 2030. In general, a 10 percent level of temporary conservation has been readily achieved by other agencies during past droughts and emergencies, if customers are informed of the need through public education efforts.

    - If the planned long-term conservation savings of 1.5 mgd are not achieved, then requiring 20 percent additional temporary demand reductions could be imposed which would be equivalent to about 3 mgd of local supply by year 2030, and would essentially take the place of the planned long-term conservation savings.

- The District's local surface water production under historic operating conditions has averaged 1.2 mgd annually over a 27-year period encompassing a range of dry, normal, wet and very wet years. With the proposed Operations Conservation Measures for creek diversions, the anticipated median supply will be 0.6 mgd; up to 2.2 mgd as a mean average over time. There will be no local surface water supply during dry years.

  - The recommended approach for local surface water is to maximize its use when it is available, by implementing raw water and distribution system improvements that would allow use of the full 6 mgd treatment plant capacity during low demand periods. Then more annual SFPUC supply would be available for use during other times of the year when local surface water is not available.

  - With recommended raw water and distribution system improvements, it is anticipated that the available local surface supply could be more effectively utilized in the future. Potentially up to 2.2 mgd, as a mean average over time, may potentially be available from local surface if peak creek flows are effectively captured and utilized, which will require adequate raw water storage capacity, raw water conveyance improvements, and some distribution system improvements. However, the amount of this supply will vary annually based on hydrologic conditions, and no local surface supply will be available during drier years and droughts.

  - During droughts, the amount of local surface water runoff is negligible. Local surface supply can only be considered as a reliable drought supply if there is sufficient storage to accommodate several dry years with minimal inflows, and if analysis of the historic hydrologic record that includes several wet and dry cycles, including severe droughts and critically dry years indicates that the storage will replenish between dry cycles. Bear Gulch Reservoir storage is limited due to operational restrictions and would require significant improvement to expand its storage capability. As recommended in Section 9, subsequent detailed studies are needed to investigate the raw water storage requirements.

- Groundwater resources in the Bear Gulch District are better than in Mid-Peninsula area, although not as good as in the South San Francisco area. Preliminary estimates suggest there may be an opportunity to supplement the Bear Gulch District water supply with 2 to 4 production wells at an average production rate of about 120 gpm per well.

  - In the near-term, further detailed groundwater studies/investigations should be undertaken subsequent to the master plan to confirm the feasibility of implementing wells at specific sites. The studies should confirm expected yield, identify specific locations for wells, evaluate groundwater quality at the

sites, and determine treatment requirements. Site field investigations, including test hole and monitoring well, are needed to confirm feasibility of individual sites at a predesign level, including providing preliminary drinking water source assessment information for the sites to the California Department of Public Health. The near-term investigation should also include completion of at least an initial study checklist to determine what level of environmental documentation will be required for the selected sites. If results of the near-term studies are favorable, then implementation of wells can proceed.

- At an average production rate of 120 gpm per well, it is anticipated that 2 to 4 wells would provide 0.35 to 0.7 mgd on an average annual basis (about 400 to 800 AF per year). However, preliminary analyses indicate that pumping may potentially impact groundwater levels and other users in the basin even at these extraction rates. Subsequent to the master plan, a comprehensive data collection effort should be done to better quantify sustainable basin yield.

- The most favorable location for groundwater wells is in the portion of the District located approximately northeast of the Alameda de las Pulgas. In general, groundwater quality conditions would require either blending with treated surface water or treatment to meet water quality standards. Depending on the specific site locations and conditions, individual wells could pump directly into the distribution system or be part of a wellfield utilizing a centralized blending/treatment facility.

- To minimize potential basin impacts, groundwater wells could be used only on a temporary basis for emergency and drought supply. One option may be to develop cooperative agreements with existing institutional well owners within the service area for emergency supply. As most of these wells are irrigation wells, they would have to be evaluated on a case-by-case basis to determine if it may be possible to upgrade them for emergency potable use and easily connect them to the distribution system.

- Another potential option may be to install new wells at major irrigation sites currently using treated water for irrigation, if the locations and terms are favorable. The wells could provide a supplemental supply for the property owner (irrigation water at the well site possibly at a somewhat lower cost per unit in return for the well site) and also an emergency Cal Water supply assuming that the location could be easily connected into Cal Water's distribution system.

■ Recycled Water supply involves longer-term measures that require regional implementation and participation by other agencies. Potential benefits are to reduce the potable supply requirements by utilizing recycled water for appropriate uses (e.g., irrigation, industrial) now served by potable water. In the Bear Gulch District, the total demand that might be met by recycled water

(assuming customers were willing) is small, less than 0.7 mgd on an average annual basis, and implementation costs are high. Extensive public education and outreach efforts will be needed to promote recycled water use. This would be a long-term supply option that would be implemented in conjunction with programs of other adjacent agencies, and will require coordination with other agencies and additional feasibility studies. This option should be re-evaluated in future master plan updates.

- Desalination (reverse osmosis [RO] treatment) of Bay water would be a longer-term measure that could be implemented in the future if determined to be cost-effective relative to the cost of other components. Implementing this component will require feasibility investigations and considerable lead time. This component may be more cost-effective at a regional level for the three Cal Water San Mateo County peninsula service areas. For example, the San Mateo system, in particular, has some features that may be more suitable for implementation of RO supply, e.g., proximity of the Bay, potential use of existing outfall for brine disposal. This long-term supply option should be further considered as part of regional water supply planning for all Cal Water's San Mateo County services, and re-evaluated in future master plan updates with respect to available technologies.

Potential sources of supplemental surface water supply will also be addressed as part of the integrated water supply planning for all three Cal Water San Mateo County peninsula systems – Bear Gulch, Mid-Peninsula, and South San Francisco. These options will consider the final results of the Bear Gulch District analyses. Potential options include:

- Supplemental purchase of excess SFPUC surface water supply during wet years, or other mutually beneficial times, for local storage and later use. Any purchase of additional SFPUC water would require negotiation with SFPUC regarding available supplemental amounts, timing of deliveries to best suit Cal Water and SFPUC, and requirements for delivery. The potential storage of SFPUC water in Bear Gulch Reservoir would need to address storing treated water in the reservoir and then retreating for distribution and how to deliver raw water to Bear Gulch reservoir (e.g., location of raw water pipelines, possibility of delivery from Crystal Springs Reservoir, etc.). If the Bear Gulch WTP is run year-round, it would require a dewatering process for sludge handling. Currently, ponds are used to dry sludge when the WTP is not operating.

- Potential wheeling of water purchased from other agencies through the SFPUC system, in coordination with the Bay Area Water Supply & Conservation Agency (BAWSCA).

- Potential interties with other agencies to obtain water from sources other than SFPUC, such as the Santa Clara Valley Water District (SCVWD). However, the portion of SCVWD's service area closest to the Bear Gulch District is currently

supplied primarily from the SFPUC system. This includes the City of Palo Alto, Stanford University, City of Santa Clara, City of Sunnyvale north of El Camino Real, and the portion of the City of Mountain View north of Freeway 101 south to Cuesta Drive and west to the Palo Alto/Los Altos border. The SCVWD supply system from sources other than SFPUC is located a considerable distance from the Bear Gulch District. SCVWD, as described in their 2003 Integrated Water Resource Planning Study, is dealing with overall water supply shortages in the future for their overall system.

- Potential wheeling of treated water from the Bear Gulch District through Redwood City to the San Carlos system; and/or potential deliveries of treated Cal Water surface water to other agencies in exchange for their SFPUC water that Cal Water could then use at the most beneficial locations. These options may be considered as a reliability backup for the San Carlos system if it appears, after completing the analyses, that significant local surface supply may be available in Bear Gulch that might benefit other Cal Water areas. The infrastructure would be in place, although pumping would be required.

7.2 Supply Scenarios

Table 7-3 summarizes the near term (to 2015) and long-term (2030) requirements for local supply to supplement SFPUC surface supply to the Bear Gulch service area, under various supply scenarios and using the high estimate of future demand projections. For the high estimate, the total projected demand is about 13.6 mgd by 2015, and 14.5 mgd by 2030 (buildout). The total demand will be met by a combination of SFPUC, local surface water, and other local supplies.

The recommended strategy assumes normal supply equal to an SFPUC average annual purchase amount of 11.6 mgd, and provides for up to a 25% reduction in surface supply under drought/emergency conditions, i.e., only 8.7 mgd of surface water available during drought/emergency conditions. SFPUC surface water supply reliability is discussed in detail in Section 6.3 and Appendix D. The 25% reduction assumes existing SFPUC supplies and an 8.5 year design drought. If SFPUC obtains additional supplies, as currently planned, the maximum reduction would be 20%.

Local supply will be needed to meet the total demand under both normal and drought/emergency conditions. The local supply would be provided from a combination of local surface water, conservation savings, temporary demand reductions, groundwater, recycled water, and desalination. To provide flexibility for future planning, Table 7-3 brackets the requirements for local supply both with the planned conservation savings, and in the event the planned savings are not achieved by customers.

Table 7-3 ***Summary of Average Annual Requirements for Local Supply to Supplement SFPUC Supply to the Bear Gulch Service Area*** [(1)]		
Condition	***Near-Term (to 2015)***	***Long-Term (2030)***
Local Supply Requirement under Normal Conditions with 11.6 mgd SFPUC Supply		
If planned long-term conservation savings are realized: assumes 0.7 mgd (5%) savings by 2015, and 1.5 mgd (10%) savings by 2030.	1.3 mgd	1.4 mgd
Without relying on any long-term conservation savings	2.0 mgd	2.9 mgd
Local Supply Requirement for Reliability During Droughts or Emergencies when SFPUC Supply is Reduced to 8.7 mgd (25 percent cutback on average) Note: Range brackets the effects of potential long-term conservation savings. Low end of range is if all planned long-term conservation savings are achieved (10% long-term reduction); high end if no long-term conservation savings are achieved.		
With 20% temporary cutback in customer demands per Water Shortage Contingency Plan	• 2.6 to 2.7 mgd of temporary demand reductions by customers • Plus 1.6 to 2.2 mgd from additional local supply	• 2.6 to 2.9 mgd of temporary demand reductions by customers • Plus 1.7 to 2.9 mgd from additional local supply
With 10% temporary cutback in customer demands	• 1.3 to 1.4 mgd of temporary demand reductions by customers • Plus 2.9 to 3.5 mgd from additional local supply	• 1.3 to 1.5 mgd of temporary demand reductions by customers • Plus 2.9 to 4.3 mgd from additional local supply
With no (0%) temporary cutback in customer demand	4.2 to 4.9 mgd	4.3 to 5.8 mgd

(1) Normal supply includes the planned SFPUC average annual purchase amount of 11.6 mgd, and provides for up to a 25% reduction on average in surface supply under drought/emergency conditions, i.e., only 8.7 mgd of surface water available during drought/emergency conditions. Local supply will be needed to meet the total demand, which will be about 13.6 mgd by year 2015, and 14.5 mgd at year 2030.

Under either normal or drought conditions, it is assumed that the Bear Gulch system will utilize the SFPUC system and distribution system storage to meet daily fluctuations in demand, i.e., SFPUC flows will be higher during peak demand periods and lower during low demands periods, and flows in excess of the SFPUC supply amount will be met from distribution storage.

As indicated in Table 7-3, successful implementation of conservation savings and temporary demand reductions when needed for short-term emergencies can greatly reduce the requirements for other types of local supply. The higher the level of temporary demand reductions, the lower the amount of local supply capacity is needed for supply reliability during droughts and emergencies. Water savings from long-term conservation measures and temporary demand reductions during droughts/emergencies are key local supplies for this plan, due to high costs of implementing other local sources.

The Interim Water Shortage Allocation Plan defines the conditions of SFPUC supply cutbacks to its wholesale customers, including Cal Water. This plan allocates each wholesale customer's share based on the following three factors: the supply assurance amount; agency purchases during the three years preceding adoption of the plan; and

the rolling average of purchases during the three years immediately preceding the onset of the shortage.

Below is a brief discussion of the proposed approach for handling potential 10% and 20% cutbacks in SFPUC supplies at year 2030 (assuming 11.6 mgd supply assurance amount and 14.5 mgd annual demand):

- 10% cutback in SFPUC supply (e.g., single dry year) will require 4.1 mgd of local supplies as follows: 2.9 mgd from 20% temporary demand reductions; 0.7 mgd from wells implemented for normal supply; and 0.5 mgd from long-term conservation savings or other local supplies. If the cutback is due to emergencies other than drought conditions, local surface water supply may be available. If 10% long-term conservation savings are achieved, then no additional local supply will be needed. If not, the 0.5 mgd would be provided from long-term measures such as additional emergency wells, desalination or recycled water.

- 20% cutback in SFPUC supply (e.g., multiple dry years) will require 5.2 mgd of local supplies as follows: 2.9 mgd from 20% temporary demand reductions; 0.7 mgd from wells implemented for normal supply; and 1.6 mgd from long-term conservation savings and/or other local supplies. If the cutback is due to emergencies other than drought conditions, local surface water supply may be available. If 10% long-term conservation savings are achieved, then no additional local supply may be needed. If not, the 1.6 mgd would be provided from long-term measures, e.g., additional emergency wells, desalination or recycled water.

If SFPUC supply cutbacks do occur, the reductions would be applied based on the annual pattern of monthly demands. According to the Interim Water Shortage Allocation Plan, SFPUC will provide a proposed schedule of monthly water budgets based on the pattern of monthly water purchases during the supply year immediately preceding the declaration of shortage. Cal Water then can review and provide an alternative monthly schedule if desired. The total demand reduction over the entire year would be expected to be 10 percent below the historic level as an annual average.

Each of the following local supply components are discussed in detail in the remainder of this section:

- Local Surface Water
- Long-Term Conservation Savings
- Temporary Demand Reductions
- Potential Groundwater Supply
- Potential Recycled Water Supply
- Potential Desalination Supply

7.3 Local Surface Supply

This section presents the analysis of surface water supply opportunities in the Bear Gulch District.

7.3.1 Overview of Local Surface Supply

San Francisquito Creek Watershed

The local surface supply for the Bear Gulch District is from Bear Gulch Creek and the upper reaches of the San Francisquito Creek watershed. Figure 7-1 provides an overview of key local surface water features in the San Francisquito Creek watershed.

The San Francisquito Creek Watershed is approximately 42 square miles (27,000 acres), about 80 percent in San Mateo County and 20 percent in Santa Clara County. The watershed includes public lands and numerous private landowners in the cities of East Palo Alto, Menlo Park, Palo Alto, Portola Valley and Woodside, unincorporated land areas of San Mateo and Santa Clara counties, and Stanford University. Stanford University is the largest landowner in the watershed owning over 8,000 acres in both counties, about 30 percent of the watershed lands.

The main stem of San Francisquito Creek begins at the base of Searsville Dam on Stanford University's Jasper Ridge Biological Preserve, and is fed by numerous tributary creeks in the upper watershed areas of Woodside and Portola Valley. The confluence of Bear Gulch and West Union Creek joins San Francisquito Creek below Searsville Dam. Los Trancos Creek runs parallel to the San Andreas Fault and joins San Francisquito Creek from the south near Stanford University. The mouth of the creek opens to the San Francisco Bay, adjacent to the City of Palo Alto Baylands Nature Preserve.

Bear Gulch Creek is a critical habitat for steelhead fish which are listed as threatened under the Federal Endangered Species Act. Cal Water's Upper Diversion dam is on the Friends of San Francisquito Creek's list of steelhead obstructions on Bear Gulch Creek. However, there are other existing obstructions downstream of the dam limiting fish movement that need to be addressed before the dam becomes the limiting constraint to upstream movement.

There is a San Francisquito Creek Joint Powers Authority (JPA) working on ecosystem restoration and flood control planning in the watershed. The JPA coordinates with the Army Corps of Engineers on projects such as bank stabilization and revegetation, watershed analysis and sediment reduction planning, and aquatic habitat assessment and limiting factors analysis. The JPA members include City of Palo Alto, City of Menlo Park, City of East Palo Alto, SCVWD, San Mateo County Flood Control District, Stanford University, and the San Francisquito Watershed Council.

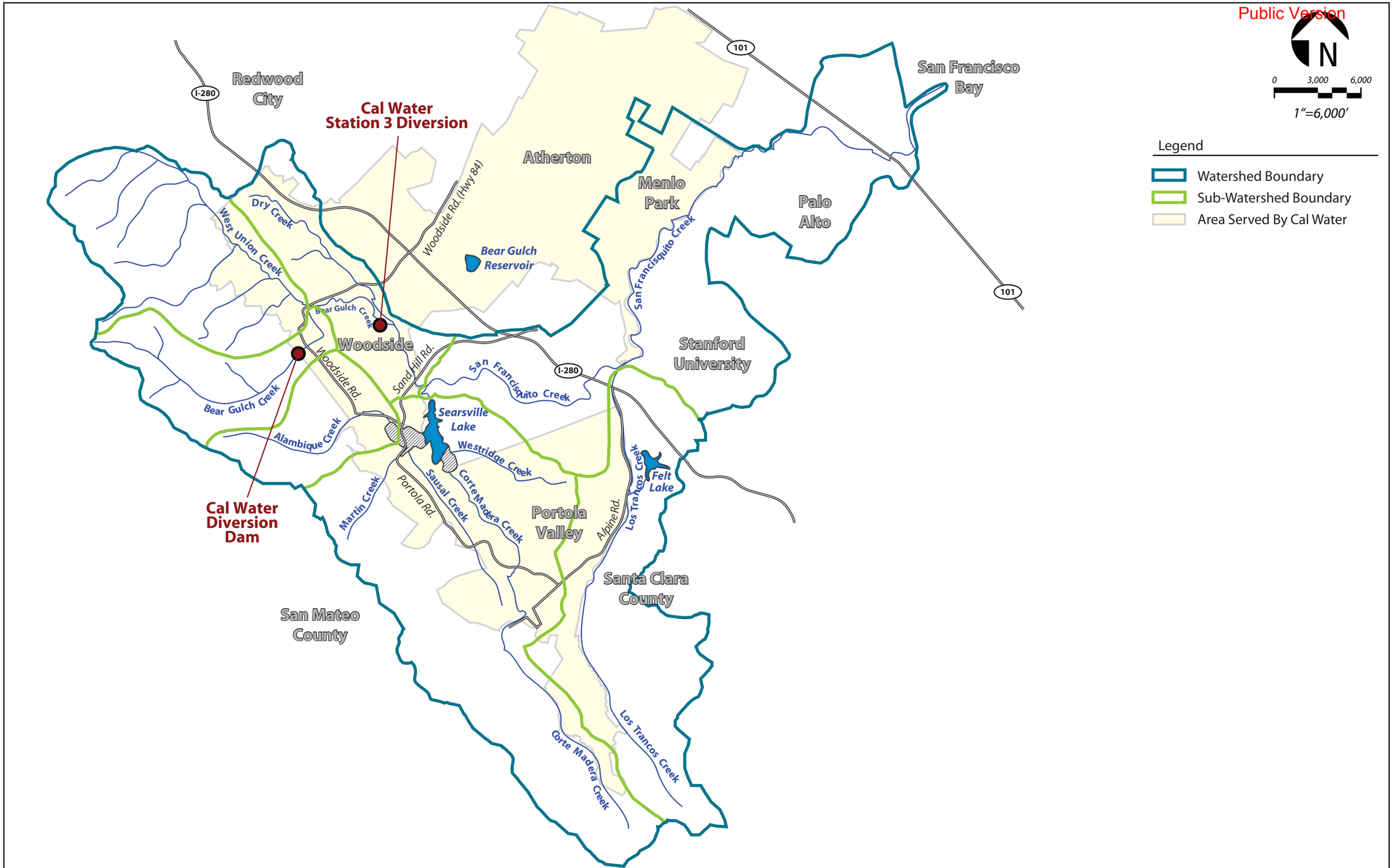

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Figure 7-1

Surface Water Features - San Francisquito Creek Watershed

Bear Gulch District Surface Supply

The Bear Gulch District has the only existing local surface water supply in Cal Water's San Mateo County Districts. The local surface supply for the Bear Gulch District is runoff from rainfall in the local drainage areas of Bear Gulch Creek, which is in the western portion of the District service area as shown on Figure 7-1.

Figure 7-2 shows the key elements of the Cal Water raw water supply system. Cal Water diverts water from the creek at two locations and conveys it to Bear Gulch Reservoir. The surface water is treated at a Cal Water treatment plant, located at the outlet of the Bear Gulch Reservoir, prior to delivery to the distribution system.

Water rights issued by the California State Water Resources Control Board Division of Water Rights limit the amount and timing of the diversions and how much water can be stored. During dry periods, the reservoir does not fill, thus limiting the amount of available local supply and requiring the District to purchase additional water from SFPUC. Cal Water would like to maximize use of the local surface water resources.

Below are descriptions of the key components of Cal Water's existing surface water supply system. Following these descriptions is a discussion of potential options for local surface water supply.

7.3.2 Diversion Locations and Requirements

Cal Water has two diversion locations on Bear Gulch Creek. Diversions are limited in time and quantity of use by the California State Water Resources Control Board Division of Water Rights through a permit on the diversion dam location and a license for the Station 3 diversion location.

Cal Water has been negotiating for several years with California Department of Fish and Game (CDFG) and the National Oceanic & Atmospheric Association's National Marine Fisheries Service (NMFS) to resolve agency concerns with both diversion facilities. These concerns include bypass flow requirements, screening of inlets, and fish passage issues. Bypass requirements are flow-based to maintain fish passage in certain portions of the creek. In October 2007, NMFS issued a biological opinion for Cal Water's construction and operation of a fish screen at the Lower Diversion Station 3 pumping plant. In response, Cal Water developed Operation Conservation Measures for both diversion locations in coordination with NMFS and CDFG. Specifics of this operations plan are discussed further below for each diversion location.

Diversion Dam

The Diversion Dam location, shown on Figures 7-1 and 7-2, is the Woodside Diversion Dam on Bear Gulch Creek at the west edge of Cal Water's service boundary. This diversion dam captures and diverts a portion of the surface runoff generated from an about 1,500-acre watershed, of which Cal Water owns about 1,300 acres.

Public Version

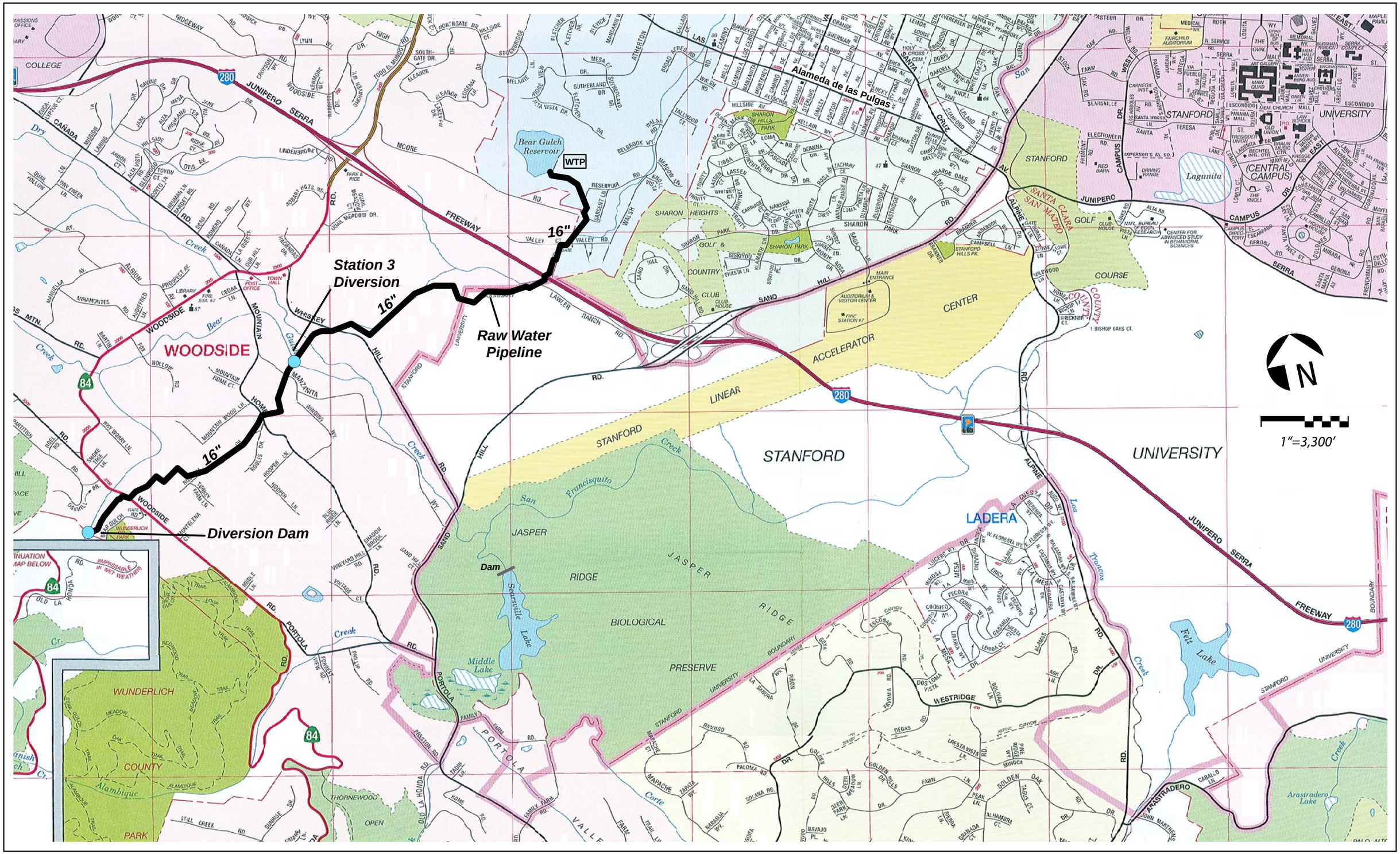

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Figure 7-2
Cal Water Surface Water Supply System

The diversion facility consists of an approximately 10-foot tall concrete diversion dam topped with 3-feet of wooden stoplogs. There is a concrete intake structure on the upstream side of the dam that diverts water into a gravity transmission line that conveys flows approximately 3.3 miles to the Bear Gulch Reservoir. The original pipeline was constructed in the 1930's, and various sections have been repaired or replaced over time resulting in a pipeline of varying materials and diameters. Most of the pipeline is 16-inch diameter (over 16,200 feet), with relatively short sections of 24-inch (500 feet) and 18-inch (600 feet). The elevation at the start of the pipeline is about 575 feet, and at the terminus about 245 feet.

Water is diverted under a riparian water right confirmed in 1901, and an appropriative right for which a permit was issued to Cal Water in 1951. The permit allows diversion of up to 11 cubic feet per second (cfs) from Bear Gulch Creek for the purpose of storage with a maximum storage amount of 1,380 AFY. The diversion is allowed year-round.

The new Cal Water operations plan for the Diversion Dam, developed in response to regulatory agency concerns, includes fish bypass flows to benefit steelhead and other fish species. Cal Water has proposed to operate at these conditions by December 15, 2010, provided necessary approvals from the State Water Resources Control Board are obtained. Between December 15 and May 31, allowed diversions will range from 0 cfs to a maximum of 12.4 cfs, depending upon the flow available in Bear Gulch Creek. Streamflows for fish passage will range from 1 cfs to 7.6 cfs. From June 1 through December 14, diversions are allowed at the full streamflow of Bear Gulch Creek, less 0.5 cfs at all times for fish passage, up to a maximum of 12.4 cfs.

Station 3 Diversion

The Station 3 Diversion, shown on Figures 7-1 and 7-2, is a dam impoundment located on Bear Gulch Creek about 1.8 miles downstream from the Upper Diversion. The surface water is pumped from the dam impoundment by the Station 3 pump station, which has been operated by Cal Water since 1930. Water pumped from the Station 3 Diversion is conveyed about 1.5 miles to the Bear Gulch Reservoir.

Station 3 consists of an intake structure and two booster pumps. The existing pumps are: 1) 60 horsepower (HP), 2,200 gallons per minute (gpm) at design head of 80 feet, installed in 1997; and 2) 30 HP, 600 gpm at design head of 100 feet, installed in 1985. The combined capacity of both pumps is estimated at 4.7 cfs (2,100 gpm). The wet well elevation of the pump station is 316 feet.

Station 3 pumps water into a 10-inch pipeline, which is approximately 800 feet long and ties into the gravity transmission pipeline that moves water from the Woodside Diversion Dam to the reservoir. When water is pumped into the transmission line from Station 3, less water can be diverted from the Woodside Diversion Dam due to hydraulic limitations. Currently, Cal Water estimates that the existing transmission pipeline capacity is about 12 cfs (about 7.8 mgd).

Water is diverted from lower Bear Gulch Creek under an appropriative water right, with a permit issued in 1930 and perfected to a license in 1958. The license defines the point of diversion and diversion rates. The diversion rates currently in the license are:

- April 15 to June 1: Diversions are limited to 4.2 cfs. The water may not be stored and must be directly used for municipal purposes. If the diversion is 24 hours per day, this would be equivalent to 8.33 AF/day and 391.5 AF total for the 47-day diversion period.
- June 1 to December 15: No diversions are allowed.
- December 15 to April 15: Diversions are limited to 5 cfs. The total amount of water that can be diverted during this period is 140 AF, which can be stored or directly used.

In 1996, Cal Water entered into an agreement with the California Department of Fish & Game to provide 100 to 200 gpm (0.23 to 0.45 cfs) in the creek immediately downstream of the diversion. The purpose is to provide flows for instream habitat.

Under the new Cal Water operations plan for the Station 3 Diversion, diversions from December 15 through May 31 will range from 0 cfs to a maximum of 9.0 cfs, depending upon the flow available in Bear Gulch Creek. Streamflows for fish passage will range from 1 cfs to 3.2 cfs. From June 1 through December 14, diversions are allowed at the full streamflow of Bear Gulch Creek, less 0.4 cfs at all times for fish passage, up to a maximum of 9.0 cfs. Cal Water has proposed to operate at these conditions beginning December 15, 2010; however, diversion at the full capacity may require revision of existing agreements, permits, and licenses. Cal Water will operate at the existing level until such approvals are obtained.

7.3.3 Bear Gulch Reservoir and Dam

Surface water diverted from the creeks is stored in the Bear Gulch Reservoir prior to treatment. The reservoir is located in the western part of Atherton, near the boundary with Woodside.

The Bear Gulch Reservoir Dam, which creates the reservoir, is an earthen dam originally constructed in 1896. Several improvements have been made since that time: rolled fill addition in 1930, rock buttress additions in 1945, downstream face rock additions in 1983, and improved instrumentation in 2000. The dam is under the jurisdiction of the California Division of Safety of Dams. Key physical data on the reservoir and dam is shown in Table 7-4.

Cal Water's profile schematic shows the dam spillway at crest elevation of 245 feet. There are three inlet valves on the intake tower to the treatment plant at elevations of 243 feet full, 208 feet, and 198 feet minimum.

Table 7-4 Physical Characteristics of Bear Gulch Reservoir and Dam	
Total Reservoir Capacity	672 acre-feet
Crest Elevation	245.1 feet
Freeboard	5.1 feet
Dam Height	61 feet
Dam Length	730 feet
Dam Width	11 feet

Note: Data obtained from dam listing of California Division of Safety of Dams.

To avoid potential issues with dam stability, Cal Water has established an operational guideline that restricts maximum drawdown of the reservoir level to 0.3 feet per day. This limit is based on empirical data from the failure of the upstream face of the dam in the late 1930s/early 1940s. The 0.3 feet per day is below the rate at which the failure occurred. A more recent geotechnical investigation on the dam structure undertaker by another Cal Water consultant adopted that limitation, but also concluded that there may be safe, deeper short-term drawdown.

7.3.4 Bear Gulch Water Treatment Plant

The surface water is treated at a treatment facility located adjacent to the Bear Gulch Reservoir. Treatment processes include clarification, filtration, chloramination, and UV disinfection. The treated water is pumped into the distribution system from the plant.

The treatment plant began operating in 1977. The plant has a rated design capacity of 6 mgd. If adequate water were available and demand high enough so that the plant could operate continuously at its design capacity throughout the year, it could produce as much as 2,190 million gallons (MG) (6,720 AF). However, actual production is limited by the amount of available water and the timing of demand relative to surface supply.

Table 7-5 summarizes the historic monthly and annual plant production from 1980 through 2006. The District's local surface water production has averaged 1.2 mgd (mean) over the 27-year period encompassing a range of dry, normal, wet and very wet years. The annual plant production has ranged from a high of 2,812 AF (916 MG or 2.5 mgd) in 1983, which was a wet year prior to initiation of the current fish release requirements, to a low of 319 AF (104 MG or 0.3 mgd) in 1992 after multiple dry years. As to be expected, the lowest production occurred during the last major drought during the extended dry period from 1987-1992. Since the 1996 fish release requirements were instituted, the highest production occurred in 2005-2006 (wet winters) of 578 to 626 MG per year (1.6 to 1.7 mgd).

Table 7-5
Historic Surface Water Production from Bear Gulch WTP (MG)

Year		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1980		53.7	81.5	106.0	89.1	106.9	84.7	67.9	24.4	0	0	0	0	614
1981		1.4	20.8	49.7	106.3	67.0	15.2	40.3	0	0	0	0.5	61.3	362
1982		72.4	41.3	89.7	109.9	136.5	98.3	88.7	51.0	0.2	0	4.7	82.4	775
1983		62.9	88.9	101.7	104.8	142.0	144.6	91.2	68.8	23.2	0	15.7	72.4	916
1984		103.3	95.9	103.7	72.1	61.2	72.5	51.3	0	0	0	0	74.6	634
1985		56.8	52.9	57.6	79.3	64.1	47.5	18.0	0	0	0	0	15.0	391
1986		33.7	16.0	81.8	122.5	101.2	63.1	50.6	6.7	0	0	0	0	476
1987		0	11.0	55.6	34.6	39.4	27.0	0	0	0	0	0	0	168
1988		9.2	39.7	42.7	18.3	0	0	0	0	0	0	0	0	110
1989		29.8	26.3	44.3	67.9	65.6	52.7	41.9	27.8	8.0	0	0	0	364
1990		0	0	0	0	0	0	7.8	56.7	43.3	6.0	37.3	13.1	164
1991		0	16.1	16.5	15.7	42.1	37.2	2.2	0	0	0	0	0	130
1992		0	0	32.4	62.6	8.9	0	0	0	0	0	0	0	104
1993		39.5	50.0	74.8	31.8	38.5	29.4	0	40.3	26.5	42.7	46.4	32.9	453
1994		14.7	0	19.3	39.6	46.4	41.6	0	0	0	0	0	13.0	175
1995		59.5	81.0	101.0	133.0	150.6	94.6	73.5	37.7	0	0	0	0	731
1996		22.1	65.1	100.7	84.3	98.6	81.4	40.1	0	0	0	10.8	41.4	544
1997		80.3	91.9	116.0	85.3	62.2	0.0	0.0	0	0	0	8.0	27.7	471
1998		47.5	39.5	55.2	62.1	79.9	77.6	30.0	13.2	29.2	32.6	46	46.7	559
1999		4.3	28.7	83.2	122.3	112.8	7.3	34.8	0	0	0	24.6	62.7	481
2000		59.9	53.1	75.5	56.4	35.8	33.2	59.6	74.9	40.9	18.0	0	0	507
2001		0	0	36.6	51.0	88.6	55.0	38.7	30.0	0	0	0	0	300
2002		44.7	47.0	73.6	108.0	46.6	32.4	13.1	4.2	18.7	0	0	0	388
2003		14.7	48.7	87.9	87.0	70.5	51.3	56	0	0	0	0	0	417
2004		0	0	24.5	69.4	57.4	41.4	11.0	1.6	4.2	16.1	0	0	226
2005		20.2	58.9	99.6	147.5	120.5	37.6	0	0	0	0	53.3	40.2	578
2006		51.9	86.2	87.8	89.4	90.9	43.9	63.4	33.7	49.8	29.5	0	0	626
Summary For All Years: 1980 - 2006														
Minimum	MG	0	0	0	0	0	0	0	0	0	0	0	0	104
	mgd	0	0	0	0	0	0	0	0	0	0	0	0	0.3
Average	MG	32.7	42.2	67.3	75.9	71.6	47.0	32.6	17.5	9.0	5.4	9.2	21.6	432
	mgd	1.1	1.5	2.2	2.5	2.3	1.6	1.1	0.6	0.3	0.2	0.3	0.7	1.2
Maximum	MG	103.3	95.9	116.0	147.5	150.6	144.6	91.2	74.9	49.8	42.7	53.3	82.4	916
	mgd	3.3	3.4	3.7	4.9	4.9	4.8	2.9	2.4	1.7	1.4	1.8	2.7	2.5

Production is also limited by Cal Water's operational guideline restricting drawdown of the reservoir level to a rate of 0.3 feet per day, which limits production to between 1 and 2 mgd when inflow to the reservoir is minimal. During the dry season, when there is little inflow to replenish water taken out of storage, the drawdown restriction limits the amount of storage that can be used to meet the hot weather demands.

As a result of recent improvements, Cal Water anticipates that the plant will be available for operation more often than in the past. Cal Water's UWMP has targeted an annual production of about 1,500 AF (490 MG) from the treatment plant, which is

about 1.34 mgd on an average annual basis. At this production level, surface water would supply about 10 percent of the total demand.

In order to maximize surface water production, the most advantageous period of time to operate the treatment plant is the winter when surface water diversions and storage are occurring. However, during rainy periods, the demand for water in the portion of the distribution system that can currently receive treatment plant water generally drops significantly. At other times, demand may be high but creek flows too low to replenish the reservoir adequately and plant production is constrained by Cal Water's maximum reservoir drawdown rate of 0.3 feet per day.

7.3.5 Optimization Guidelines for Bear Gulch WTP

The District has developed optimization guidelines to maximize the amount of water that can be treated at the Bear Gulch WTP. Table 7-6 summarizes these guidelines.

Table 7-6
Bear Gulch WTP Optimization Guidelines [(1)]

Water availability	• Must have adequate rainfall. • Minimum runoff amount required. • Must perform annual sediment removal in creeks.
Water diversion	• Meet regulatory requirements. • Observe operating window for Station 3 diversion. • Keep diversion screen clean and operating. • Keep sandbag dam maintained when needed at Station 3 diversion. • Keep Station 3 in good operational condition. • Keep raw water pipeline to reservoir in good operating condition.
Reservoir management	• Start treating water early enough in season to allow maximum capacity for runoff to be stored in reservoir. • Observe all drawdown restrictions. • Utilize rapid drawdown procedure when appropriate.
Treatment plant optimization	• Equipment must operate properly. • Filter to waste must be optimized to avoid down time. • Sump to waste must be minimized. • Avoid turbidity spikes in reservoir water that can take plant off-line. • When high turbidity hits sump, pump out as quickly as possible to get back on-line.
Blending maximization (Lake Tank level management)	• Maintain minimum CT. • Avoid high Lake Tank shutdown. • Manage Lake Tank level. • Properly manage "H" valve to minimize use. • Consider creating "easy H valve controller".
Distribution system and pumping optimization	• Must operate Pumps 4C, F and I to move water from Plant. • Keep Station 4G and H off as much as possible to reduce SFPUC supply. • Keep Station 20 off as much as possible to reduce SFPUC supply. • Reduce flow from SFPUC connections as much as possible. • Utilize PRV, portable boosters, or future station to get water to low zone. • Balance multiple pumping lifts so production can be maximized.

[(1)] Optimization Guideline was provided by District, December 2005 update.

7.3.6 Local Surface Water Flows

The local surface water available from Bear Gulch Creek is constrained by hydrology (wet and dry cycles) and by diversion requirements. Tables 7-7 and 7-8 show the estimated monthly flow rates in Bear Gulch Creek at the Diversion Dam and Station 3 Diversion, respectively.

Table 7-9 shows actual diversions at the Station 3 Diversion from 2000 through 2005. This data is from Cal Water's Tech Memo on "Bear Creek Hydrology Investigation for Environmental Review and Permitting" August 18, 2005.

Table 7-7
Estimated Monthly Flow Rates in Bear Gulch Creek at Diversion Dam Location [(1)]

Month	Minimum		Median		Mean		Maximum (during major storms)	
	cfs	mgd	cfs	mgd	cfs	mgd	cfs	mgd
January	0.10	0.06	1.10	0.71	4.30	2.78	62.20	40.20
February	0.15	0.10	2.60	1.68	6.50	4.20	84.20	54.42
March	0.26	0.17	2.50	1.62	4.10	2.65	45.60	29.47
April	0.02	0.01	1.10	0.71	1.70	1.10	15.80	10.21
May	0.00	0.00	0.58	0.37	0.90	0.58	5.50	3.55
June	0.01	0.01	0.27	0.17	0.47	0.30	2.80	1.81
July	0.00	0.00	0.20	0.13	0.24	0.16	1.20	0.78
August	0.00	0.00	0.15	0.10	0.15	0.10	0.86	0.56
September	0.00	0.00	0.14	0.09	0.15	0.10	1.20	0.78
October	0.02	0.01	0.17	0.11	0.21	0.14	3.70	2.39
November	0.03	0.02	0.27	0.17	0.54	0.35	14.30	9.24
December	0.03	0.02	0.53	0.34	1.90	1.23	44.10	28.50

[(1)] Source of Data: Cal Water Tech Memo on Bear Creek Hydrology Investigation for Environmental Review & Permitting dated August 18, 2005 (prepared by CH2MHill for Cal Water).

Table 7-8
Estimated Monthly Flow Rates in Bear Gulch Creek at Station 3 Diversion Location [1]

Month	Minimum		Median		Mean		Maximum Instantaneous (peak flow during major storms)	
	cfs	mgd	cfs	mgd	cfs	mgd	cfs	mgd
January	0.27	0.17	2.97	1.92	11.61	7.50	167.94	108.53
February	0.41	0.26	7.02	4.54	17.55	11.34	227.34	146.92
March	0.70	0.45	6.75	4.36	11.07	7.15	123.12	79.57
April	0.05	0.03	2.97	1.92	4.59	2.97	42.66	27.57
May	0.00	0.00	1.57	1.01	2.43	1.57	14.85	9.60
June	0.03	0.02	0.73	0.47	1.27	0.82	7.56	4.89
July	0.00	0.00	0.54	0.35	0.65	0.42	3.24	2.09
August	0.00	0.00	0.41	0.26	0.41	0.26	2.32	1.50
September	0.00	0.00	0.38	0.24	0.41	0.26	3.24	2.09
October	0.05	0.03	0.46	0.30	0.57	0.37	9.99	6.46
November	0.08	0.05	0.73	0.47	1.46	0.94	38.61	24.95
December	0.08	0.05	1.43	0.92	5.13	3.32	119.07	76.95

[1] Estimated as 2.7 times the flow rates shown in Table 7-7 for the Diversion Dam location based on Cal Water Tech Memo on Bear Creek Hydrology Investigation for Environmental Review & Permitting, August 18, 2005 (prepared by CH2MHill). The Tech Memo did not provide estimated flow rates at Station 3 Diversion, but indicated the Station 3 Diversion flow (downstream of confluence with West Union Creek) was 2.7 times greater consistent with the tributary drainage areas.

Table 7-9
Historical Cal Water Diversions at Station 3 Diversion Location from 2000 through 2005

Period	Permit Requirements	2000 AF	2000 cfs on average	2000 mgd on average	2001 AF	2001 cfs on average	2001 mgd on average	2002 AF	2002 cfs on average	2002 mgd on average
December 15 - 31	Diversion rate cannot exceed 5.0 cfs (3.23 mgd). Storage allowed. Maximum diversion amount of 140 AF.	0	0	0	0	0	0	0	0	0
January		47.6	0.8	0.5	49.9	0.8	0.5	60.7	1.0	0.6
February		53.8	1.0	0.6	80.3	1.4	0.9	46.7	0.8	0.5
March		24.2	0.4	0.3	12.4	0.2	0.1	14.0	0.2	0.1
April 1 - 15		46.6	1.6	1.0	17.9	0.6	0.4	27.9	0.9	0.6
April 16 - 30	Diversion rate cannot exceed 4.2 cfs (2.71 mgd). No storage allowed. Maximum diversion amount of 391.5 AF assuming diversion 24 hours per day for the entire period at the maximum rate.	28.3	1.0	0.6	24.3	0.8	0.5	18.2	0.6	0.4
May		30.6	0.5	0.3	12.0	0.2	0.1	11.0	0.2	0.1
June - December 14	No diversions allowed.	0	0	0	0	0	0	0	0	0
TOTAL DIVERSION AMOUNT FOR ENTIRE YEAR (maximum allowable = 531.5 AF)		231.1			196.8			178.5		

Period	Permit Requirements	2003 AF	2003 cfs on average	2003 mgd on average	2004 AF	2004 cfs on average	2004 mgd on average	2005 AF	2005 cfs on average	2005 mgd on average
December 15 - 31	Diversion rate cannot exceed 5.0 cfs (3.23 mgd). Storage allowed. Maximum diversion amount of 140 AF.	0	0	0	37.9	0.6	0.4	0	0	0
January		13.2	0.2	0.1	73.3	1.2	0.8	4.1	0.1	0.0
February		51.9	0.9	0.6	14.5	0.3	0.2	4.5	0.1	0.1
March		45.4	0.7	0.5	19.8	0.3	0.2	42.9	0.7	0.5
April 1 - 15		13.8	0.5	0.3	13.2	0.4	0.3	27.5	0.9	0.6
Subtotal for diversion periods when storage is		124.3			158.7			79.0		
April 16 - 30	Diversion rate cannot exceed 4.2 cfs (2.71 mgd). No	0.0	0.0	0.0	4.4	0.1	0.1	33.9	1.1	0.7
May		53.1	0.9	0.6	0.4	0.0	0.0	123.6	2.0	1.3
Subtotal for diversion periods when no storage is		53.1			4.8			157.5		
June - December 14	No diversions allowed.	0	0	0	0	0	0	0	0	0
TOTAL DIVERSION AMOUNT FOR ENTIRE YEAR		177.4			163.5			236.5		

Notes:
The low diversion amount in January and February 2005 is assumed to be due to heavy rainfall and nearly full capacity of Bear Gulch Reservoir.
If treatment plant production is higher than diversion amounts, Cal Water assumes that diverted flows are being directly used up to the production rate.

Source of Data: Cal Water Tech Memo "Bear Creek Hydrology Investigation for Environmental Review and Permitting", August 18, 2005.

For the Diversion Dam and the Station 3 Diversion, respectively, Figures 7-3 and 7-4 graphically illustrate the monthly variation in creek flows over the year. The mean creek flows are the average flows anticipated to occur over time. The median flows represent the value at which half of the flows are anticipated to be higher and half to be lower.

During major storm events in the winter months, maximum flows (instantaneous peak flows) in the creeks can temporarily be much higher than the mean flows shown on the figures. However, maximum flows would occur only infrequently and for short periods, typically during major storms that occur in above normal or wet years when soils are already saturated. Therefore, the mean and median flows in the creeks are much lower than the maximum flows.

The minimum flows can be considered representative of dry and critically dry years. During dry years, the available surface supply from the creeks to replenish reservoir storage is neglible, i.e., essentially all surface supply must be provided from storage.

Figures 7-3 and 7-4 graphically illustrate District buildout demands over the year along with mean, median, and minimum creek flows. As illustrated on the figures, creek flows are highest when demands are lowest and are low or non-existent when demands are highest.

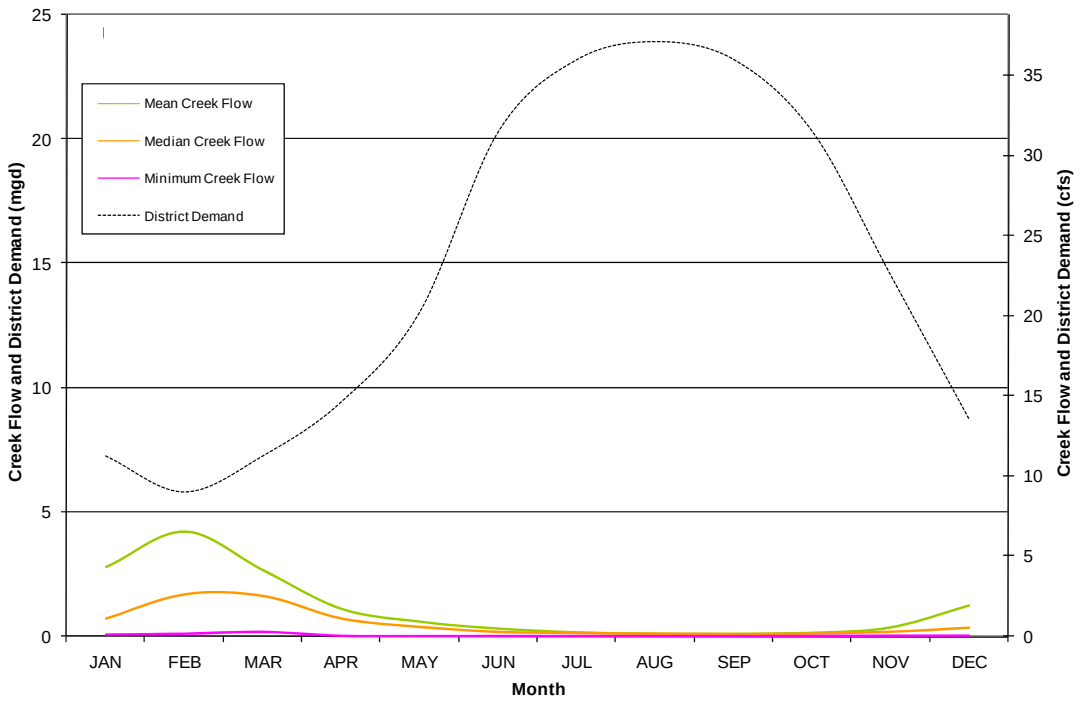


Figure 7-3
Historic Creek Flows at Diversion Dam

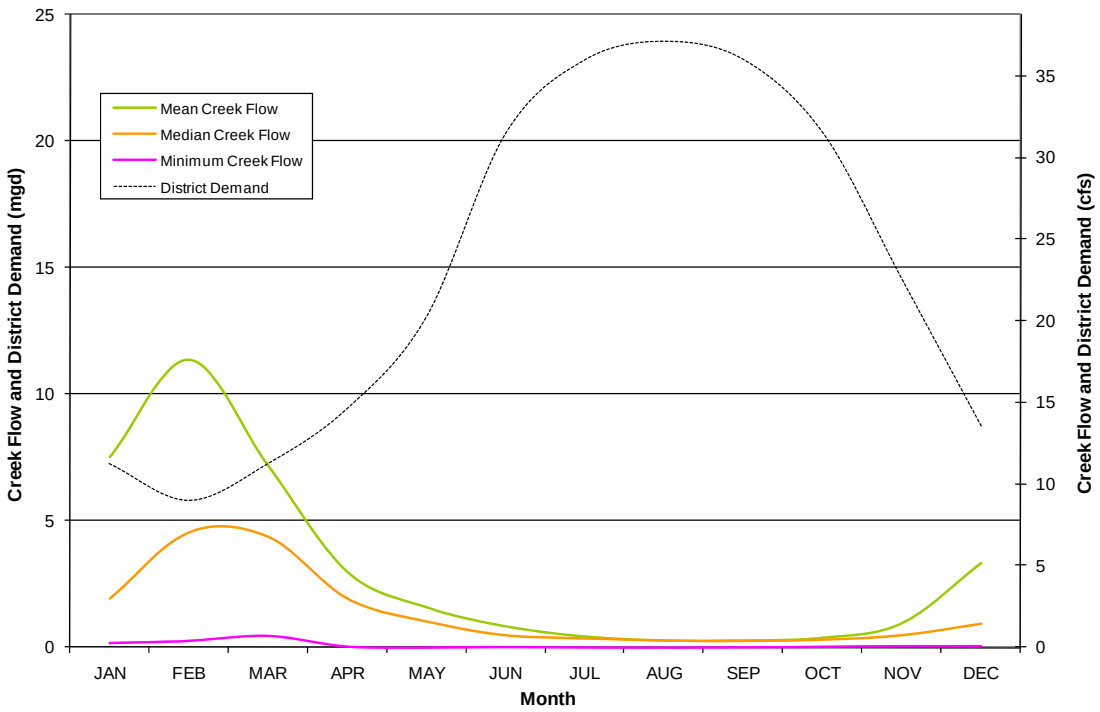


Figure 7-4
Historic Creek Flows at Station 3 Diversion

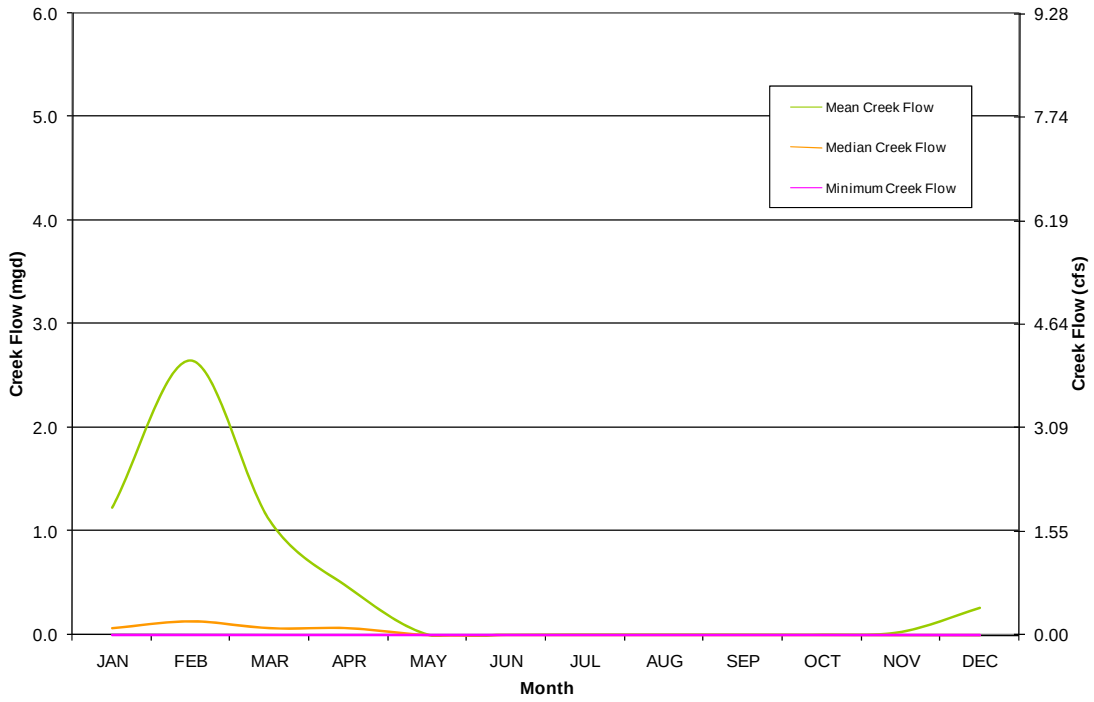
As described in Section 7.3.2, Cal Water has developed new operations plans for both diversion locations to address regulatory agency concerns about environmental issues, primarily fish bypass flows. Tables 7-10 and 7-11 present the proposed flow schedules for the Diversion Dam and Station 3 Diversion, respectively, under the new operations plan.

Table 7-10
Proposed Operations Measures at the Diversion Dam

Amount of Bear Gulch Flow	***Bypass Flow***	***Allowed Diversion***
December 15 through May 31		
Less than 1 cfs	All flow	0 cfs
Greater than or equal to 1 cfs and less than 2.4 cfs	1 cfs	Up to 1.4 cfs
Greater than or equal to 2.4 cfs and less than 7.6 cfs	2.4 cfs	Up to 5.2 cfs
Greater than or equal to 7.6 cfs	7.6 cfs	Up to 12.4 cfs
June 1 through December 14		
Less than 0.5 cfs	All flow	0 cfs
Greater than or equal to 0.5 cfs	0.5 cfs	up to 12.4 cfs

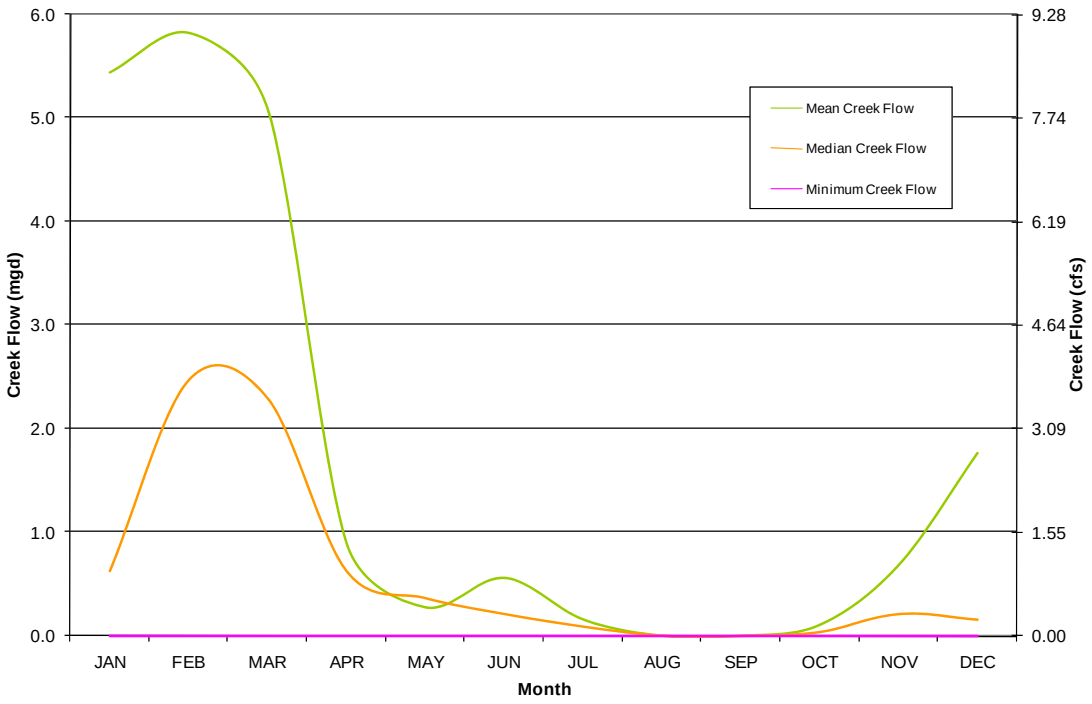
Table 7-11 Proposed Operations Measures at the Station 3 Diversion		
Amount of Bear Gulch Flow	**Bypass Flow**	**Allowed Diversion**
December 15 through May 31		
Less than 1 cfs	All flow	0 cfs
Greater than or equal to 1 cfs and less than 2 cfs	1 cfs	Up to 1 cfs
Greater than or equal to 2 cfs and less than 3.2 cfs	2 cfs	Up to 1.2 cfs
Greater than or equal to 3.2 cfs	3.2 cfs	Up to 9 cfs
June 1 through December 14		
Less than 0.4 cfs	All flow	0 cfs
Greater than or equal to 0.4 cfs	0.4 cfs	up to 9 cfs

Using the estimated monthly flows at each diversion shown in Tables 7-7 and 7-8, CDM calculated the potential available supply amount at each diversion based on the above proposed operations measures, i.e., the amount that could be diverted after the bypass flow requirements are met. Figures 7-5 and 7-6 illustrate the monthly variation over the year in allowable creek diversions under mean, median, and minimum creek flow conditions, i.e., allowable diversions after meeting bypass flow requirements. Considerably more water is available for potential supply at the Station 3 Diversion. Under minimum creek flow conditions, no water could be diverted at either location.



Note: Allowable diversion amount is the flow that can be diverted by Cal Water for supply after meeting the bypass flow requirements in the proposed Operations Conservation Measures.

Figure 7-5
Diversion Dam – Allowable Diversion Amount for Water Supply



Note: Allowable diversion amount is the flow that can be diverted by Cal Water for supply after meeting the bypass flow requirements in the proposed Operations Conservation Measures.

Figure 7-6
Station 3 Diversion – Allowable Diversion Amount for Water Supply

Table 7-12 summarizes the potential amount of annual surface supply available for diversion by Cal Water for the following two cases:

1) Current diversion limits plus maintaining a minimum 200 gpm bypass flow at the diversion locations based on the 1996 CDFG agreement.

2) The future scenario, shown on Figures 7-5 and 7-6, with Cal Water diversions following the proposed Operation Conservation Measures.

Table 7-12 shows the annual supply amounts anticipated under mean, median, and minimum creek flow conditions with the two assumptions regarding environmental (fish) bypass flows.

Table 7-12 Potential Annual Surface Supply from Bear Creek												
Diversion Location	**Potential Annual Supply Based on Creek Flows**											
	Current Conditions – With minimum fish bypass flow of 200 gpm (0.45 cfs) at all times at both diversion locations						**Proposed Operation Conservation Measures**					
	Mean		**Median**		**Minimum**		**Mean**		**Median**		**Minimum**	
	MG	**AF**	**MG**	**AF**	**MG**	**AF**	**MG**	**AF**	**MG**	**AF**	**MG**	**AF**
Diversion Dam	324	994	110	338	0	0	169	518	10	29	0	0
Station 3	505	1,550	332	1,019	5	15	625	1,919	212	649	0	0
Total at Diversion Dam and Station 3 (as sum of separate diversions at each location)	829 (2.3 mgd)	2,544	442 (1.2 mgd)	1,356	5	15	794 (2.2 mgd)	2,436	221 (0.6 mgd)	679	0	0

As indicated on Table 7-12, with the previous bypass flow requirements, the median amount of annual supply was about 1.2 mgd, which is similar to the historical average. With the new bypass requirements, the median amount of annual supply will drop by half to 0.6 mgd, due to higher bypass requirements under low creek flow conditions.

According to Table 7-12, Cal Water could potentially divert up to 2.2 mgd on a mean (average) basis over time, but this will not be a consistent annual amount. During wet years with high creek flows, a larger amount of local surface would be used, which will require diverting higher flows, up to the maximum allowable diversion amounts, during high storm flows and wet years. During dry years with low creek flow conditions, there will be little or no supply available.

The annual supply amounts on Table 7-12 are "theoretical" amounts that do not consider facility limitations, such as the raw water supply system capacity or the ability to convey the treated water from the plant in the existing distribution system. In addition, adequate storage must be available when diverted flows exceed treatment plant capacity or system demands. These facility capacity issues are discussed in Section 7.3.7 below.

During wet years, the constraints on local surface water supply are due primarily to permit and regulatory requirements, e.g., maintaining adequate flows for fish. During droughts, which may be single dry years or several consecutive dry years, the amount of local surface water runoff will be very small. For example, during the last major drought period from 1987 to 1992, Cal Water's local surface water production ranged from 104 to 168 AF per year.

During droughts, all surface supplies in the Northern California area are impacted, although the degree of impact may vary by location. It is likely that a drought

affecting Cal Water local surface water supply will also affect SFPUC surface water, i.e., SFPUC may place restrictions on the imported surface supply. Other agencies that provide surface supply will also be affected by drought conditions.

7.3.7 Potential Options to Maximize Local Surface Supply

Use of local surface supply is currently constrained by the amount of available surface supply to be treated at the plant and then effectively conveyed in the distribution system. The 6-mgd design capacity of the plant is far in excess of the currently available surface water supply. Several potential options are discussed below to increase local surface supply.

Raw Water Conveyance Improvements

In order to maximize use of local surface supplies in the distribution system during the wet months from January through April, sufficient raw water conveyance capacity must be available to capture and convey intermittent peak storm flows to the reservoir and treatment plant. Historically, local surface water use has been optimized in early spring after a rainy winter with continuing sustained runoff, i.e., when runoff is still occurring while demands are increasing.

Improvements will be needed to the raw water conveyance facilities from the Diversion Dam and Station 3 Diversion locations to the reservoir/plant. Below are maximum allowable diversion amounts based on the proposed Operation Conservation Measures:

Diversion Location	***Maximum Allowable Diversion Rate (per proposed Operation Conservation Measures)***		
	(cfs)	***(mgd)***	***(gpm)***
Diversion Dam	12.4	8	5600
Station 3	9	5.8	4000
Combined (downstream of Station 3)	21.4	13.8	9600

Improvements will be needed to the raw water pipeline between the diversion locations and the reservoir/plant, in order to convey the maximum allowable diversion flows. In addition, the existing pipeline is very old and some sections have already required repair or replacement. Options to provide the required conveyance capacity include:

- Replace the entire pipeline with larger diameter pipe to handle the maximum allowable combined diversion flows. Continue conveying all flows to the reservoir/plant in this single pipeline. Conceptual sizing indicates that a 24- to 30-inch pipeline would be required (estimated at 9500 feet of 24-inch and 7800 feet of 30-inch).

- Utilize the existing pipeline to convey flows only from the Diversion Dam. Construct a separate 18- to 20-inch pipeline (estimated at 7800 feet) to convey the

9 cfs (5.8 mgd) flows between Station 3 and the reservoir/plant. Depending on the alignment selected for the new pipeline, there may an opportunity to utilize an existing 18-inch line in Woodside Road that is no longer needed for the treated water distribution system, since a new 24-inch main was constructed in a parallel alignment.

With the additional raw water conveyance capacity, it will be possible to capture more water during peak storms to utilize directly and/or store in the reservoir if capacity is available. During some winters, there may be only 1 or 2 storms with high flows, with runoff lasting only for short periods.

Station 3 improvements will be required to increase pumping capacity and provide more flexibility to handle varying flow rates. A total firm pumping capacity of 9 cfs (5.8 mgd or 4,000 gpm) should be provided to handle the maximum allowable diversion rate. This is about double the combined capacity of the two pumps at the existing pump station. Use of variable frequency drives on one ore more pumps would allow more flexibility in capturing and conveying varying creek flows.

As discussed below, distribution system improvements have been identified that will enable the distribution system to utilize the full treatment plant capacity of up to 6 mgd during the winter low demand periods when creek flows are higher. Storage in Bear Gulch Reservoir and/or another raw water storage site will be needed to accommodate peak flow diversions that are in excess of the 6 mgd treatment plant capacity, e.g., during storms that generate the maximum allowable diversion amounts. As discussed below, adequate raw water storage capacity must be available in order to fully utilize the increased raw water conveyance capacity.

Bear Gulch Reservoir Storage Options

Achieving the potential mean (average) annual supply of 2.2 mgd shown on Table 7-12 will require about 300 AF of storage capacity, as an annual average, based on conceptual evaluation using the mean monthly flows in Table 7-12. This assumes that water would be diverted from both diversion locations up the maximum allowable by the proposed Operations Conservation Measures when creek flows are available, that raw water conveyance improvements are implemented to convey up to the maximum allowable diversions from both locations, and that the distribution system improvements discussed in Section 8.10 are implemented to allow local surface water to be used up to the 6 mgd treatment plant capacity. Diverted flows in excess of the 6 mgd plant capacity would be stored, and then used when creek flows are lower. This storage amount is almost half of the Bear Gulch Reservoir total storage capacity.

Use of the existing reservoir storage capacity at the Bear Gulch Reservoir is constrained by the operational guideline limiting drawdown to no more than 0.3 feet per day to avoid impacting the dam structure. When inflow to the reservoir is minimal, e.g., summer or dry years, this constraint can limit use of stored water to a maximum of 1 to 2 mgd per day.

Cal Water should conduct a detailed investigation of the validity of this operational guideline, what mitigation would be required to be able to utilize stored water at higher rates, and the available capacity for excess flow diversions without drawdown limitations. This will require detailed site investigation and analysis of the existing dam structure and detailed hydrologic analyses of anticipated diversions and corresponding storage requirements, which are beyond the scope of this master plan. Section 9 contains recommendations regarding subsequent studies.

In order to provide supply during drier years, greater use of storage will be needed. During drier years and droughts, surface water supply is typically supplemented from storage, and the amount of stored water diminishes since inflows are typically too low to replenish the amount used. Local surface supply can only be considered as a reliable drought supply if there is sufficient storage to accommodate several dry years with minimal inflows, and if analysis of the historic hydrologic record that includes several wet and dry cycles, including severe droughts and critically dry years indicates that the storage will replenish between dry cycles.

Additional storage capacity, beyond that available in the existing reservoir, would improve the reliability of dry year supply. Options to increase the storage capacity of the existing Bear Gulch Reservoir may include dredging or raising the dam. This option would also require detailed field investigation and feasibility studies of the existing reservoir and dam, and potential impacts to the plant, which are beyond the scope of this master plan. Section 9 contains recommendations regarding subsequent studies, as appropriate.

Distribution System Improvement Options

Section 8 describes how the hydraulic model of the distribution system was used to investigate expanding the area effectively served by the treatment plant. The area receiving treated local surface water is currently limited by hydraulic constraints.

During higher demand periods, there is sufficient demand in the area that can be served from the plant to utilize all the treated local surface supply; especially since during the highest demand periods, there is essentially no local surface supply except that available from the reservoir. During lower demand periods, when more local surface supply is available, the demands in the portion of the system that can currently effectively be served from the plant are too low to utilize all the available local water. If the area that can be served from the plant during low demand periods is expanded, the available local surface supply during the winter rainy season could be more effectively used.

As discussed in Section 8.10, the hydraulic evaluation of the distribution system identified improvements to allow up to 6 mgd of treated surface water from the plant to be effectively used in the distribution system during low demand days. These improvements are described in Section 8.10. With these improvements, full plant capacity can be utilized assuming that adequate raw water supply is available.

Supplemental Groundwater Supply to Water Treatment Plant

Hydrogeology effectively eliminates consideration of an option to install groundwater wells in the vicinity of the diversions or the reservoir to supplement the surface supply. The portion of the service area south and west of approximately the Alameda de Las Pulgas, which is the general vicinity of the reservoir and diversions, does not have water-bearing subsurface deposits.

As discussed in Section 7.6, the water bearing sediments in the Bear Gulch District area are generally located northeast of approximately Alameda de las Pulgas. Section 7.6 identifies 2 to 4 production wells (0.35 to 0.7 mgd) as a potential future supply source. Depending on the specific sites and characteristics, these wells may pump directly into the distribution system with individual wellhead treatment or to a centralized treatment/blending facility prior to distribution.

Section 7.6 mentions a potential option to convey groundwater from future wells to the water treatment plant. This would require construction of a long pipeline through developed areas, since the identified promising sites are located about 2.5 to 4 miles from the plant. There are existing parallel treated pipelines in Atherton Avenue from El Camino Real to the plant, which were evaluated to see if one could be converted to a groundwater (raw water) conveyance pipeline. However, both pipelines are needed as distribution system pipelines in order to maintain adequate pressures in Zone 220, especially in the higher elevation areas near zones 400 and 319.

As discussed in Section 7.6, groundwater is a local supply component, regardless of whether it is conveyed to the surface water treatment plant. Conveying it to the plant does not provide additional local supply; it is one option to provide centralized treatment if needed.

Other Potential Raw Water Storage Sites

As shown on Figures 7-1 and 7-2, there are two other lakes near the western portion of the Bear Gulch District: 1) Searsville Lake, and 2) Felt Lake. Potential use of these lakes for future Cal Water raw water storage is discussed below. Either option would require major coordination efforts with Stanford University and the San Francisquito Creek JPA. At this time, neither option appears promising; however, Cal Water should continue to monitor them in case conditions change in the future, and/or as part of a future regional effort with other agencies.

According to Stanford University planning documents, the Stanford Water Shop operates a separate non-potable water system supplied from Searsville Lake and Felt Lake. Stanford has three water diversions in the San Francisquito Creek Watershed: at the Searsville Dam; at a pumping facility on San Francisquito Creek located at the Stanford Golf Course near Junipero Serro Boulevard; and the Felt Lake diversion on Los Trancos Creek at Arastradero Road.

The University has no treatment facilities for the non-potable system and relies solely on natural precipitation for replenishment of the lake storage. The non-potable lake system is used for irrigation and backup fire protection. Irrigation uses include campus areas, athletic fields, various leasehold operations, and the Stanford Golf Course. Since 1985, there has been a program to maintain and expand the lake water system to irrigate more university areas with non-potable rather than domestic treated water.

Stanford University, similar to other agencies with domestic water supply from the SFPUC system, anticipates future shortages in domestic water supply as the campus expands. Therefore, emphasis has been placed on converting potential uses that could be supplied by non-potable water from the domestic system to the lake system.

Searsville Lake

Searsville Lake is west of the intersection of Portola Road and Sand Hill Road. Searsville Dam is about 1.5 miles from the existing Cal Water 16-inch raw water pipeline that crosses Whiskey Hill Road as it conveys water from Station 3 to the Bear Gulch Reservoir. It would be prohibitively costly to consider conveying water directly to the Reservoir, since existing roads do not provide a reasonably direct alignment. A pipeline from the dam would have to be constructed within the Jasper Ridge Biological Preserve to Sand Hill Road and then in Whiskey Hill Road to the 16-inch raw water pipeline.

Searsville Lake is located on Stanford property within the Jasper Ridge Biological Preserve. The lake is fed from several tributary creeks in the upper San Francisquito watershed, and outlets to San Francisquito Creek. Over time, the lake area has diminished due to sediment buildup behind the dam. Currently, the lake has a storage capacity of about 450 AF with adjacent seasonal wetland habitat.

The Jasper Ridge Biological Preserve that contains Searsville Lake and surrounding wetlands is an essential element of Stanford's scientific programs and the focus of considerable academic research efforts. No recreational activities are allowed in the Preserve to protect its educational and habitat benefits.

In recent years, there has been talk of a variety of potential options for Searsville Lake and Dam including removing or modifying the dam to improve steelhead habitat to altering the dam to provide better flood control management. In response to such discussions, the Stanford University web site contains a position statement from several Stanford professors associated with the Preserve regarding potential changes to Searsville Lake/Dam. In their view, any modifications could have significant repercussions to the Preserve and its educational programs, as well as significant ecosystem tradeoffs. Therefore, this Committee has requested that the University include the following objectives and conditions as part of any modification proposal:

1) Any modification proposal must be accompanied by a commitment to implement and support long-term research on the consequences for biodiversity and ecosystem function.

2) Baseline surveys must be integral before, during, and after any modification effort. Such surveys should include, but not be limited to, current lake bathymetry, upstream and downstream streamflow and sediment flux, groundwater head distribution, and changes in size, location and composition of associated habitats. Monitoring of these and other conditions should continue during and following any changes.

3) An adaptive management approach should be adopted for any plan for dam modification to protect native biodiversity and ongoing research and educational program activities.

4) Any sediment removal requiring dewatering before transport should include de-watering on lands outside the boundaries of the Preserve due to the associated loss of land that would be dedicated to such an effort.

5) Dam removal or alteration feasibility studies should answer the following questions:

   - What is the biodiversity tradeoff associated with dam removal or other management options? Evaluation of potential habitat benefits versus habitat losses associated with any dam management option is essential.
   - How will sediment removal affect the Preserve?
   - How will heavy equipment traffic impact the Preserve and how can these impacts be minimized?
   - How will dam alteration impact the Preserve riparian habitats and the movement of native and non-native invasive species?

6) The Committee and other relevant members of the Jasper Ridge community and staff should be provided an opportunity to assist in formulation and review of any EIR or CEQA effort associated with a dam management project.

Felt Lake

Felt Lake is located in Santa Clara County off Los Trancos Creek, which is tributary to San Francisquito Creek. Felt Lake has a storage capacity of about 1,100 AF. Water for Felt Lake is diverted from Los Trancos Creek by gravity via a concrete flume/diversion structure.

Felt Lake is part of the Stanford University non-potable water supply system. It also provides recreational and educational opportunities for the campus. Stanford University has constructed (or is constructing) a nearby hiking trail.

The Stanford University Center for Conservation Biology conducts research at Felt Lake area in addition to the Jasper Regional Biological Preserve. In addition,

university civil engineering classes conduct field trips to view the facilities, and university biological sciences classes conduct field trips to view the habitats. Felt Lake is also within the scope of the San Francisquito Creek JPA watershed management efforts.

Felt Lake is located outside the Bear Gulch District service area, west of the intersection of Alpine Road and Westridge Drive. Cal Water's existing raw water facilities are located about 5 miles away by way of an alignment in existing streets along Alpine Road to Alameda de las Pulgas and then Walsh Road to Reservoir Road. Caltrans does not allow longitudinal alignments in freeways, so an alignment along Highway 280 was not considered. It would be prohibitively costly and disruptive to consider conveying water directly to the Reservoir and treatment plant.

7.4 Long-Term Conservation Savings

Cal Water has a water conservation program in place for the Bear Gulch service area, and participates in demand management efforts in conjunction with the California Urban Water Conservation Council. The Bear Gulch UWMP outlines the current and proposed best management practices (BMPs) for water conservation. Cal Water has set a goal of 10 percent reduction in demand by Year 2030. These reductions would be permanent long-term water savings.

Implementation of conservation measures will require significant public outreach efforts, as well as ongoing evaluation of implementation effectiveness in reducing demands. Cal Water's current and proposed measures to achieve 10 percent permanent long-term savings include:

- Residential Audits
- Plumbing Retrofits
- Metering for New Development and Retrofits
- High Efficiency Washing Machine Rebates
- Public Education
- School Education
- Ultra-Low Flow Toilet Rebates
- Large Landscape Program (Evapotranspiration [ET] Controllers)

Conservation savings are anticipated to occur because of: existing conservation programs mandated by State and Federal laws that result in structural measures to reduce water use, such as State requirements for water saving devices (e.g., toilets and faucets) in new construction; the replacement over time of conventional toilets and faucets with low-flow hardware in existing households; State and local requirements for low water use irrigation systems; as well as the greater awareness and willingness on the part of customers to apply conservation measures even in non-drought years.

Permanent conservation measures result in similar water savings every year after they are implemented. After implementation of permanent structural measures, fewer conservation measures remain available for drought conservation, and they tend to be more costly. This phenomenon is called demand hardening.

Due to the high costs of implementing other local supply sources, water savings from long-term conservation measures are a key component of the recommended water supply strategy for the Bear Gulch District. The master plan scope includes a qualitative evaluation of conservation feasibility and potential yield based on available information; it does not include quantitative assessment of expected savings.

The District's UWMP outlines the proposed program for promoting water conservation to provide a 10% reduction in demand. The UWMP analysis follows procedures recommended in "BMP Costs & Savings Study" (March 2005) prepared for California Urban Water Conservation Council by A & N Technical Services Inc.

In general, once structural measures are implemented, such as retrofit of ultra low flow toilets or conversion to lower water use irrigation systems and/or landscaping, water savings become permanent (assuming adequate maintenance). Measures affecting public behavior, such as water audits and education, require periodic reinforcement to remain effective.

Review of the UWMP analysis indicates that a cost savings of $600/AF was used as the value of conserved water, which is the current cost of SFPUC supply. It is recommended that future UWMP analysis increase the cost savings per AF of conserved water to reflect the future cost of SFPUC supply, which is expected to increase to $1500/AF or more, or the cost of developing other local supplies, such as groundwater or desalination, which are even higher. This adjustment would better reflect the value of the water conservation savings, and justify greater emphasis and funding for the water conservation program.

The proposed conservation program and individual demand management measures should be reviewed regularly and adequate funding provided for implementation. Periodic evaluation of progress is needed to determine the effectiveness of the demand management measures in achieving the target goal.

Cal Water recently implemented a two-tier rate structure designed to encourage conservation. However, due to the higher per service demands in the Bear Gulch District, a third (higher) tier or surcharge for excessive use may be needed to affect the highest users in this service area, who are typically very affluent. For example, the District has some very large residential users with much higher use than typically residential customers, e.g., trout ponds and streams on residential properties. A surcharge may be appropriate for very large users, if such usage is a key factor for increased demands that require costly improvements. A third tier or surcharge would be applicable only to the Bear Gulch District, and would require internal policy decisions by Cal Water.

Other options for improving conservation practices in the Bear Gulch District include:

- Installation of irrigation-specific meters for public spaces such as schools and parks, new development, and older homes undergoing significant remodeling or rebuilding.

- Installation of ET-based irrigation controllers for large residences, parks, and schools (the Large Landscape Program BMP is specific to commercial services). Some irrigation controllers use historical and/or real-time ET data to develop an irrigation schedule suited to the particular landscape being irrigated. The real-time data comes from on-site temperature and soil moisture sensors, sunlight intensity indicators, or daily weather service data accessed through phone lines.

According to the California Department of Water Resources (DWR) Office of Water Use Efficiency (OWUE), "The advantages of using an ET controller include: reduced run-off, less damage to pavement, fences and buildings: increased health of plants from fewer diseases and insect pests and better air circulation in the soil, fewer 'soggy' or dry areas, lower water bills, and reduced energy costs. ET based controllers have been used in large turf areas such as golf courses and parks for some time. Newer models are being used and tested for use by residential customers throughout the state."

The water savings from ET-based irrigation devices has been estimated at 20-30 percent for typical users. The University of California Riverside is performing a study of the efficiency of these controllers for residential and park uses. The study objectives are, "1. Is there a real potential for water savings? 2. Do the controllers meet plant water needs? 3. What ET data is used (real time, historical or both), and 4. Is the controller suitable for use and adjustment by the average homeowner or landscape professional?"

From 2002-2004, SFPUC studied the water savings, cost savings, and benefit-cost ratios of a large variety of conservation measures. SFPUC developed a model of detailed future water demands using data for each SFPUC wholesaler, such as Cal Water. The effectiveness of any particular conservation measure varies by the characteristics of each individual wholesaler. In order to evaluate the potential market for each conservation measure, the model included the data for each wholesaler's service area, such as number and types of toilets, number and size of large landscape areas, number of hotels/motels and number of rooms, and number of coin-operated laundries. For each wholesaler, the model was able to determine water savings and cost for each conservation measure, and the benefit-cost ratios that would result for the water utility and the consumer for each individual measure.

The results of this study were published in "Journal AWWA" in February 2006, and presented a ranking of water conservation measures by annual water savings and cost-benefit ratio for an "example" wholesale customer. Recognizing that these results could be different for different wholesalers, the four highest annual water

savings measures for this "example" wholesale customer were residential ultra-low flow toilet rebates (0.50 mgd), rebates for low flow toilets (0.47 mgd), commercial water audits (0.23 mgd), and residential water surveys (0.18 mgd). The four conservation measures with the highest benefit-cost ratio were incentives for retrofitting submetering (1.7), commercial water audits (1.6), financial incentives for irrigation upgrades (1.3), and clothes washer rebates (1.2). Study results specific to the Bear Gulch District may be available from SFPUC, if requested by Cal Water.

7.5 Temporary Demand Reductions

In addition to the long-term conservation measures, Cal Water has a Water Shortage Contingency Plan that specifies temporary actions to reduce water use during drought or emergency conditions. These actions are grouped into four stages, depending on the severity of the shortage.

The anticipated maximum cutback in SFPUC supply during droughts or emergencies is up to 25 percent (with existing SFPUC supply sources), which falls between Stage 2 and Stage 3. The appropriate mix of the above temporary measures could be put in place to temporarily reduce demand if needed.

Implementing the temporary measures will require greater staff effort for monitoring and enforcement, but will not require any capital improvements. Depending on the actual reductions achieved by customers, Cal Water may need to institute more restrictive measures to achieve the required reduction, such as water use restrictions/prohibitions and penalties. Extensive public outreach efforts will be needed during the emergency period.

For a Stage 2 (20%) reduction in supply, the following actions would be undertaken:

- Aggressively continue public education and school education programs.
- Ask customers for 10 to 20 percent voluntary or mandatory water use reductions. California Public Utilities Commission (CPUC) approval must be obtained prior to implementation of mandatory reductions.
- Support passage of drought ordinances by appropriate governmental authorities.

For a Stage 3 (35%) reduction in supply, the following actions would be undertaken:

- Implement mandatory restrictions after receiving CPUC approval.
- Maintain rigorous public information campaign explaining water shortage conditions.
- Put water use restrictions into effect. Prohibited uses may include irrigating landscaping during certain hours or days of the week, watering resulting in gutter flooding, using a hose without shutoff device filling of pools or fountains, or other similar restrictions.

- Monitor weekly production for compliance with necessary reductions.
- Install flow restrictors on service line of customers who consistently exceed their allocation.

Two measures that are not currently included in the UWMP, but could be considered for future implementation if needed are:

- Institute rationing programs through fixed allotments based on percentage cutbacks.
- Implement rate changes to penalize use over allotment.

7.6 Potential Groundwater Supply

This section summarizes the key findings from the evaluation of potential groundwater supply opportunities in the Bear Gulch District. HydroFocus, as subconsultant to CDM, conducted the groundwater evaluation. Appendix F contains their complete report.

As shown on Figure 7-7, the water bearing sediments in the Bear Gulch District area are generally located northeast of approximately Alameda de las Pulgas. Beneath the Bear Gulch District, water-bearing sediment thickness generally increases to the east.

The greatest density of existing water supply wells is located within the Town of Atherton. Detailed study in the Town of Atherton measured an average discharge rate from 11 residential irrigation wells of about 30 gpm, and an average discharge rate from 6 institutional wells of about 120 gpm (Metzger and Fio, 1997). Institutional wells are generally deeper and larger than the residential wells, and would be more comparable to a municipal supply wells.

Conservative estimates developed for this master plan of current inflows and outflows in the San Francisquito Cone groundwater basin indicate approximately 1,200 to 2,400 acre-feet per year excess of recharge over pumpage (approximately 1 to 2 million mgd on an average annual basis). Since the Bear Gulch District covers about 36 percent of the basin's surface area, this suggests that about 0.36 mgd to 0.72 mgd of this groundwater on an average annual basis may potentially be available for extraction by Cal Water (about 400 AF to 800 AF per year).

Based on these preliminary estimates, there may be an opportunity to supplement the Bear Gulch District water supply with 2 to 4 production wells. It is anticipated that the average production rate would be about 120 gpm per well, similar to existing institutional wells. At an average production rate of 120 gpm per well, it is anticipated that 2 to 4 wells would provide 0.35 to 0.7 mgd of supply on an average annual basis. Figure 7-8 identifies six promising sites for future test wells. These sites were identified based on open space areas and potential willing cooperators such as parks, schools, fire stations, and other public facilities.

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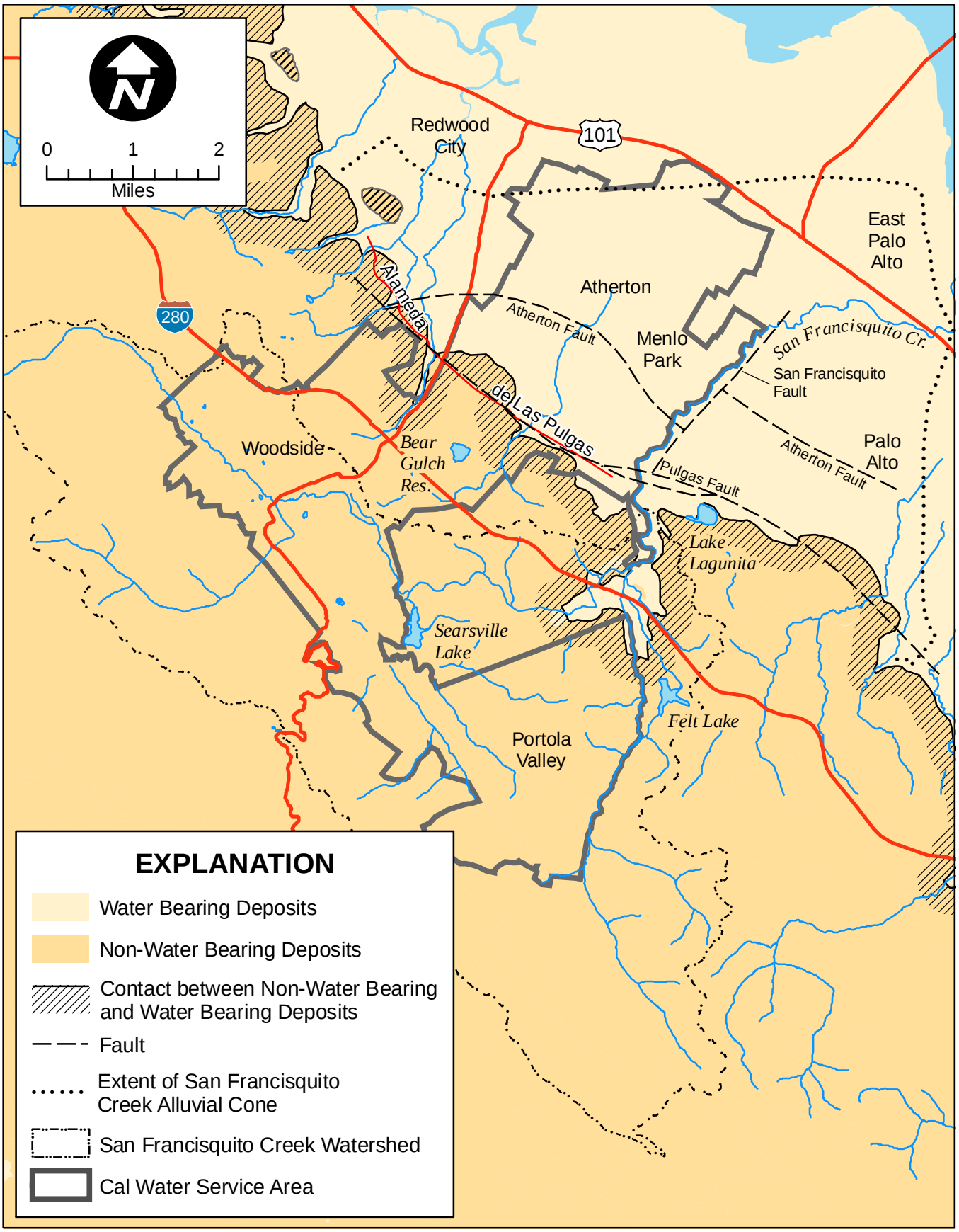

HYDROFOCUS INC. Solutions for Land and Water Resources	Distribution of Water Bearing and Non-Water Bearing Areas, San Francisquito Cone.	Figure 7-7
PROJECT: 5027	DATE: 6/13/07	

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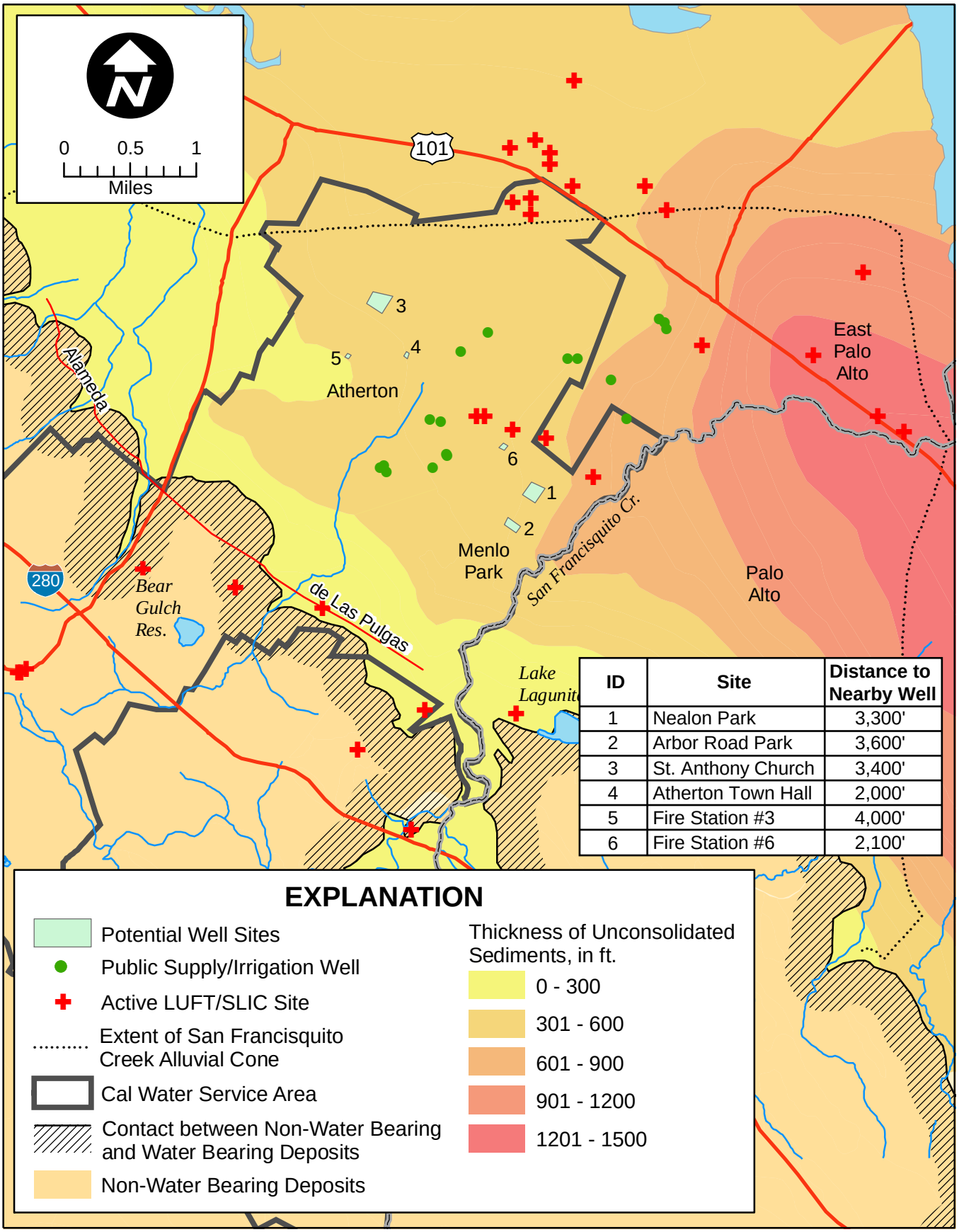

ID	Site	Distance to Nearby Well
1	Nealon Park	3,300'
2	Arbor Road Park	3,600'
3	St. Anthony Church	3,400'
4	Atherton Town Hall	2,000'
5	Fire Station #3	4,000'
6	Fire Station #6	2,100'

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Promising Sites for Potential New Water Supply Wells, Bear Gulch Service Area, San Francisquito Cone.

Figure 7-8

PROJECT: 5027

DATE: 6/12/07

The best quality groundwater is expected in wells near San Francisquito Creek and within the central portions of the Bear Gulch District. However, all the groundwater in the area is generally classified as "Very Hard". Water quality issues of the most concern for all wells, even in the better areas, include high Total Dissolved Solids (TDS) concentrations and manganese, which are likely to be above the secondary Maximum Contaminant Level. Other potential issues that occur in some wells are high chloride and sulfate concentrations.

More detailed study would be needed of the groundwater quality at specific well sites to determine whether blending with surface water would be sufficient to achieve acceptable blended water quality, or if wellhead treatment would be needed. Another option would be to convey the groundwater from individual wells to a central site for treatment and/or blending. For example, Section 8 discusses the potential conversion of an existing parallel treated water distribution pipeline in Atherton Avenue for use as a groundwater conveyance pipeline to convey water to the Bear Gulch WTP for treatment and blending. Another option, depending on the actual locations of the wells, would be to construct a centralized blending facility near the wells.

Based on preliminary assessments conducted for this master plan, there may be potential impacts on other groundwater users due to Cal Water pumping. A regional-scale steady-state groundwater flow model was utilized for a preliminary assessment of annual average volumetric water balance changes that may result from a 0.36 mgd and 0.72 mgd pumping increase. The model results indicate that additional groundwater use by Cal Water may conceivably impact groundwater conditions beneath portions of Redwood City, Menlo Park, East Palo Alto, and Palo Alto. At 0.36 mgd annual pumping rate, about 60 percent of the annual supply is derived from subsurface flow that would otherwise discharge to San Francisco Bay, and the remainder from flow that would otherwise move beneath the bay toward Alameda County. At 0.72 mgd annual pumping rate, almost all the subsurface flow that otherwise discharges to the bay is captured as well as almost 50 percent of the flow beneath the bay to Alameda County.

Analytical well functions were used to simulate changes in groundwater elevation drawdown as a result of pumping. If the pumping occurs at a constant monthly rate during the year, the maximum and annual drawdown occurs at the end of the one-year pumping cycle, with groundwater levels in the vicinity of the new wells about 30 feet lower at the end of the cycle. If the wells are operated seasonally, e.g., for six months from May to December, the maximum drawdown of more than 50 feet occurs at the end of the seasonal pumping period, and the levels recover significantly by the end of the subsequent 6-month recovery period, ending up with a residual drawdown of only about 5 feet in the vicinity of the wells.

In the Bear Gulch District, overdraft and excessive drawdown can impact all users by increasing well pumping lifts; degradation of groundwater quality by saltwater intrusion; and, land surface subsidence. Additionally, shallow groundwater

contamination by past industrial activities has occurred at sites located at the margins of San Francisco Bay, and lower groundwater levels may increase the vertical and inland movement of contaminant plumes.

Although the Town of Atherton's drainage criteria identify shallow groundwater as a construction issue in parts of Atherton, extraction of this shallow water for potential use must consider potential inland movement of bay water, the susceptibility of shallow zone groundwater to degradation by land surface activities and leaking sewer lines, and potential impacts to trees from water table drawdown resulting from pumping and consequential dewatering.

To minimize potential basin impacts from sustained pumping, wells could be used on a temporary basis for emergency supply, rather than as a normal supply source. One option may be to develop cooperative agreements with existing institutional well owners within the service area for emergency supply. As most of these wells are irrigation wells, they would have to be evaluated on a case-by-case basis to determine if it may be possible to upgrade them for emergency potable use and easily connect them to the distribution system.

Another potential option may be to install new wells at major irrigation sites currently using treated water for irrigation, if the locations and terms are favorable. The wells could provide a supplemental supply for the property owner (irrigation water at the well site possibly at a somewhat lower cost per unit in return for the well site) and also an emergency Cal Water supply assuming that the location could be easily connected into Cal Water's distribution system. This approach may facilitate access agreements with property owners, provide a small increase in annual supply (i.e., the irrigator would no longer be using Cal Water supplied water), and an emergency groundwater supply to Cal Water.

Projects providing groundwater recharge would help in supplementing sustainable groundwater supply. For example, if future recycled water supply is implemented in the Bear Gulch District, using recycled water for irrigation instead of private irrigation wells would help recharge the groundwater basin. Similarly, potential percolation basins or injection wells may enhance groundwater recharge and increase groundwater supplies.

The groundwater analyses conducted for this master plan are at a conceptual planning level. A comprehensive data collection effort can better quantify basin yield and manage water resources. Key data for improving San Francisquito Cone safe yield estimates include observed groundwater level changes in wells and estimated pumpage. Additionally, it is important to account for all major water sources entering and leaving the basin to assess the magnitude of groundwater accretion or depletion.

Figure 7-9 identifies some existing well sites that are potential candidates for groundwater level monitoring (i.e., installing water level recorders in existing wells).

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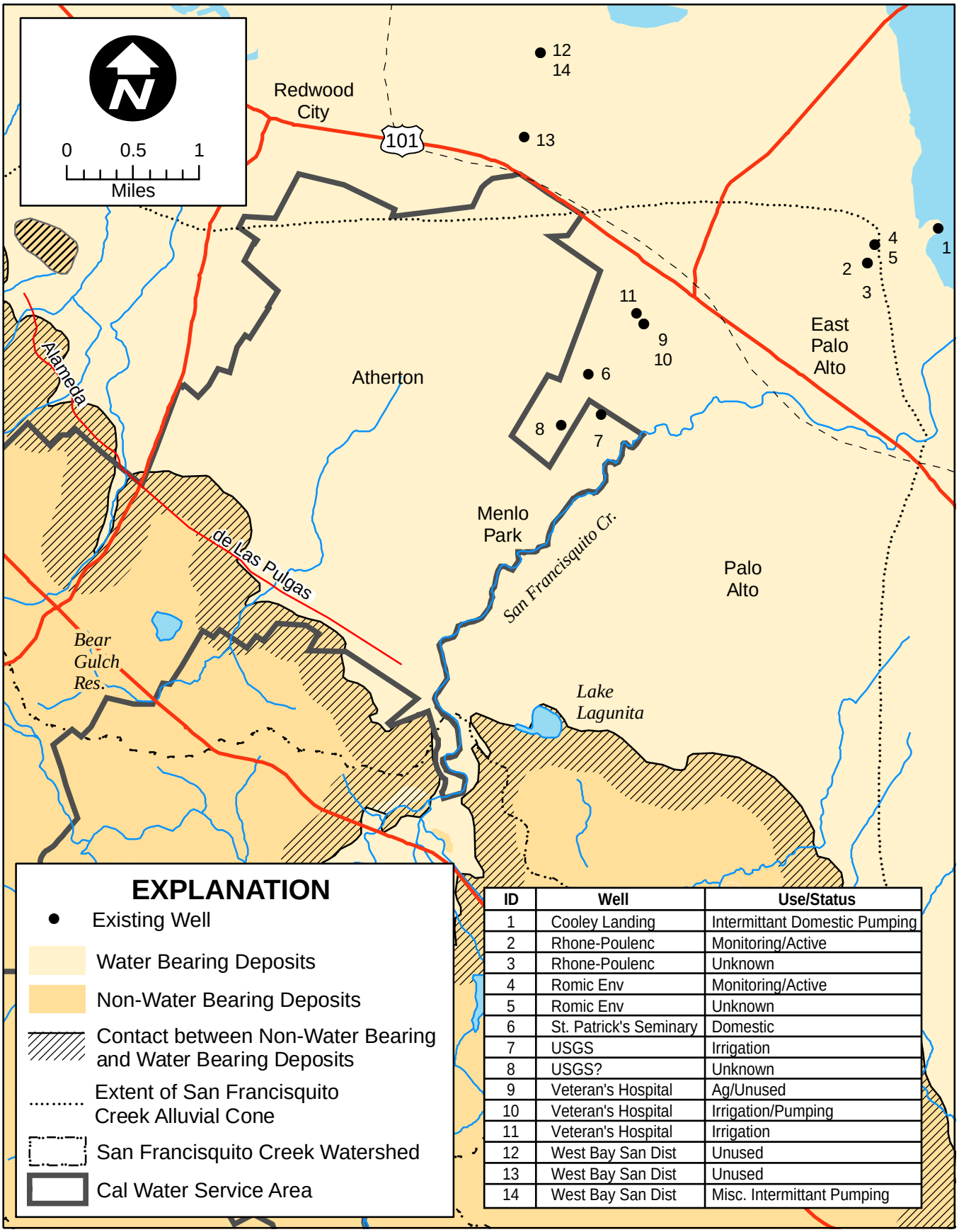

ID	Well	Use/Status
1	Cooley Landing	Intermittant Domestic Pumping
2	Rhone-Poulenc	Monitoring/Active
3	Rhone-Poulenc	Unknown
4	Romic Env	Monitoring/Active
5	Romic Env	Unknown
6	St. Patrick's Seminary	Domestic
7	USGS	Irrigation
8	USGS?	Unknown
9	Veteran's Hospital	Ag/Unused
10	Veteran's Hospital	Irrigation/Pumping
11	Veteran's Hospital	Irrigation
12	West Bay San Dist	Unused
13	West Bay San Dist	Unused
14	West Bay San Dist	Misc. Intermittant Pumping

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Potential Existing Wells for Groundwater Level Monitoring, Bear Gulch District, San Francisquito Cone.

Figure 7-9

PROJECT: 5027

DATE: 6/13/07

It is recommended that Cal Water begin collecting data as soon as possible to develop a historical database of information to help respond to future questions or concerns from other users, if wells are developed in the future.

It is anticipated that groundwater supply from new wells in the Bear Gulch District would be about $1,000 to $1,200 per AF if only disinfection is needed at the wellhead (assuming that the water quality is acceptable after blending with the surface supply). If more extensive wellhead treatment is required, such as manganese removal, the cost for groundwater supply would be on the order of $1,600 to $2,100 per AF. These estimates are based on unit costs initially developed for the South San Francisco and Mid-Peninsula supply evaluations, which have been modified to reflect Bear Gulch conditions. These costs do not include land acquisition and assume that all wells will be installed on Cal Water properties or public properties per agreement with Cal Water.

7.7 Potential Recycled Water Supply

This section presents an analysis of potential recycled water supply opportunities in the Bear Gulch District.

7.7.1 Wastewater Service in the Bear Gulch District

The Bear Gulch District serves Atherton, portions of Menlo Park, Portola Valley, Woodside, and areas of unincorporated San Mateo County (North Fair Oaks, Menlo Oaks, Sequoia Tract, West Menlo Park, Weekend Acres, Ladera, Los Trancos Woods, and Vista Verde). This area is served by two wastewater collection agencies – West Bay Sanitary District and Fair Oaks Sewer Maintenance District. Both of these agencies convey wastewater for treatment at the South Bayside System Authority (SBSA) Regional Wastewater Treatment Plant in Redwood City. Significant portions of Portola Valley and Woodside, most of Los Trancos Woods, and all of Vista Verde, are served by private septic systems.

West Bay Sanitary District

The West Bay Sanitary District (WBSD) serves all of Menlo Park within the Bear Gulch district, and portions of Cal Water's service area in Atherton, Portola Valley, Woodside, and unincorporated San Mateo County (Menlo Oaks, West Menlo Park, Weekend Acres, Ladera, and parts of Los Trancos Woods). WBSD collects wastewater flows and transports them to the South Bayside System Authority (SBSA) Regional Treatment Plant in Redwood Shores. The SBSA is jointly owned and operated by WBSD, Belmont, Redwood City, and San Carlos.

Fair Oaks Sewer Maintenance District

San Mateo County operates ten small sewer maintenance and sanitation districts. The Fair Oaks Sewer Maintenance District collects wastewater in portions of Atherton, Woodside, and the unincorporated North Fair Oaks and Sequoia Tract areas. The Fair

Oaks District contracts with Redwood City for wastewater treatment capacity at the SBSA plant.

South Bayside System Authority

The SBSA is a joint powers authority responsible for the collection, treatment, and disposal of wastewater for Belmont, Redwood City, San Carlos, and the West Bay Sanitary District. Redwood City and San Carlos contract out a portion of their treatment capacity to treat wastewater flows from nearby San Mateo County sewer maintenance and sanitation districts, including the Fair Oaks Sewer Maintenance District.

The SBSA wastewater treatment plant (WWTP) is located on the eastern end of the Redwood Shores peninsula of Redwood City. The treatment plant has an average dry weather capacity of 29 million gallons per day (mgd). Advanced two-stage biological treatment and filtration produces tertiary-level treated wastewater discharged to the San Francisco Bay near Redwood Shores.

7.7.2 Local Recycled Water Sources

There are WWTPs producing recycled water in the area surrounding the Bear Gulch District. Redwood City's recycled water project is operated from the SBSA WWTP in Redwood Shores. Palo Alto's Regional Water Quality Control Plant serves recycled water in Palo Alto and Mountain View. The locations of both facilities are shown in relation to the Bear Gulch District in Figure 7-10.

Redwood City Recycled Water Project

In 1999, SBSA and Redwood City started a pilot program to produce disinfected tertiary recycled water meeting California Department of Health Services (DHS) standards for unrestricted use (i.e., body contact, surface irrigation of food crops, etc.). Wastewater must undergo coagulation, filtration, and disinfection to meet this standard. The pilot program produced disinfected tertiary recycled water in batches from the wastewater treatment plant effluent.

The recycled water pilot plant, with a capacity of 0.25 mgd, has served customers in the Redwood Shores area. The program was intended to operate for only two years, but was extended through 2006. The pilot program supplied 14.5 mg in 2000 and increased supply to 32.7 mg per year in 2004. Landscape irrigation customers used about 30 percent of the recycled water during 2001 through 2004. The rest of the recycled water is used by SBSA for dust control and its own landscaping.

The RWQCB has permitted Redwood City and SBSA to continue producing and distributing recycled water within their current service area. If the agencies decide to serve new areas in the future, additional environmental analysis would be needed. The RWQCB permit would be amended to reflect the expanded service area.

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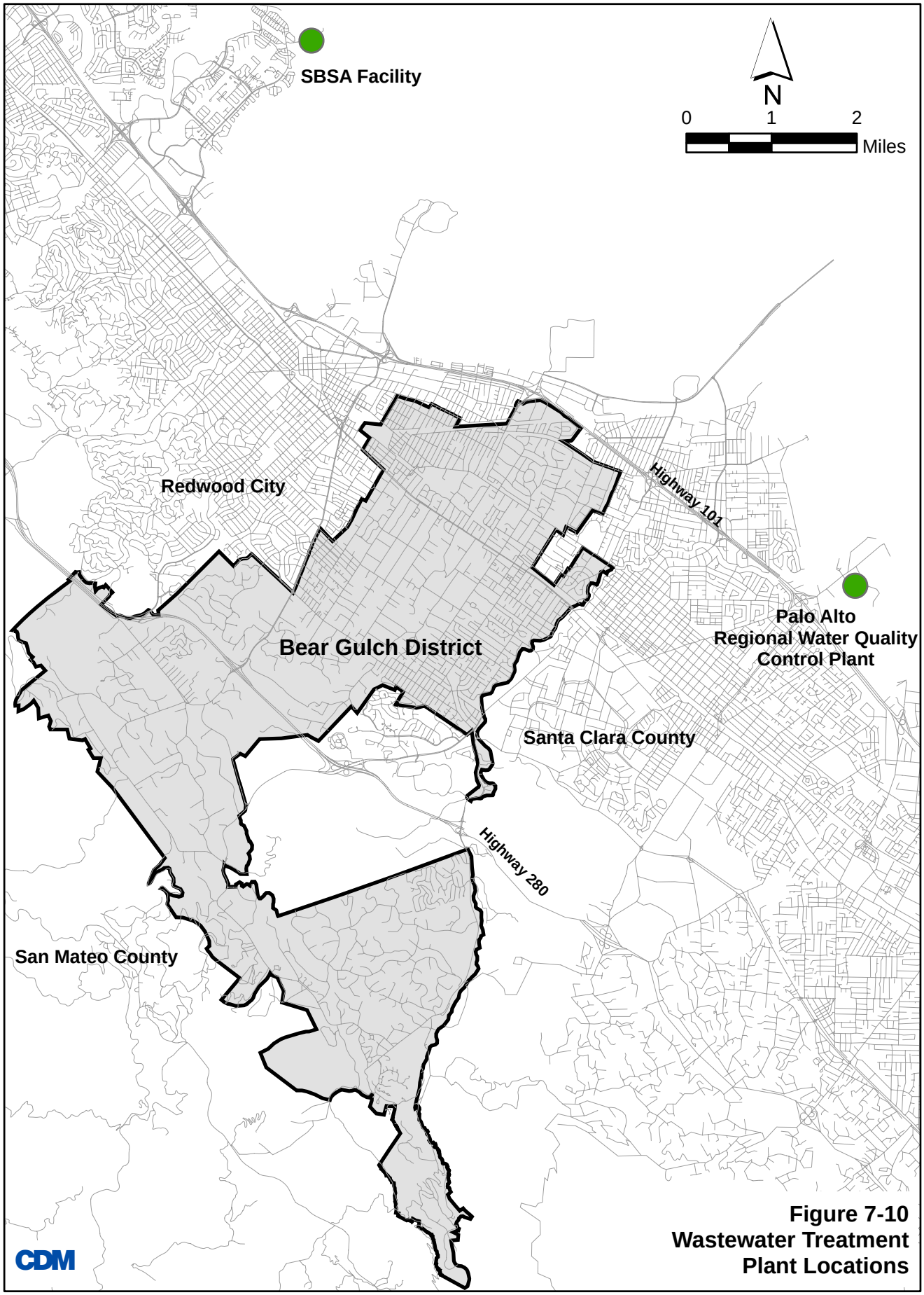

Figure 7-10
Wastewater Treatment Plant Locations

In 2003, Redwood City approved a city-wide recycled water plan for landscape irrigation, industrial uses (e.g., cooling), and certain indoor uses (e.g., toilet flushing in new developments). Additional treatment facilities are being constructed to produce disinfected tertiary recycled water for voluntary use within Redwood City.

Redwood City is participating in regional water supply planning efforts and the City's Recycled Water Project is listed in the Bay Area Integrated Regional Water Management Plan as a "Priority Near-Term Project."

Facilities for Redwood City Recycled Water Project

Figure 7-11 shows the Redwood City recycled water system and major facilities. The system will consist of the existing tertiary treatment plant, permanent treatment facilities (dual-media filters, coagulant dosing and mixing, hypochlorite dosing in chlorine contact chamber) with a capacity of 1.78 mgd, three 2.1-million gallon storage tanks at the SBSA site, a 12-mgd pump station at the SBSA site, a possible booster pump station, and distribution system piping to three service areas. The treatment plant improvements were expected to be complete in 2007.

According to Redwood City's design consultant Kennedy Jenks, the pipeline conveying water out of the SBSA facility is 30 inches in diameter. As shown in Figure 7-11, the pipeline branches to serve recycled water to both sides of Redwood Shores. The 16-inch pipeline along the northwest side of the Redwood Shores, along Marine Parkway, is complete. A 24-inch line will run along the southeast side, Redwood Shores Parkway. The 24-inch pipeline segment along Freeway 101 is complete. In the Greater Bayfront Area, a 24-inch line will run along the freeway to connect to Seaport Boulevard, which runs north.

A potential booster pump station may be located near the intersection of Bayshore Freeway 101 and Redwood Shores Parkway and would only be required when the project is ready to cross Freeway 101 or expand westward. Detailed modeling has not been performed.

Customers Identified by Redwood City

Redwood City surveyed potential customers in 2004 for their interest in participating in the recycled water project. Discussions were held with potential customers in the Redwood Shores area, the Port of Redwood City, and the Seapoint Industrial Association.

Currently, the Redwood City Recycled Water Project will serve customers only within the city limits. Redwood City is projecting 108 customers for its recycled water, with a demand of about 2,000 AFY. The estimated potable water reduction is about 1,700 AFY. Of those customers, 93 are currently served by the pilot program. The remaining 15 are future developments. According to Redwood City's 2005 UWMP, the recycled water will be used for landscape irrigation, industrial purposes, and indoor uses (e.g., toilet flushing in new commercial buildings). Redwood City is

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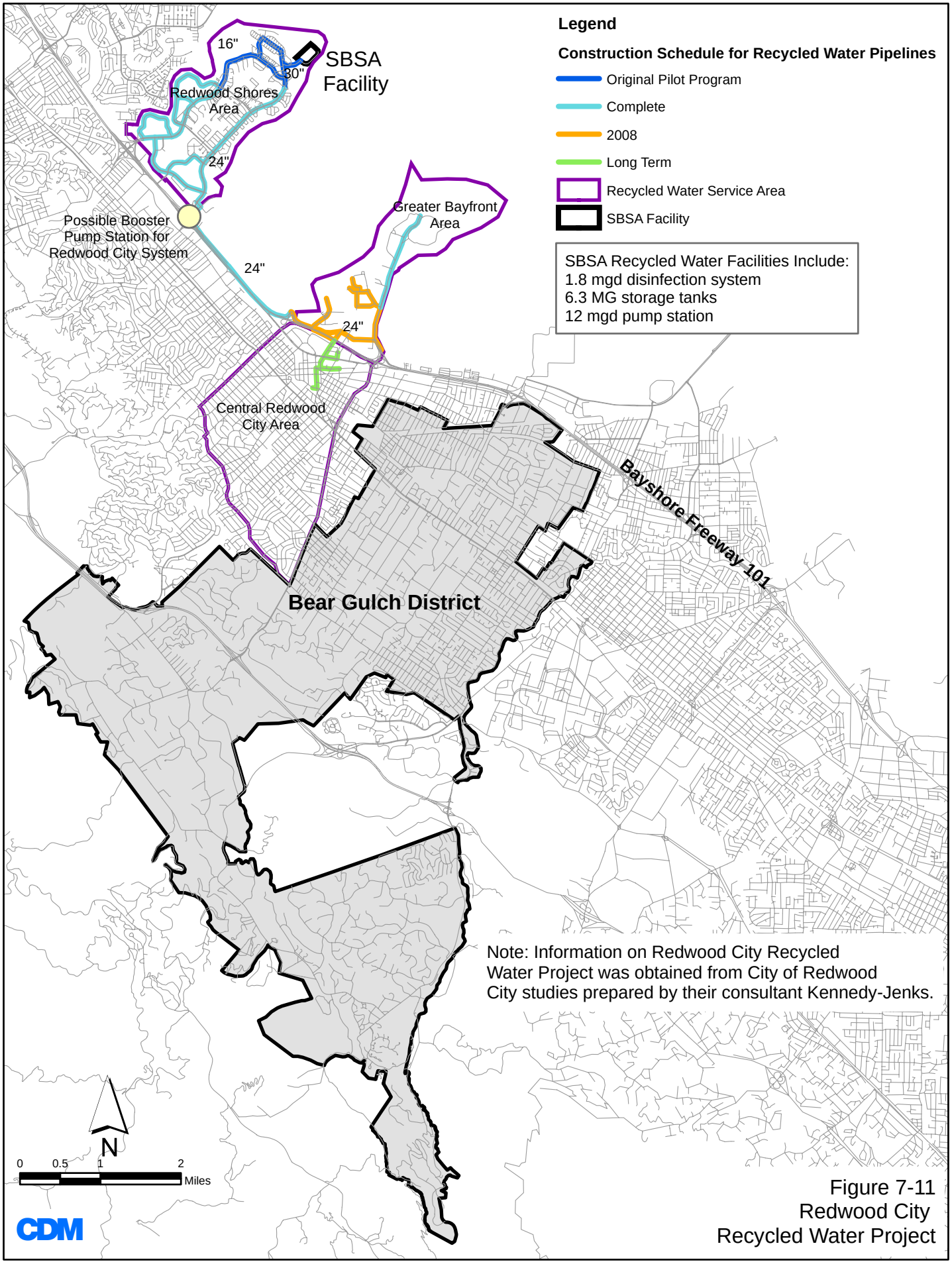

Figure 7-11
Redwood City
Recycled Water Project

currently working with commercial and landscaping customers on the design and construction of retrofits so customers can receive recycled water.

Redwood City's maximum theoretical demand for all potential customers in Redwood Shores, Greater Bayfront, and Central Redwood City was estimated to be 3,300 AFY in the initial studies. During the planning process, the size of the project was reduced because of design considerations regarding pumping to uphill customers and public concerns. Redwood City considered, but did not implement, mandated recycled water use for existing residences and homeowners' associations.

Redwood City eliminated all parks, all schools, and some homeowners' associations as potential customers due to concerns over the use of recycled water near homes and children's play areas. The only landscape irrigation customers that remained in the Redwood City project were commercial businesses, City-owned properties, Caltrans rights-of-way, and common areas of some homeowners' associations. Public concerns included:

- Potential unknown health impacts, especially to children;
- Potential negative impact on property values; and
- Citizen choice versus public mandate on infrastructure

Cal Water is discussing with Redwood City the potential for recycled water service to the Mid Peninsula District (San Carlos and San Mateo).

Projected Demand for Redwood City Recycled Water Project

Table 7-13 presents information on the projected demand, including customer categories, for recycled water in Redwood City. Average day demand refers to the average daily usage of water over a year. Maximum month average demand is the average daily demand during the maximum month of usage in summer. Peak hour maximum month demand is the peak flow during a one-hour period on the day of maximum demand.

Table 7-13
Redwood City Recycled Water Demand

	2005	2010	2015	2020	2025	2030
Projected Demand (AFY)						
Pilot Program Customers	30	30	30	30	30	30
Landscape Irrigation	0	766	866	946	1,013	1,163
Industrial Uses	0	97	133	133	133	133
Cooling	0	29	69	69	69	69
New Developments	0	0	80	220	450	600
Total (AFY)	***30***	***922***	***1,178***	***1,398***	***1,695***	***1,995***
Average Day Demand (mgd)	***0.03***	***0.82***	***1.05***	***1.25***	***1.51***	***1.78***
Maximum Month Average Demand (mgd)	***0.06***	***1.98***	***2.52***	***2.99***	***3.63***	***4.28***
Peak Hour Maximum Month Demand (mgd)	***0.17***	***5.28***	***6.74***	***7.99***	***9.70***	***11.41***

Redwood City's maximum month peaking factor is 2.4, representing the ratio of maximum month average day demand to average day demand. The peak hour peaking factor is 2.67, representing the ration of peak hour maximum month demand to the maximum month average demand. Redwood City assumes a nine-hour, overnight irrigation period.

To determine the recycled water demands, Redwood City reviewed landscape irrigation practices and historic water meter data for the potential irrigation customers. The city estimated theoretical average day irrigation water demands using the following equation based on evapotranspiration rates (ETo):

$$\text{Demand (AFY)} = \frac{(\text{ETo in inches}/12\text{ in/ft}) * (\#\text{ acres irrigated}) * (\text{Crop Coefficient}) * (\text{ETo Factor})}{\text{Overall Irrigation Efficiency Rating}}$$

Where:

1) Average annual ETo for Redwood City = 42.80 inches (from Redwood City weather station)
2) Crop Coefficient: 0.75 for cool season turf; 0.30 for low water use ornamentals
3) ETo Factor: 1.00 for average year; 1.30 for dry year; 0.70 for wet year
4) Overall Irrigation Efficiency Rating = Distribution Uniformity (70% efficient) * Landscape Management Practices Average (60% efficient)

Figure 7-12 presents the yearly demand distribution for irrigation customers based upon average ETo. The majority of irrigation demand occurs in the summer months of May through September.

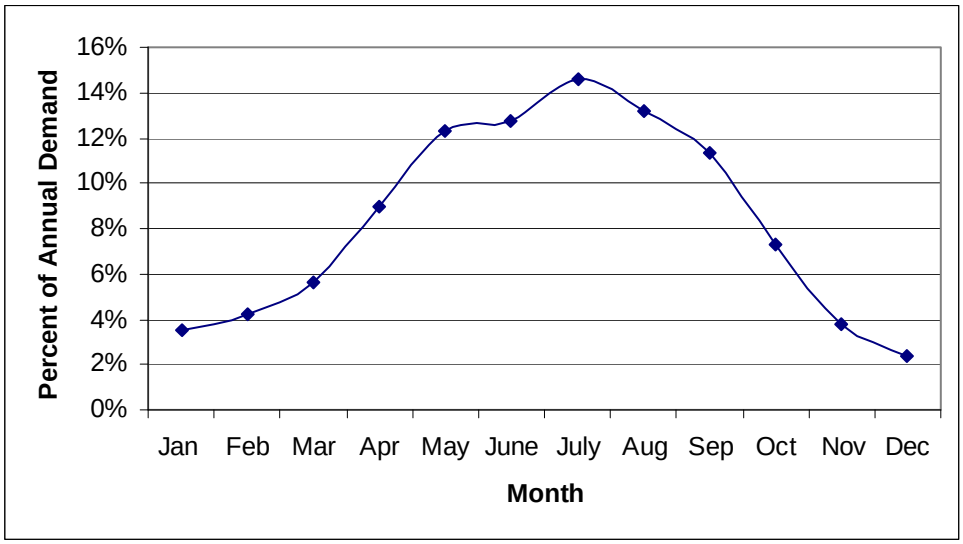

Figure 7-12
Demand Distribution for Redwood City Irrigation Users

Timing for Redwood City Recycled Water Facilities

As shown on Figure 7-11, the Redwood City recycled water distribution system is divided into three service areas: Redwood Shores; Greater Bayfront; and Central Redwood City. Construction will be completed in phases as shown on Figure 7-11. It is currently anticipated that the distribution system will be completely in place by 2009 or 2010, except for a long-term phase to serve the Central Redwood City area which has not yet been scheduled. The Central Redwood City area is the section of project closest to the Bear Gulch District.

Palo Alto Water Reuse Program

Palo Alto has produced recycled water at its Regional Water Quality Control Plant (RWQCP) since the 1980s. The RWQCP is operated by Palo Alto through a joint sewer agreement with Mountain View, Los Altos, East Palo Alto Sanitary District, Los Altos Hills, and Stanford.

Palo Alto - Current Facilities and Customers

The RWQCP, shown in Figures 7-10 and 7-13, was built in 1972 with secondary wastewater treatment. In 1978, the plant was upgraded with fixed film reactors and dual media filters to produce tertiary treated wastewater effluent. The plant's average dry weather capacity is 39 mgd, and the effluent is discharged to unnamed slough near Palo Alto Airport. Two million gallons per day of tertiary treated effluent are filtered and disinfected for the Palo Alto Water Reuse Program to meet DHS standards for unrestricted use. Storage is available for 3 MG of recycled water supply.

The Water Reuse Program currently serves three customers. As shown on Figure 7-13, the pipeline from the RWQCP goes southwest and tees with the main customer pipeline that parallels Bayshore Freeway 101. A 12-inch diameter pipe serves the Palo Alto Golf Course to the north, part of the recycled water program since 1992. A small line has served the Emily Renzel Marsh, online since 1993. A 10-inch line serves Greer Park, which first used recycled water in 1990. Additional recycled water is used at the RWQCP for landscaping and construction dust control.

Two 12-inch lines served the Shoreline Park and Golf Course in Mountain View since 1980. Service was suspended in 2001 when the pipeline condition deteriorated and started leaking.

Palo Alto - Future Facilities

Palo Alto secured state funding for the design and construction of a realigned 24-inch pipeline to serve the Shoreline Golf Course and additional customers in the Mountain View North Bayshore Area. Recycled water service will be available for the parks and businesses in the North Bayshore Area for landscape irrigation. The location of this new pipeline is shown on Figure 7-13. According to Palo Alto RWQCP staff, the projected demand in the North Bayshore Area is 1,500 AFY.

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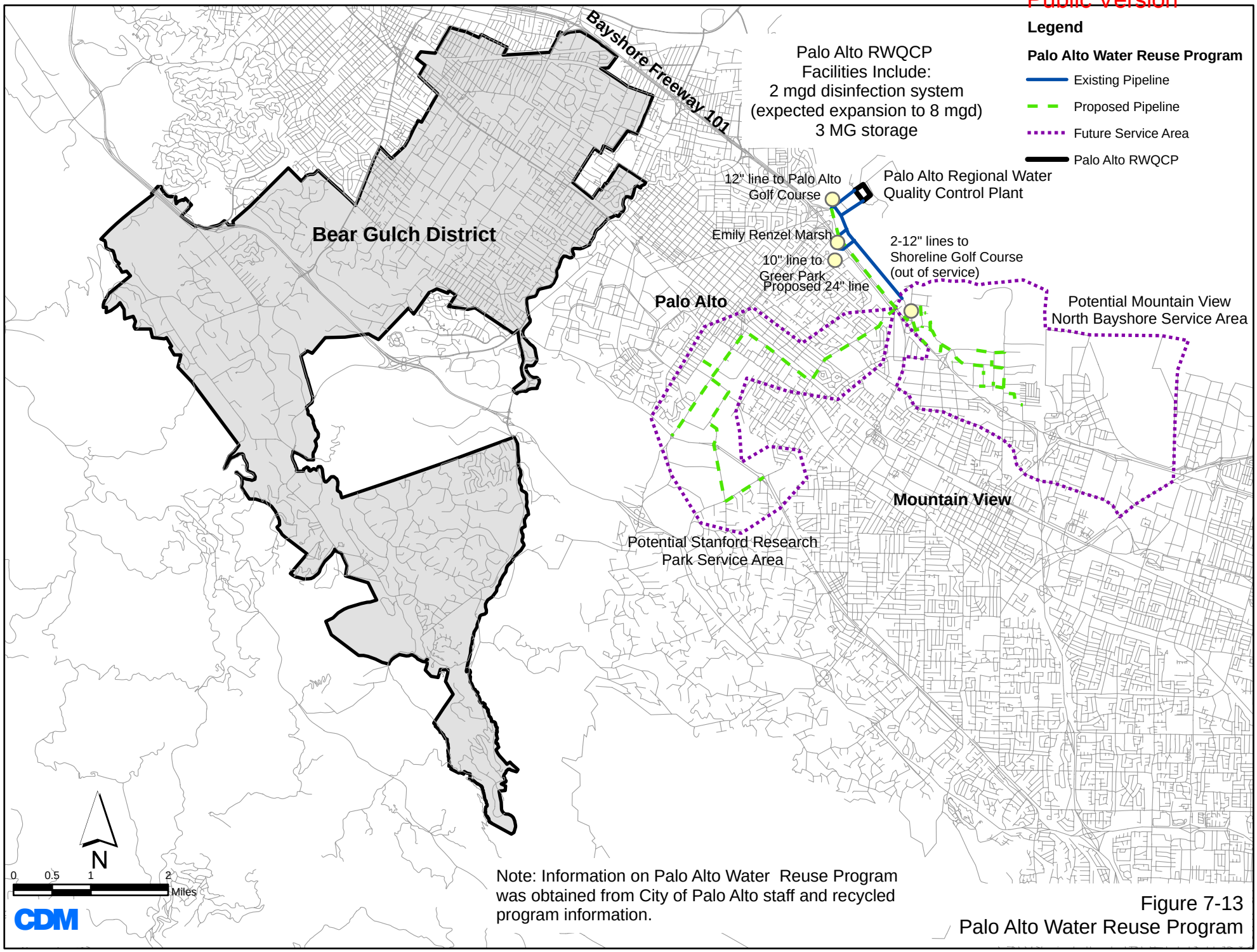

Note: Information on Palo Alto Water Reuse Program was obtained from City of Palo Alto staff and recycled program information.

Figure 7-13
Palo Alto Water Reuse Program

To serve this additional demand, the recycled water production capacity will be upgraded first to 4 mgd, and then to 8 mgd. Further expansion is possible as additional customers are identified in the future.

Palo Alto is currently planning the third phase of their recycled water program (phase 1 serves the existing customers; phase 2 is the extension to Mountain View). The phase 3 project would initially serve approximately 800 AFY of landscape irrigation demand, mostly in the Stanford Research Park Area. Future extensions could serve Stanford University and Los Altos Hills and potentially connect a loop to the new Mountain View pipeline. The project would include 6 miles of pipeline and a booster station to serve over 50 customers. The preferred pipeline alignment is shown on Figure 7-13.

Timing for Palo Alto Facilities
Construction is currently underway for the pipeline to Mountain View and is expected to be complete in December 2008. Recycled water service to the North Bayshore Area would be available in 2009. Information available on Palo Alto's web site indicated several key challenges would need to be overcome for the third phase project to move forward – project funding, cost effectiveness, and stakeholder support. Assuming those issues are addressed, the project could potentially be online by 2011.

7.7.3 Potential Recycled Water Customers in Bear Gulch District

Figure 7-14 shows the location of potential recycled water customers in the Bear Gulch District, with an identification number corresponding to Table 7-14. The potential customers were identified either by CDM, based upon the land use information developed during the master plan efforts, or by Redwood City during development of their Reclamation Master Plan in 1991. No information on potential recycled water supply/customers was publicly available from Atherton, Menlo Park, Portola Valley, Woodside, or San Mateo County.

There were seven residential and multi-family residential services within the top 20 largest users in the district. These services were removed from consideration as potential recycled water users due to their distance from potential facilities or their small demand. Four are in the upper zones in Woodside or Portola Valley, west of Highway 280. The remaining three services have an average annual demand of only 0.05 mgd.

Redwood City recognized that adjacent communities might be interested in purchasing recycled water, so the city looked into potential reclaimed water users in Atherton, Menlo Park, and Woodside as part of their Phase 2 Market Assessment in 1991. Six potential sites were identified by Redwood City within the Bear Gulch District: Menlo Country Club, Woodside High School, Jack W. Lyle Park, Nealon Park, Menlo-Atherton High School, and the El Camino Real median.

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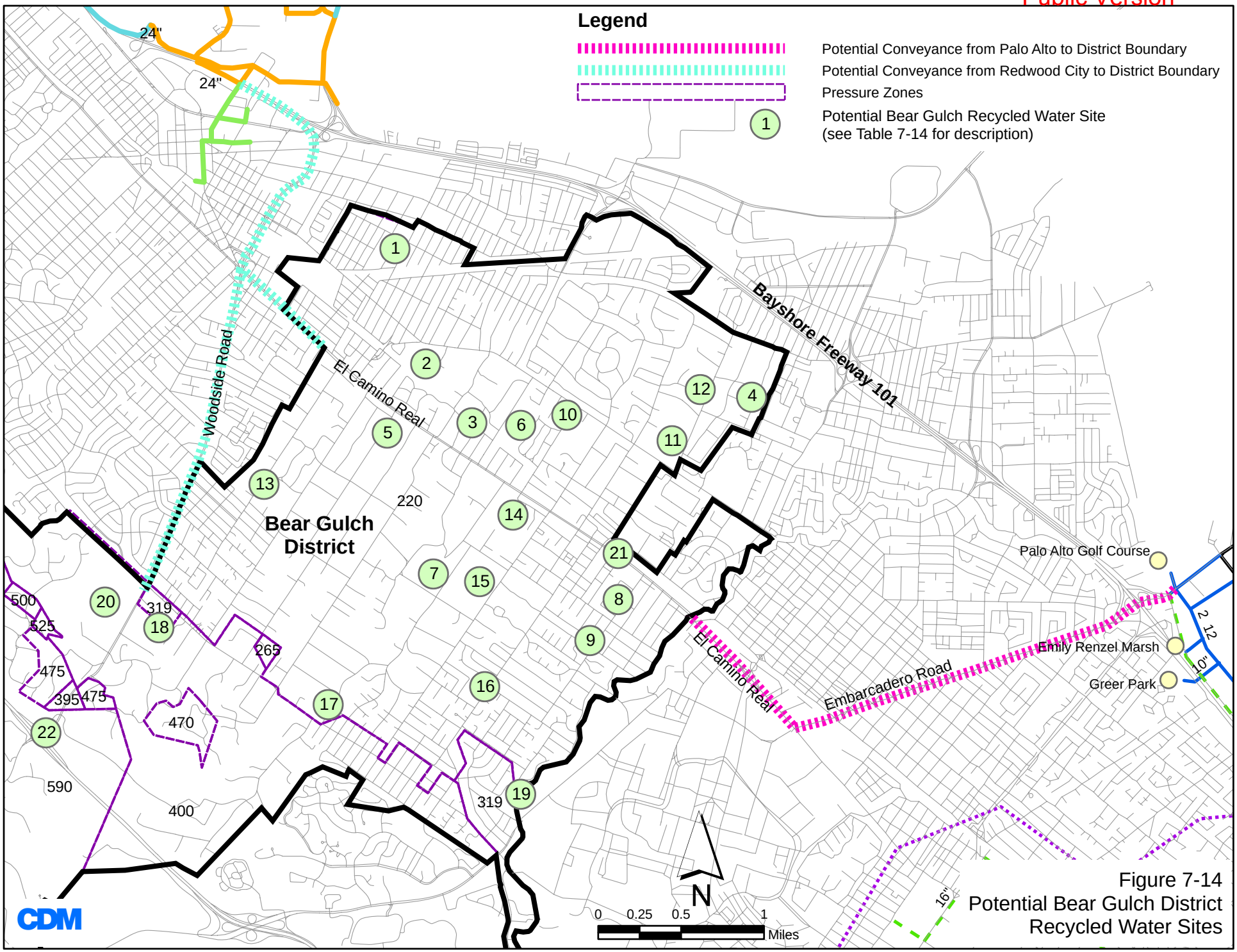

Figure 7-14
Potential Bear Gulch District
Recycled Water Sites

Table 7-14 lists potential Bear Gulch District recycled water customers and demands by customer type. The demands presented were calculated using the same methodology as was used for Redwood City customers in their more recent studies referenced above. The locations of the El Camino Real Median and Highway 280 landscaping are approximate.

Table 7-14
Potential Recycled Water Use Sites in the Bear Gulch District by Customer Category

Site ID	Site Name	Total Site Area (acres) (1)	Annual Average Demand (AFY)	Annual Average Demand (mgd)	Max Month Average Day (mgd)	Max Month Peak Hour (mgd)
Public Facility						
1	Public Facility	7.0	7.8	0.007	0.017	0.045
2	Public Facility	17.8	19.9	0.018	0.043	0.114
3	Atherton Town Hall	6.5	7.2	0.006	0.015	0.041
4	Public Facility	7.0	7.8	0.007	0.017	0.045
5	Public Facility	0.2	0.3	0.000	0.001	0.002
	Subtotal	*38.5*	*43.0*	*0.038*	*0.092*	*0.246*
Parks						
6	Holbrook Palmer Park	23.1	51.4	0.046	0.110	0.294
7	Circus Club (2)	29.2	65.1	0.058	0.139	0.372
8	Nealon Park	9.5	21.2	0.019	0.045	0.121
9	Jack W. Lyle Park	4.5	10.1	0.009	0.022	0.058
	Subtotal	*66.2*	*147.8*	*0.132*	*0.317*	*0.845*
School						
10	Encinal School	10.6	11.9	0.011	0.025	0.068
11	Menlo-Atherton High School	41.4	46.2	0.041	0.099	0.264
12	Laurel School	7.5	8.4	0.008	0.018	0.048
13	Selby School	5.6	6.3	0.006	0.013	0.036
14	Menlo College (2)	83.5	93.2	0.083	0.200	0.533
15	St. Joseph & Sacred Heart School (2)	64.4	71.9	0.064	0.154	0.411
16	Hillview School	10.3	11.5	0.010	0.025	0.066
17	Los Lomitas School	8.7	9.8	0.009	0.021	0.056
18	Woodside High School	34.6	38.6	0.034	0.083	0.221
19	Oak Knoll School	9.6	10.7	0.010	0.023	0.061
	Subtotal	*276.3*	*308.3*	*0.275*	*0.661*	*1.764*
Golf Course						
20	Menlo Country Club (2)	146.1	326.1	0.291	0.699	1.866
	Subtotal	*146.1*	*326.1*	*0.291*	*0.699*	*1.866*
Commercial						
21	El Camino Real Median (3)	5.0	11.2	0.010	0.024	0.064
22	Highway 280 Median (3)	5.0	11.2	0.010	0.024	0.064
	Subtotal	*10.0*	*22.3*	*0.020*	*0.048*	*0.128*
	GRAND TOTAL	*537.1*	*847.4*	*0.757*	*1.816*	*4.849*

(1) Total site area is for the entire site and is equal to the sum of irrigated and non-irrigated acreage.
(2) Menlo Country Club, Menlo College, Circus Club, and St. Joseph & Sacred Heart School have private springs or wells for irrigation. Incentives would be needed to switch to recycled water use.
(3) Estimated acreage for El Camion Real Median landscaping came from the 1991 Redwood City study. CDM assumed the same acreage for Highway 280 Median landscaping.

These potential customers include parks, golf courses, schools and public facilities, which typically have large irrigated areas. These are "theoretical" customers and demands that may or may not be publicly acceptable to serve. As noted earlier in this memo, Redwood City eliminated parks and schools from their project due to public concerns.

The preliminary demand estimates are based on the following preliminary assumptions regarding potential recycled water use:

- Evapotranspiration rate: 43.1 inches (based on Palo Alto ETo, from the City of Palo Alto's "Landscape Efficiency Standards for the City of Palo Alto," 2002))
- Crop Coefficient: 0.75 for cool season turf; 0.30 for low water use ornamentals
- Overall Irrigation Efficiency Rating = Distribution Uniformity (70% efficient) * Landscape Management Practices Average (60% efficient)
- Irrigated Acreage:
  - Parks: 60% of total acreage, (30% turf, 70% ornamental)
  - Golf Courses: 60% of total acreage, (30% turf, 70% ornamental)
  - Schools: 30% of total acreage, (30% turf, 70% ornamental)
  - Public Facilities: 30% of total acreage, (30% turf, 70% ornamental)

Evapotranspiration data for Woodside was also available, but this analysis uses Palo Alto data, since the majority of potential recycled water sites for Bear Gulch are located in the northeastern part of the district. The climate in this area is more similar to that of Palo Alto than to Woodside.

Table 7-15 presents the potential recycled water sites and demands in the Bear Gulch District by pressure zone. Key findings include:

- About 57 percent of the annual recycled water demand occurs in the lowest pressure zone, Zone 220. This zone may be feasible to serve from the Redwood City recycled water system, whose long-term service area is closer to the Bear Gulch District than the Palo Alto recycled water plant. More detailed investigation would be required to confirm the requirements. The recycled demand in the Zone 220 is estimated at 0.43 mgd on an average annual basis; however, these sites are spread throughout the zone and not concentrated along any single route.

- The remaining 0.33 mgd average annual demand is in Zones 319 and higher. Zone 400 accounts for about 40 percent of the demand, almost exclusively from the Menlo Country Club, the largest potential user in the district at about 326 AFY. However, Menlo Country Club (#20) uses private springs for non-potable water uses. Circus Club (#7), Menlo College (#14), and St. Joseph & Sacred Heart

School (#15) each have private wells for landscaping water use, which means incentives would be needed for them to switch to recycled water use.

- Zones 319 and 590 have only 3 percent of the demand. These areas are less feasible to serve because of their distance from either recycled water plant, which would require significantly more improvements to convey recycled water to these customers.

Table 7-15
Potential Recycled Water Use Sites in the Bear Gulch District by Pressure Zone

Site ID	Site Name	Total Site Area (acres) (1)	Annual Average Demand (AFY)	Annual Average Demand (mgd)	Max Month Average Day (mgd)	Max Month Peak Hour (mgd)
Pressure Zone 220						
1	Public Facility	7.0	7.8	0.007	0.017	0.045
3	Atherton Town Hall	6.5	7.2	0.006	0.015	0.041
4	Public Facility	7.0	7.8	0.007	0.017	0.045
5	Public Facility	0.2	0.3	0.000	0.001	0.002
6	Holbrook Palmer Park	23.1	51.4	0.046	0.110	0.294
7	Circus Club (2)	29.2	65.1	0.058	0.139	0.372
8	Nealon Park	9.5	21.2	0.019	0.045	0.121
9	Jack W. Lyle Park	4.5	10.1	0.009	0.022	0.058
10	Encinal School	10.6	11.9	0.011	0.025	0.068
11	Menlo-Atherton High School	41.4	46.2	0.041	0.099	0.264
12	Laurel School	7.5	8.4	0.008	0.018	0.048
13	Selby School	5.6	6.3	0.006	0.013	0.036
14	Menlo College	83.5	93.2	0.083	0.200	0.533
15	St. Joseph & Sacred Heart School (2)	64.4	71.9	0.064	0.154	0.411
16	Hillview School	10.3	11.5	0.010	0.025	0.066
17	Los Lomitas School	8.7	9.8	0.009	0.021	0.056
18	Woodside High School	34.6	38.6	0.034	0.083	0.221
21	El Camino Real Median	5.0	11.2	0.010	0.024	0.064
	Subtotal	*358.6*	*479.6*	*0.428*	*1.028*	*2.744*
Pressure Zone 319						
2	Public Facility	17.8	19.9	0.018	0.043	0.114
	Subtotal	*17.8*	*19.9*	*0.018*	*0.043*	*0.114*
Pressure Zone 400						
19	Oak Knoll School	9.6	10.7	0.010	0.023	0.061
20	Menlo Country Club (2)	146.1	326.1	0.291	0.699	1.866
	Subtotal	*155.7*	*336.8*	*0.301*	*0.722*	*1.927*
Pressure Zone 590						
22	Highway 280 Median	5.0	11.2	0.010	0.024	0.064
	Subtotal	*5.0*	*11.2*	*0.010*	*0.024*	*0.064*
	GRAND TOTAL	*537.1*	*847.4*	*0.757*	*1.816*	*4.849*

(1) Total site area is for the entire site and is equal to the sum of irrigated and non-irrigated acreage.
(2) Menlo Country Club, Menlo College, Circus Club, and St. Joseph & Sacred Heart School have private springs or wells for irrigation. Incentives would be needed to switch to recycled water use.

CDM also reviewed the customer usage data in the database provided by Cal Water. There were three customers identified in Revenue Class 7, which is for irrigation meters with irrigation rates. However, each customer's water use in 2004 was less than 0.3 AFY, so they were not considered in this study. For the other revenue classes (customer types), the usage data did not differentiate between domestic and irrigation use.

7.7.4 Potential Opportunities for Recycled Water Supply

The Bear Gulch District could be served by either the Redwood City Recycled Water Project or the Palo Alto Water Reuse Program. Recycled water service from either plant would require new facilities including storage, pump stations, and pipelines to convey recycled water to customers.

As shown on Figure 7-14, if Bear Gulch was served from Redwood City, a conveyance pipeline could run from the future Redwood City pipelines along a generalized conceptual alignment from Freeway 101 along Woodside Road (Route 84), and then along El Camino Real to the boundary of the Bear Gulch District at Zone 220. This potential pipeline alignment would be about 2.2 miles long.

In previous discussions with Redwood City about recycled water service (as part of the Mid-Peninsula planning effort), the Redwood City Director of Public Works indicated a long-term concept (10-15 years in the future) has been considered for their project to serve the Menlo Country Club and neighboring high schools. The Redwood City recycled water system is also the likely recycled water supplier for the Mid-Peninsula service area. Therefore, an alternative option for potential recycled water service from Redwood City to the Bear Gulch District is further discussed below.

Recycled water service from the Palo Alto RWQCP would entail a conveyance pipeline running from the plant southwest along Embarcadero Road through Palo Alto, then northwest along El Camino Real to reach the boundary of Zone 220, as shown in Figure 7-14. This potential pipeline alignment would be about 3.4 miles long (over a mile longer than the pipeline from the Redwood City system).

Palo Alto staff indicated that their Recycled Water Master Plan did consider extending service to areas such as Menlo Park and Atherton. In July 2006, Palo Alto conducted a market assessment for recycled water in their service area, identifying five potential project areas for Palo Alto's recycled water project to be expanded in the future. The study identified the University Avenue area as having the ability to expand recycled water service up the San Mateo County peninsula, if pipelines were added to serve Menlo Park and later connect to the Redwood City Recycled Water Project. If this expansion were to occur, it is likely the recycled water pipelines would cross the lower Bear Gulch District. However, the study chose a different potential service area as the project priority, and additional planning was not conducted for

service to University Avenue or Menlo Park. These communities are lower priorities for the program because of their distance from the treatment plant.

CDM did not further assess potential recycled water service from Palo Alto given the greater distance for the conveyance pipeline and low priority for potential future service to the area from the Palo Alto plant. Unless Palo Alto moves forward with greater expansion of their recycled water system to serve Stanford University, future supply from the Redwood City system appears to be the more feasible option to be considered at this time. Cal Water should continue to monitor the developments in Palo Alto's system.

In addition to potential supply from Redwood City, CDM evaluated a potential option for a satellite treatment facility located on a sewer trunk within the Bear Gulch District. District staff had asked about this as an option in order to constructing the conveyance pipeline from the Redwood City system to the District service area. This alternative option is further discussed below.

The two largest potential customers in the District are the Menlo Country Club and Menlo College. An initial system to serve these two customers would meet about half of the anticipated recycled water demand in the District, and other smaller customers could also be served if close to the alignment. However, each has its own private non-potable water supply (springs or wells), so incentives would be needed to persuade them to switch to recycled water. Cal Water could potentially benefit by either greater recharge in the local groundwater basin if these two large irrigators were not pumping groundwater, and/or by purchasing or reaching an agreement with these entities to use their wells for potable emergency supply if needed and allow their continued use for on-site irrigation when not needed for emergency use (well improvements would be needed to allow potable use).

Implementation of a recycled water project in the Bear Gulch District would likely face similar public concerns as in Redwood City on the use of recycled water at schools, parks, and near homes. Redwood City eliminated all parks, all schools, and some homeowners' associations as potential customers due to concerns over the use of recycled water near homes and children's play areas. Public concerns included: potential unknown health impacts, especially to children; potential negative impact on property values; and citizen choice versus public mandate on infrastructure.

More detailed feasibility studies would be needed subsequent to the master plan to further investigate and confirm customers that could feasibly be served, the anticipated achievable level of recycled demand considering public acceptance issues, and the corresponding infrastructure requirements and cost.

7.7.5 Alternative Options for Bear Gulch Recycled Water System

CDM evaluated two alternative options for Cal Water to serve the Bear Gulch District with recycled water. These options were developed at a conceptual planning level of detail only, consistent with the project scope. The options include:

- Option 1 – Supply from the Redwood City Recycled Water System
- Option 2 – Scalping Plant (Satellite Treatment Plant) off Existing Wastewater Trunk Line

Conceptual corridors are identified for general pipeline alignments; future siting studies will be needed to identify specific alignments. More detailed feasibility studies will be needed subsequent to the master plan to further investigate and confirm customers that could feasibly be served, the anticipated achievable level of recycled demand considering public acceptance issues, and the corresponding infrastructure sizes, requirements, and cost.

These options address service to the Cal Water service area only. If Cal Water wants to investigate the possible interest and potential customers for partnerships with other neighboring communities, such as Menlo Park, Palo Alto, and East Palo Alto, this could be done as part of a future recycled water feasibility study.

Option 1 – Supply from Redwood City Recycled Water System

As shown on Figure 7-15, Option 1 assumes that Redwood City supplies recycled water to the Bear Gulch District. The treatment plant with associated storage and pumping facilities are part of the Redwood City system. The storage at the treatment plant would accommodate the variations in irrigation demands that will differ from the wastewater flows. Cal Water would purchase the recycled supply from Redwood City.

The recycled water supply would be taken from Redwood City's 24-inch diameter line along Highway 101, at the connection of Redwood City's Central Redwood City Area and Greater Bayfront Area. This tie-in location connects to Redwood City's largest pipeline in the immediate area. It will be necessary to cross Highway 101 since the Redwood City pipeline is located on the east side of the freeway.

Option 1 includes potential alignments for recycled water distribution pipelines serving customers in the low zone (220), with one branch to the 400 zone to reach the larger customers. For the low zone (220), it may be possible to serve directly from the Redwood City system without additional pumping, although this will need to be confirmed by future hydraulic modeling analyses. However, this option includes a pump station at the connection point to the Redwood City system to allow service to the Menlo Country Club in the upper zone.

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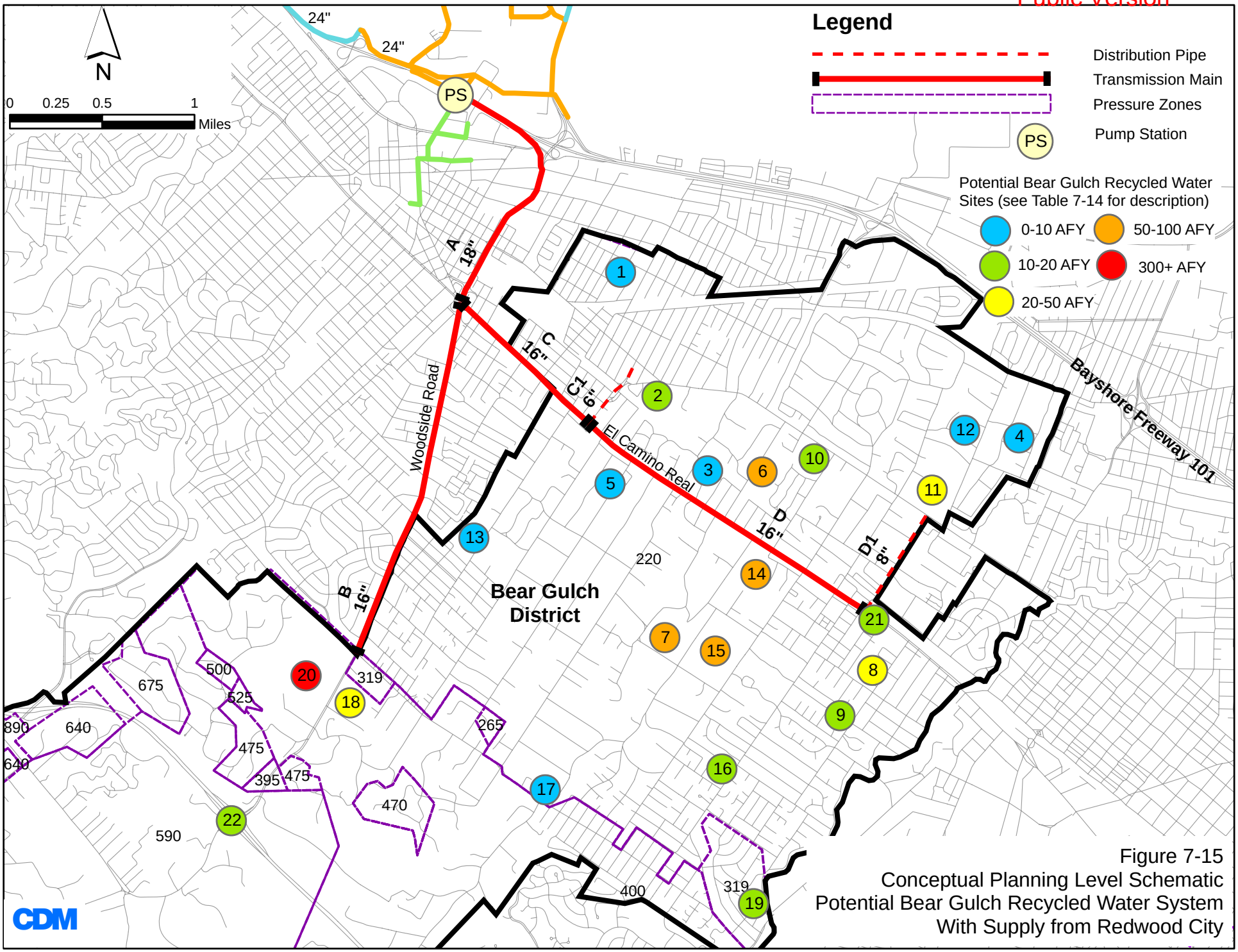

Figure 7-15
Conceptual Planning Level Schematic
Potential Bear Gulch Recycled Water System
With Supply from Redwood City

CDM

Table 7-16 presents a summary of demand and cost information for Option 1. These costs include the major recycled water facilities to bring water from the Redwood City system and distribute it to the major customer groups within the District. In addition, a preliminary estimate is included of the potential cost range for purchase of Redwood City recycled water supply, as discussed further below.

Table 7-16 includes a preliminary estimate of the potential cost to purchase recycled water supply from Redwood City based on available information from public reports. Cal Water has requested information from Redwood City regarding the anticipated purchase cost for recycled water that would be supplied from their system. However, Redwood City has not provided any information to date.

Redwood City purchases their recycled water supply from the SBSA recycled water plant at about $500 per AF. The cost of construction and operation of the Redwood City recycled water delivery system adds about $3,100 per AF to the cost. Therefore, the total cost to Redwood City is about $3,600 per AF. For this preliminary estimate, it is assumed that the purchase cost would fall somewhere between the $500 minimum to recover the SBSA purchase cost, to a maximum of $3,600 which would fully recover all the City's costs for their entire delivery and distribution system. Since Cal Water would utilize only some of the major pipelines, it is likely that a purchase price falling somewhere in that range could be negotiated. There would be benefits to Redwood City in adding wholesale customers, such as Cal Water, that would utilize excess available capacity and share the City's cost burden for the delivery system.

As indicated in Table 7-16, the unit cost for recycled water supply is very high due to the large amount of new infrastructure that will be needed and the small amount of potential demand that would be served. This is consistent with available information regarding other agencies in the area that have unit costs for recycled water ranging from about $2,000 per AF up to $6,000 per AF. As part of a future feasibility study, more detailed studies and hydraulic analysis will be needed to confirm potential customers/demands in the Bear Gulch District and to develop specific requirements and costs for all the required facility components.

Appendix G provides details on the cost, size, and length of individual pipeline segments used in preparing the Table 7-16 cost summary. The conceptual pipeline sizes were based on simple Hazen-Williams calculations to meet a desirable velocity target of 3 to 5 feet per second and desirable headloss target of less than 5 feet per 1,000 feet. Hydraulic modeling will be needed in future studies to refine these initial conceptual pipeline sizes, and identify any needed storage or pumping facilities.

Option 2 – Scalping Plant (Satellite Treatment Plant)

In Option 2, a "scalping" plant would be sited along a major wastewater trunk line in the Bear Gulch District. A scalping plant would pull raw wastewater from the sewer lines for and treat it locally at a small "satellite" treatment facility.

Table 7-16
Conceptual Planning-Level Costs for Recycled Water Pipeline System with Supply from Redwood City (1)

Annual Average Demand (AFY)	Annual Average Demand (mgd)	Max Month Peak Hour (mgd)	Capital Costs ($ Million) (1)			Annual Revenue Requirement for Facilities ($ Million) (2)	Annual Facilities Cost per AF	Annual O&M Cost per AF	Preliminary Estimate of Potential Purchase Cost Range of Redwood City Supply per AF (3)	Total Cost Per AF
			Pipelines	Pump Station	Total					
847	0.76	4.85	$11.7	$2.0	$13.7	$2.1	$2,425	$400	$500 - $3600	$3325 to $6425

(1) Appendix G provides a detailed breakdown of the demands and costs for the conceptual pipeline system (by segment and cumulative). The capital costs include construction costs plus a construction contingency and project implementation allowance.

(2) Annual revenue requirements were estimated as 15% of the total capital cost, which is Cal Water's rule of thumb for order of magnitude estimates. The 15% factor includes the authorized rate of return, the cost to borrow half the amount, and the tax liability. This represents the initial revenue requirement for project implementation. The actual revenue requirement will decrease over time due to depreciation.

(3) Cal Water has requested information from Redwood City regarding the anticipated purchase cost for recycled water that would be supplied from their system. However, Redwood City has not provided any information to date. The preliminary estimate of the potential purchase cost for recycled water supply from Redwood City is based on the available information from public reports. The City purchases the recycled water supply from the SBSA plant at about $500 per AF. The cost of construction and operation of the Redwood City recycled water delivery system adds about $3,100 per AF to the cost. Therefore, the total cost to Redwood City is about $3,600 per AF. For this preliminary estimate, it is assumed that the purchase cost would fall somewhere between the $500 minimum to recover the cost of purchase from SBSA, to a maximum of $3600 which would fully recover all their costs for their entire delivery and distribution system. Since Cal Water would utilize only some major pipelines, it is likely that a purchase price falling somewhere in that range could be negotiated. There would be benefits to Redwood City in adding wholesale customers, such as Cal Water, that would utilize excess available capacity and share the City's cost burden.

An advantage to this over Option 1 is that the supply source could be located closer to the potential large customers to avoid constructing a long conveyance pipeline. However, this option would require significant infrastructure in addition to distribution pipelines within the District. A treatment facility would have to be constructed as part of this option. In addition, equalization storage would be required at the facility, since the wastewater flows available in the sewer will not match the irrigation demands. Significant regulations and permitting requirements are applicable to construction and operation of such a treatment system.

Tertiary treatment is required for the recycled water that would be used by potential customers in the Bear Gulch District. To provide the required quality, a Membrane Bioreactor (MBR) combined with final disinfection using ultraviolet (UV) radiation would be a suitable choice for a scalping plant.

A Membrane Bioreactor (MBR) combines biological treatment of wastewater with the use of membranes for treatment of solids and liquid portions. This process produces a high quality treated effluent using a smaller footprint than a conventional treatment plant. However, it is a complex multi-step process, not a simple package unit, as described below.

Initial pretreatment steps use coarse screens to separate large suspended material from raw wastewater, then a degritter to remove grit, and finally finer screens to remove debris still present. The collected screenings are discharged back into the sewer system for further treatment elsewhere. An aeration basin is then used to stabilize the soluble and dissolved organic matter in the wastewater via biological oxidation. This produces a biomass which is separated from the effluent by the membranes in the MBR system. The membranes can be either microfiltration (MF) or ultrafiltration (UF) systems depending on the desired effluent quality, with UF providing higher quality effluent. The effluent of an ultrafiltration system has very low concentrations of suspended solids, biological oxygen demand and coliform bacteria.

The MBR process can remove a sufficient amount of turbidity and pathogens from the influent wastewater to make UV radiation a viable and cost-effective disinfection option for the final treatment process before distribution to customers. Disinfection is required where humans may be exposed to the treated effluent, such as the potential reuse customers in the Bear Gulch District.

All solids produced by the process are returned to the sewer system for conveyance to the downstream treatment plant for treatment and disposal. The treatment plant serving the sewer systems in the Bear Gulch District is the same plant that produces the recycled water for the Redwood City recycled water system.

Figure 7-16 displays the location of the major trunk lines for both the West Bay Sanitary District and the Fair Oaks Sewer Maintenance District, based on information provided by the districts. Figure 7-16 also indicates several possible conceptual

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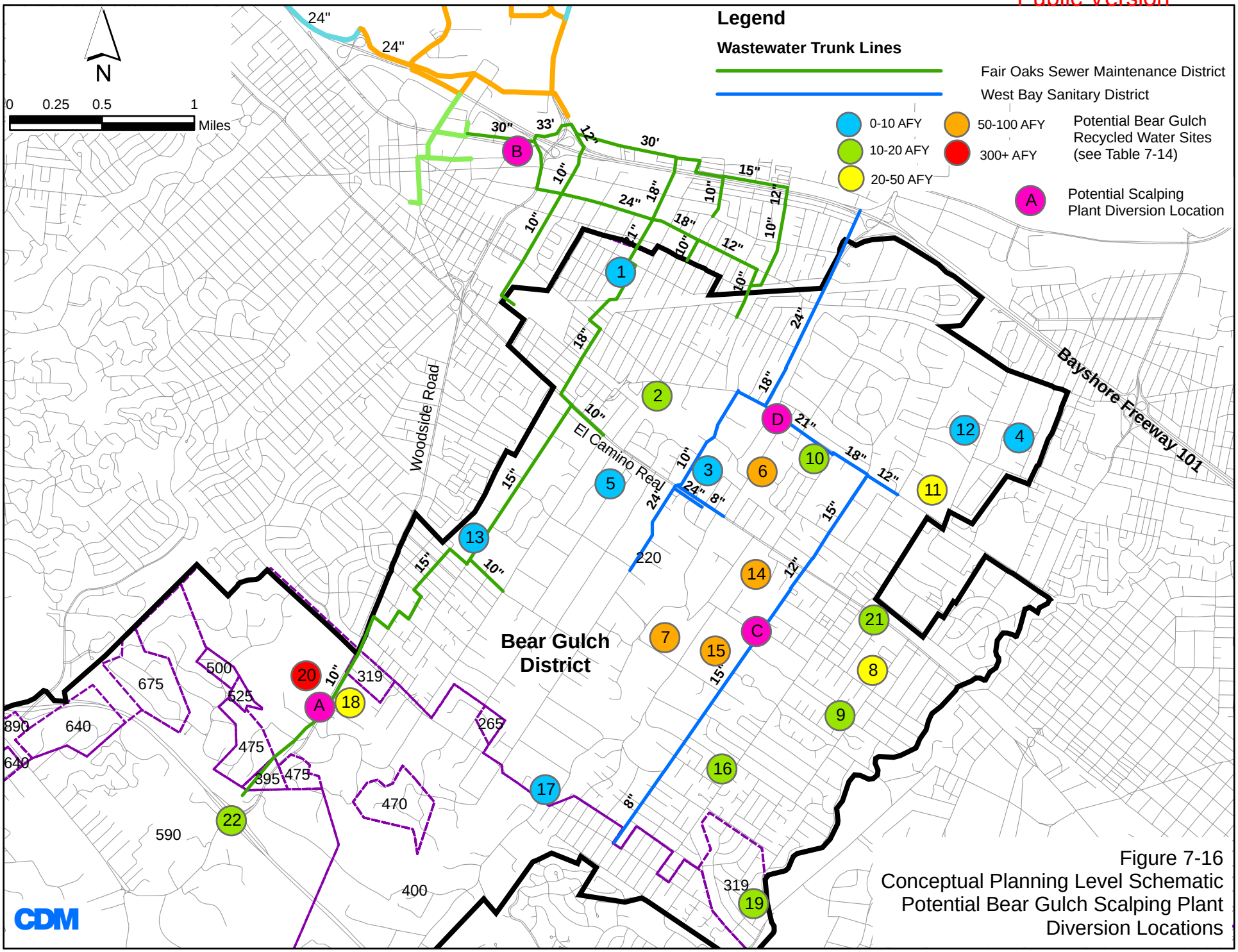

Figure 7-16
Conceptual Planning Level Schematic
Potential Bear Gulch Scalping Plant
Diversion Locations

locations to divert raw sewage to a scalping plant, based on potential locations to serve the largest groups of demands.

The scalping plant location must be carefully selected to ensure that it is close to a major sewer trunk to minimize conveyance costs. There must be an available site for the plant that is close to the diversion location. There must be adequate wastewater flow in the trunk to serve the recycled water demands. Storage would be required at the plant to accommodate the daily and seasonal variations in irrigation demands, since the demands will not match the wastewater flows.

Given the residential nature of much of the Bear Gulch District, it will be difficult for Cal Water to find a suitable location for the scalping plant that could also accommodate storage. It is likely that the only potential plant sites would be at the large parcels with a significant amount of open space, such as the Menlo Country Club or other golf courses, large schools such as Menlo College, or large parks. The larger irrigation users in the district (Menlo Country Club, Menlo College, Circus Club, and St. Joseph & Sacred Heart School) may have more space available, but they all have private irrigation supplies and would require incentives to switch to recycled water.

Sufficient flow must be available in the sewer trunk at the diversion location to meet the recycled water demands. In recycled systems used primarily for irrigation, such as the Bear Gulch District, recycled water demand is highest when wastewater flows are lowest (in the night-time hours when most irrigation occurs). Irrigation demand also has significant seasonal variations, and is highest in the summer months and neglible in the winter months. It is typically not acceptable to the sewer agency to scalp the entire wastewater flow from a trunk line. Adequate flow must be provided to prevent solids deposition. Generally, the minimum flow required for a sewer line to remain self cleansing is 2 feet per second

For each potential diversion location shown on Figure 7-16, CDM developed a preliminary conceptual estimate of the wastewater flow available using standard calculations for gravity flow systems and some general assumptions regarding typical wastewater flows.

Table 7-17 summarizes the potential irrigation demand and the preliminary estimates of potential wastewater flow at each potential diversion location. The conceptual estimate of potential wastewater flow is based on a minimum velocity of 2 fps for initial discussion purposes.

Table 7-17
Potential Scalping Plant Locations

ID	Sewer Diameter	Conceptual Estimate of Potential Wastewater Flow at 25% to 50% of Full Pipe Capacity (1)	Potential Irrigation Demand Served (peak hour)	Potential Recycled Water Sites Served
A	10”	0.2 to 0.4 mgd	1.93 mgd	18, 20
B	30”	1.6 to 3.2 mgd	4.85 mgd	All sites (or system could be designed to serve only the larger sites commensurate with the available supply)
C	15”	0.4 to 0.8 mgd	1.32 mgd	7, 14, 15
D	21”	0.8 to 1.6 mgd	0.40 mgd	3, 6, 10

(1) The conceptual estimate of potential wastewater flow is based on a minimum velocity of 2 fps. These estimates are for initial discussion purposes. Detailed information on available flows in the system would be required from the local sewer agency if Cal Water wants to further investigate this option.

Detailed information on available flows in the system would be required from the local sewer agency if Cal Water wants to further investigate this option. Additional studies, in conjunction with the local sewer agency, would be necessary to determine which trunk lines have sufficient flows to serve the recycled water project, while still maintaining adequate flows in the sewer lines.

As indicated on Table 7-17, the 10-inch and 15-inch trunk sewers (Locations A and C) are closest to some of the largest potential recycled water users. However, the potential available wastewater flows on these smaller sewers would require a significant amount of equalization storage to be able to accommodate the peak irrigation demands. Location D on a 21-inch trunk sewer appears to have adequate flow to serve the potential nearby customers; however, these customers have relatively small demand.

Location B on the 30-inch trunk sewer will have the largest wastewater flow available, since it is the largest downstream trunk sewer in the system. However, this location is very close to the potential connection point to the Redwood City recycled water system. It would be more cost effective and easier to implement a connection to the Redwood City system than to construct an independent treatment plant with associated storage and pumping facilities.

From this initial evaluation, it appears that a scalping plant option would be more difficult and costly to implement than a potential future connection to the Redwood City system. Cal Water would need to procure a location of suitable size for the plant, which would treat raw wastewater, and related structures such as equalization storage and finished water storage. There are significant regulatory and permitting requirements for siting such a plant in a dense urban area.

A preliminary conceptual estimate of the supply cost of this option, including the treatment facility and related structures as well as the recycled water distribution system, is on the order of $6,000 to $8,000 per AF. This preliminary estimate is based on the detailed feasibility study conducted for comparable alternatives in the Recycled Water Study conducted by the Cities of South San Francisco and San Bruno. In the South San Francisco Recycled Water Study, these alternatives involving satellite plants were dropped from consideration since it was one of the highest cost alternatives. The selected alternative, which was significantly lower cost, was supply from a modified existing wastewater treatment plant. If Cal Water wishes to explore the scalping (satellite) plant option further, more detailed investigation can be conducted to further refine the preliminary cost estimate.

7.8 Potential Desalination Supply

As a long-term supply option, bay water could be used as a future supply source with desalination to remove salts using a treatment process such as reverse osmosis (RO). With RO treatment, water is run at high pressures through a series of membranes that remove dissolved solids, aqueous salts, viruses, and bacteria.

Reverse osmosis unit

Figure 7-17 shows a typical desalination process schematic. Additional investigation will be needed to confirm its feasibility and costs. This component should be considered as part of Cal Water regional supply planning for its three San Mateo County peninsula service areas.

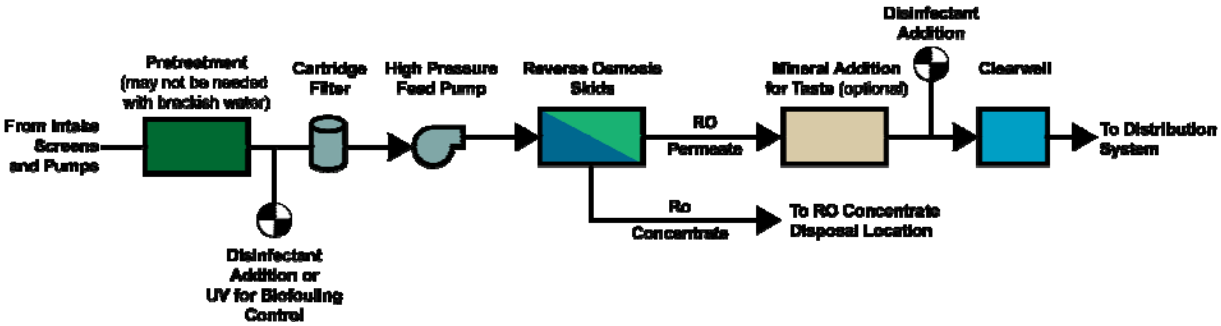

Figure 7-17
Typical Desalination Process Schematic

There are currently about 20 desalination projects proposed in California, 4 in the Bay Area, though none have entered the construction phase yet. The California Coastal Commission has approved several pilot plants, but no large facilities. Significant issues for permitting approval include fisheries impingement and entrainment in the intake piping, brine disposal, and land use changes resulting from increased water supplies.

RO package treatment facilities (skid-mounted units) are typically available in standard modular sizes of 0.5 mgd, 1.0 mgd, and 2.0 mgd capacities. With RO, water is forced through a semi-permeable membrane by pressure differential, and dissolved salts pass through the membrane due to concentration differential. The RO process can remove more than 99 percent of all dissolved minerals and organic compounds from water, as well as biological and colloidal suspended matter.

Typically about fifty percent or less of Bay water would be recovered as potable, while a higher percentage of brackish groundwater could be recovered through the same process. The specific recovery rate would depend on the quality of the source water and the design parameters of the RO processes. One or more passes may be needed through the RO membranes depending on the source water quality and the desired finished water quality. The remaining waste stream (salty brine) would require disposal.

The raw water needed for desalination could be pumped directly from the Bay, so a filtration system would be needed before the water reaches the RO unit. If brackish wells are used as source water, no filtration may be needed before the RO process depending on the salt content. Total Dissolved Solids (TDS) concentrations in well water samples are greatest near the San Francisco Bay. Most shallow Bay Plain monitoring well water samples contain TDS concentrations that range from very brackish (>10,000 mg/L) to substantially greater than seawater (>35,000 mg/L). It would be anticipated that the water quality of the brackish wells would degrade over time and become more similar to Bay water (saltier). Therefore, there may be no long-term advantages to brackish wells rather than treating Bay water. Additional detailed investigation would be needed to confirm these preliminary findings.

Post-treatment will be needed after the RO process. RO processes produce corrosive finished water because they lower the pH and remove too much calcium and alkalinity. The pH is lowered to about 5.5 to 7 during the RO process to prevent calcium carbonate from precipitating in the membrane. The acidification causes a significant amount of alkalinity to convert to carbon dioxide. Post-treatment may include:

- pH and alkalinity recovery – raising the pH will also convert carbon dioxide into alkalinity.

- Gas stripping – may be needed to remove gasses, such as hydrogen sulfide, that may cause taste and odor problems, if groundwater or other sources are used that contain them.

- Disinfection – disinfection will be required to destroy pathogenic microorganisms and provide an adequate residual in the distribution system.

The existing distribution system was evaluated to determine the most effective locations to accommodate potential future RO supply, i.e., potential locations of RO supply delivery points that would be compatible with the existing distribution system and minimize the need for distribution system improvements. This discussion is included in the Section 8 water system analysis, with respect to accommodating future supply sources.

The total annual cost for RO supply, including both capital cost recovery and O&M is estimated to be approximately $2,000 per AF for treatment of Bay water (treatment of brackish groundwater would be less). The annual cost per AF includes the following components: 1) capital cost of about $1,200 per AF (assuming Cal Water's standard assumption at 15% capital costs for the initial annual revenue requirement; this component would decrease over time due to depreciation); and 2) annual O&M cost of $800 per AF. The annual cost assumes that the water is treated to the standard level for municipal domestic consumption, and that brine disposal can be accomplished using an existing outfall line or similar method at relatively low cost.

Brine disposal must be permitted by the Regional Water Quality Control Board under a National Pollutant Discharge Elimination System permit. Brine disposal has been a difficult issue for RO projects, and sometimes a fatal flaw. Potential disposal options include: discharging through an existing outfall such as a wastewater plant outfall, direct discharge to a waterway via a new discharge outfall, injection into deep saline wells if geologic conditions are appropriate, and other options such as selling the brine to a local salt company if a willing buyer can be identified.

Another option may be to consider potential "zero-liquid-discharge" (ZLD) solutions for disposal of brine. Such technologies include mechanical evaporation or solar evaporation to reduce brine volume. Mechanical evaporation concentrates the RO waste stream from the RO process by converting the water component to condensable water vapor, leaving behind a wet salt to be disposed of at a landfill. The most common technology used for mechanical evaporation includes a vertical-tube-falling-film RO concentrate concentrator followed by a forced-circulation crystallizer. The most common form of solar evaporation is evaporation ponds. The evaporation processes are very energy intensive.

Due to the high costs of zero liquid discharge processes, the waste stream is reduced in volume prior to application of an evaporation process in order to reduce the capital and/or life cycle costs of the overall treatment system. Prior to evaporation, the waste

stream is reduced in volume using technologies such as electrodialysis reversal, vibratory shear-enhanced processing, or enhanced membrane systems.

Using "zero liquid discharge" technologies is estimated to approximately double the cost of the RO supply. With such technologies, the total annual cost would be about $4,000 per AF.

Potential future desalination (reverse osmosis [RO] supply) is a long-term supply option for the Bear Gulch District, that could be implemented in the future if determined to be cost-effective relative to the cost of other supply components. This component may be more cost-effective at a regional level for the three Cal Water San Mateo County peninsula service areas. The most cost effective location for future RO supply will be determined as part of an upcoming integrated water supply planning study for all the Cal Water San Mateo Peninsula service areas. For example, the San Mateo system and South San Francisco systems are adjacent to the Bay, which would provide an unlimited raw water supply source. In the San Mateo system, there may potentially be an option for use of the existing wastewater treatment plant outfall for brine discharge.

Raw water supply to an RO treatment system in the Bear Gulch area could be supplied from either the Bay or from brackish (poor quality) groundwater within the service area. The Bear Gulch service area does not abut the Bay. Providing raw water supply from the Bay, which is unlimited supply, would require extensive raw water supply improvements to convey the Bay water to an RO facility located within the Bear Gulch service area. Utilizing brackish or poor quality groundwater within the service area, would be a limited supply, due to potential groundwater basin impacts, and could conflict with the proposed use of better quality groundwater as another supply component.

The existing Bear Gulch distribution system could accommodate future RO supply deliveries, e.g., potential locations of RO supply delivery points that would be compatible with existing distribution system and minimize/eliminate the need for distribution system improvements. These potential locations would be on the large diameter transmission mains in zone 220 that convey supply from the SFPUC turnouts into the system. If future RO supplies were delivered to this low zone transmission grid, it would replace SFPUC supply and could be accommodated without impacting operations. Specific locations would be identified as part of more detailed feasibility and siting studies, if a future RO supply project were identified for implementation in the Bear Gulch District as an outcome of the integrated supply planning study.

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Section 8
Water System Analysis

This section describes the water system analysis conducted for the Bear Gulch District distribution system. The analysis includes: SFPUC turnout capacity evaluation; pumping capacity evaluation; storage capacity evaluation; pressure reducing valve capacity evaluation; pipeline system evaluation; supply reliability evaluation; and replacement guidelines.

The analysis is based on the Section 5 performance criteria. Section 7 describes the water supply strategy. Section 9 presents the integrated plan recommendations for water supply and distribution system improvements.

For reference, Section 4 contains Figure 4-1 showing the modeled system color-coded by pressure zone; Figure 4-2 showing a profile schematic of the system; and Figure 4-3 showing the distribution pipelines color-coded by diameter and the location of all major facilities including reservoirs, pump stations, PRVs, and turnouts.

8.1 Summary of Key Analysis Findings

Key findings from the water system analysis are summarized below for the Bear Gulch District distribution system. The remainder of this section provides a detailed discussion of each analysis component.

- **Future Demands.** There is little difference in the requirements for the existing and buildout demand scenarios due to the small future increase in demands. The average day demand at buildout for the entire Bear Gulch system is projected to increase by about 1.1 mgd over existing, which is an 8% increase. About 65 percent of the future growth will occur in Zone 220, which is the largest and lowest zone.

- **SFPUC Turnout Capacity**. There is adequate existing SFPUC turnout capacity for buildout conditions for maximum day demand, which is the performance criterion, but not peak hour demand. Per Cal Water performance criteria, storage would be used to meet the difference between maximum day and peak hour demand.

- **Pumping Capacity**. There are only small capacity deficiencies under normal operating conditions. There is a 0.49 mgd shortage of existing firm pumping capacity for buildout demands at booster pump station 13. Hydropneumatic pump stations have adequate capacity for normal operating conditions i.e., peak hour demands; except for zone 640 which can be supplied by zone 805 via PRV; however, none are able to meet the current criteria for fire flow. Pump station improvements that consider capacity, reliability, and replacement needs are discussed in Section 8.11.2, and contained in the Section 9 plan recommendations.

- **Storage Capacity**. A total of 18 MG additional storage in the Bear Gulch system is required for buildout demands to fully meet the performance criteria established in Section 5. The largest zone, 220, requires about 13 MG additional storage by buildout. The storage sub area including zones 400, 319-A and 319-B requires 2.4 MG of additional storage. There are also a few smaller zones that require a small amount of additional storage, which could be met by upsizing the tanks when they are replaced due to age/condition. Reservoir improvements that consider capacity, reliability, and replacement needs are discussed in Section 8.11.3, and contained in the Section 9 plan recommendations.

- **PRV Capacity**. Zones served solely by PRVs were evaluated. All 25 of the zones have adequate capacity for peak hour on maximum demand day. Seventeen of 25 zones do not have adequate capacity for fire flow on average hour of maximum day. PRV improvements to address these deficiencies are contained in the Section 9 plan recommendations.

- **Pipeline System**. The major issue identified in the hydraulic analysis is that some pipelines which supply Woodside Hills in the northwest part of zone 400 have high headloss that causes low pressures in the Woodside Hills area. Otherwise, the pipeline system has adequate hydraulic capacity for buildout peak hour demands under normal conditions. However, some pipeline improvements are recommended to increase system reliability, e.g., being able to serve large portions of the service area from more than one critical delivery location. Pipeline improvements that consider capacity, reliability and replacement needs are discussed in Section 8.11.4, and contained in the Section 9 plan recommendations.

- **Reliability Evaluation**. There are potential opportunities for relatively simple system modifications that would enhance supply reliability, consisting of a PRV bypass and an emergency pump at two key locations. At some key pump station locations, either on-site generators or hook-ups for portable generators are recommended. These improvements are discussed in Section 8.9, and contained in the Section 9 plan recommendations.

- **Ability to Accommodate Local Supply Options**. Improvements to fully utilize Bear Gulch water treatment plant capacity to deliver local surface water to the distribution system during low demand periods are identified in Section 8.10.1, and contained in the Section 9 plan recommendations. Potential future groundwater and desalination supply could be accommodated in the low zone and conveyed to the rest of the system with minimal improvements.

- **Replacement Guidelines**. In general, the Bear Gulch system facilities are very well maintained, although some are old with respect to typical useful life expectancies. A number of facilities are near or over their expected useful life. Replacement

recommendations for pump stations and reservoirs are discussed in Sections 8.11.2 and 8.11.3, in conjunction with capacity and reliability considerations.

8.2 Demands by Zone for Water System Analysis

Table 8-1 shows the average day, maximum day and peak hour demands by zone for existing and buildout conditions. For the Bear Gulch system as a whole, there will be about a 1.1 mgd or 8 percent increase in average day demand between existing and buildout conditions. Due to the small amount of growth between existing and buildout conditions, it was not necessary to evaluate intermediate scenarios.

As indicated in Table 8-1, future growth in demands will occur primarily in Zone 220, which is the largest and lowest zone, representing 60 percent of total demand. The second and third largest zones, 400 and 590 representing 22 percent of total demand, are expected to increase by about 10 percent. Demand in zones 660, 715 and 815 representing about 9 percent of total demand (each comprise about 3%) are expected to increase by 9 to 10 percent. Other zones are essentially built-out.

8.3 Calibrated Computer Model for Hydraulic Analyses

A computerized hydraulic model of the Bear Gulch system was developed and used for the water system analysis. The model was developed from the ArcGIS geodatabase provided by Cal Water, using H20MAP software version 7.0 by MWHSoft. H20MAP is a stand-alone GIS-based program that combines spatial analysis tools and mapping functions with a versatile hydraulic model.

The model was calibrated using hydrant test data provided by Cal Water, and verification runs were conducted for a maximum demand day and four other demand days using system data provided by Cal Water. The model calibration and verification showed that the model provides a reasonable representation of the Bear Gulch system and is a suitable planning tool for use in water system analyses to determine improvement needs, operational evaluations, and other purposes such as water quality evaluations.

Appendix H contains a detailed description of the H2OMAP hydraulic model developed for this master plan and used for the water system analysis. The appendix describes the modeled facilities and the model demand allocations, as well as the model calibration and verification.

8.4 SFPUC Turnout Capacity Evaluation

All SFPUC supplies are delivered to either zone 220 or zone 319 and then conveyed to other zones through the distribution system. The performance criterion for supply is for the turnout capacity to be equal to maximum day, average hour demand, assuming peak hour demand is met from storage.

Table 8-1
Bear Gulch System - Demands by Zone

Zone	Existing			Buildout			Comments
	Average Day Demand (mgd)	Maximum Day Demand [1] (mgd)	Peak Hour Demand [2] (mgd)	Average Day Demand (mgd)	Maximum Day Demand [1] (mgd)	Peak Hour Demand [2] (mgd)	
220	7.89	16.56	28.15	8.60	18.05	30.69	About 60% of total demand. 9% increase in demand at buildout. 65% of future growth occurs in this zone.
265	0.01	0.03	0.04	0.01	0.03	0.04	Very small zone; built out
319-A	0.05	0.11	0.18	0.05	0.11	0.18	About 2% of total demand; built out
319-B	0.18	0.38	0.65	0.18	0.38	0.65	Very small zones; built out
319-C	0.01	0.02	0.04	0.01	0.02	0.04	
395	0.01	0.02	0.03	0.01	0.02	0.03	
400	1.15	2.41	4.09	1.25	2.63	4.48	About 8% of total demand; 9% increase in demand at buildout
440	0.07	0.14	0.23	0.07	0.14	0.23	Very small zones; built out
470	0.09	0.20	0.33	0.09	0.20	0.34	
475-A	0.04	0.08	0.13	0.04	0.08	0.13	
475-B	0.04	0.07	0.13	0.04	0.08	0.13	
500	0.01	0.02	0.04	0.01	0.02	0.04	
510	0.02	0.04	0.07	0.02	0.04	0.07	
525	0.01	0.02	0.03	0.01	0.02	0.03	
560	0.02	0.04	0.06	0.02	0.04	0.06	
590	1.76	3.69	6.27	1.93	4.05	6.88	About 14% of total demand; 10% increase in demand at buildout
640	0.09	0.18	0.31	0.09	0.18	0.31	Very small zones; built out
655	0.02	0.04	0.07	0.02	0.04	0.07	
660	0.37	0.78	1.33	0.41	0.86	1.46	About 3% of total demand; 10% increase in demand at buildout
675-A	0.14	0.29	0.49	0.14	0.30	0.50	Very small zones; built out
675-B	0.03	0.07	0.11	0.03	0.07	0.11	
680	0.01	0.01	0.02	0.01	0.01	0.02	
715	0.38	0.80	1.37	0.41	0.87	1.48	About 3% of total demand; 9% increase in demand at buildout
750	0.08	0.17	0.30	0.08	0.17	0.30	Very small zones; built out
795-1	0.02	0.05	0.08	0.02	0.05	0.08	
795-2	0.00	0.00	0.00	0.00	0.00	0.00	
800	0.01	0.02	0.03	0.01	0.02	0.03	
805	0.13	0.27	0.46	0.13	0.27	0.46	
815	0.37	0.77	1.32	0.41	0.85	1.45	About 3% of total demand; 10% increase in demand at buildout
835-A	0.04	0.09	0.15	0.04	0.09	0.15	Very small zones; built out
835-B	0.00	0.00	0.00	0.00	0.00	0.00	
850	0.01	0.01	0.02	0.01	0.01	0.02	
880	0.01	0.01	0.02	0.01	0.01	0.02	
910	0.08	0.16	0.27	0.08	0.16	0.27	
960	0.06	0.13	0.22	0.06	0.13	0.22	
1025	0.06	0.13	0.22	0.06	0.13	0.22	
1055	0.02	0.05	0.08	0.02	0.05	0.08	
1090	0.03	0.06	0.10	0.03	0.06	0.10	
1265-1	0.03	0.07	0.12	0.03	0.07	0.12	
1265-2A	0.01	0.01	0.02	0.01	0.01	0.02	
1265-2B	0.01	0.02	0.03	0.01	0.02	0.03	
1265-2C	0.00	0.00	0.01	0.00	0.00	0.01	
1435	0.01	0.03	0.05	0.01	0.03	0.05	
1600	0.02	0.04	0.06	0.02	0.04	0.06	
1890	0.01	0.03	0.05	0.01	0.03	0.05	
Total	**13.38**	**28.10**	**47.77**	**14.49**	**30.42**	**51.72**	Total increase at buildout of 1.1 mgd (about 8%) over existing average day demand.

Notes: [1] Maximum day demand at 2.1 times average day demand.
[2] Peak hour demand at 1.7 times maximum day (3.57 times average day demand).

Tables 8-2A and 8-2B compare existing and buildout demands required by the supply zones with the capacities of the SFPUC turnouts supplying the system. Turnout capacity was based on standard ClaVal sizes and flow calculations. It is assumed that the meter is capable of conveying flow equal to the sum of the valve capacities at each turnout, and that all valves at each turnout are open during normal operation.

Analysis was not performed on either the SFPUC system or on standby turnouts to/from adjacent water agencies.

Key findings include:

- There is adequate existing SFPUC turnout capacity to provide maximum day (average hour) demands for the entire system under normal conditions, which is the performance criterion. Storage is used to meet peaking needs in excess of the average hour on the maximum day. In the Bear Gulch system, there is not enough turnout capacity to peak off the SFPUC system in zone 220 and upper zones served through it.

8.5 Pumping Capacity Evaluation

Tables 8-3A and 8-3B compare the existing pump station capacities with existing and buildout demands in the zones served by pump stations. Pump capacities on the tables are based on design flows from the manufacturer's performance curve for each pump. The tables show the total capacity of the existing pump stations and the firm capacity with the largest pump serving the zone out of service. If there are multiple pump stations serving an area, only one standby pump is required for the area.

For zones with gravity storage, firm pump station capacity must be sufficient to meet the maximum day demand of the zone it is pumping into plus all zones served through that zone. For zones served by hydropneumatic pump stations, pump capacity must be sufficient to meet the greater of either peak hour demand or the average hourly demand on the maximum day plus fire flow.

Key findings include:

- Of the 16 booster pump stations supplying zones, 15 pump stations have sufficient capacity to meet buildout demands.

- One booster pump station, station 13, which supplies zone 715 and the Los Trancos area, has a small deficit of 0.5 mgd at buildout.

Table 8-2A Bear Gulch
Comparison of Supplies and Zone Demand - Existing Conditions with SFPUC Supply Only [1]

Supply Delivered to Zone	Zones Included	Existing Average Day, Average Hour Demand	Existing Maximum Day, Average Hour Demand	Existing Maximum Day, Peak Hour Demand (mgd)	SFPUC Turnouts		
					SFPUC Active Turnouts [3]	Total Capacity [2] (gpm)	Total Capacity [2] (mgd)
220	220	7.89	16.56	28.15	BG-01 (6")	1800	2.6
	400	1.15	2.41	4.09	BG-01 (8")	3100	4.5
	470	0.09	0.20	0.33	BG-02 (4")	800	1.2
	265	0.01	0.03	0.04	BG-02 (6")	1800	2.6
	319-A	0.05	0.11	0.18	BG-03 (4")	800	1.2
	319-B	0.18	0.38	0.65	BG-03 (4")	800	1.2
	319-C	0.01	0.02	0.04	BG-04 (6")	1800	2.6
	590	1.76	3.69	6.27	BG-05 (6")	1800	2.6
	525	0.01	0.02	0.03	BG-05 (6")	1800	2.6
	500	0.01	0.02	0.04	BG-07 (6")	1800	2.6
	395	0.01	0.02	0.03	BG-07 (6")	1800	2.6
	475-A	0.04	0.08	0.13	BG-07 (8")	3100	4.5
	475-B	0.04	0.07	0.13			
	640	0.09	0.18	0.31			
	805	0.13	0.27	0.46			
	835-A	0.04	0.09	0.15			
	880	0.01	0.01	0.02			
	1090	0.03	0.06	0.10			
	675-A	0.14	0.29	0.49			
	795-1	0.02	0.05	0.08			
	795-2	0.00	0.00	0.00			
	800	0.01	0.02	0.03			
	1025	0.06	0.13	0.22			
	850	0.01	0.01	0.02			
	660	0.37	0.78	1.33			
	715	0.38	0.80	1.37			
	675-B	0.03	0.07	0.11			
	750	0.08	0.17	0.30			
	960	0.06	0.13	0.22			
	1055	0.02	0.05	0.08			
	1265-1	0.03	0.07	0.12			
	1265-2A	0.01	0.01	0.02			
	1265-2B	0.01	0.02	0.03			
	1265-2C	0.00	0.00	0.01			
	1435	0.01	0.03	0.05			
	1600	0.02	0.04	0.06			
	1890	0.01	0.03	0.05			
	Subtotal	**12.81**	**26.90**	**45.72**		**21200**	**30.5**
319	440	0.07	0.14	0.23	BG-06 (8")	3100	4.5
	560	0.02	0.04	0.06	BG-06 (8")	3100	4.5
	680	0.01	0.01	0.02			
	815	0.37	0.77	1.32			
	655	0.02	0.04	0.07			
	510	0.02	0.04	0.07			
	835-B	0.00	0.00	0.00			
	910	0.08	0.16	0.27			
	Subtotal	**0.57**	**1.20**	**2.04**		**6200**	**8.9**
Total		**13.38**	**28.10**	**47.77**		**27400**	**39.5**

[1] The analysis compared turnout capacity with maximum day (average hour) demand, assuming peak hour demand is met from storage.

[2] Turnout capacity was based on standard ClaVal sizes and flow calculations. It is assumed that the meter is capable of conveying flow equal to the sum of the valve capacities at each turnout, and that all valves at each turnout are open during normal operation.

[3] Standby turnouts from adjacent water agencies are not included.

Table 8-2B Bear Gulch
Comparison of Supplies and Zone Demand - Buildout Conditions with SFPUC Supply Only [1]

Supply Delivered to Zone	Zones Included	Buildout Average Day, Average Hour Demand (mgd)	Buildout Maximum Day, Average Hour Demand (mgd)	Buildout Maximum Day, Peak Hour Demand (mgd)	SFPUC Turnouts		
					SFPUC Active Turnouts [3]	Total Capacity [2] (gpm)	Total Capacity [2] (mgd)
220	220	8.60	18.05	30.69	BG-01 (6")	1800	2.6
	400	1.25	2.63	4.48	BG-01 (8")	3100	4.5
	470	0.09	0.20	0.34	BG-02 (4")	800	1.2
	265	0.01	0.03	0.04	BG-02 (6")	1800	2.6
	319-A	0.05	0.11	0.18	BG-03 (4")	800	1.2
	319-B	0.18	0.38	0.65	BG-03 (4")	800	1.2
	319-C	0.01	0.02	0.04	BG-04 (6")	1800	2.6
	590	1.93	4.05	6.88	BG-05 (6")	1800	2.6
	525	0.01	0.02	0.03	BG-05 (6")	1800	2.6
	500	0.01	0.02	0.04	BG-07 (6")	1800	2.6
	395	0.01	0.02	0.03	BG-07 (6")	1800	2.6
	475-A	0.04	0.08	0.13	BG-07 (8")	3100	4.5
	475-B	0.04	0.08	0.13			
	640	0.09	0.18	0.31			
	805	0.13	0.27	0.46			
	835-A	0.04	0.09	0.15			
	880	0.01	0.01	0.02			
	1090	0.03	0.06	0.10			
	675-A	0.14	0.30	0.50			
	795-1	0.02	0.05	0.08			
	795-2	0.00	0.00	0.00			
	800	0.01	0.02	0.03			
	1025	0.06	0.13	0.22			
	850	0.01	0.01	0.02			
	660	0.41	0.86	1.46			
	715	0.41	0.87	1.48			
	675-B	0.03	0.07	0.11			
	750	0.08	0.17	0.30			
	960	0.06	0.13	0.22			
	1055	0.02	0.05	0.08			
	1265-1	0.03	0.07	0.12			
	1265-2A	0.01	0.01	0.02			
	1265-2B	0.01	0.02	0.03			
	1265-2C	0.00	0.00	0.01			
	1435	0.01	0.03	0.05			
	1600	0.02	0.04	0.06			
	1890	0.01	0.03	0.05			
	Subtotal	**13.88**	**29.14**	**49.54**		**21200**	**30.5**
319	440	0.07	0.14	0.23	BG-06 (8")	3100	4.5
	560	0.02	0.04	0.06	BG-06 (8")	3100	4.5
	680	0.01	0.01	0.02			
	815	0.41	0.85	1.45			
	655	0.02	0.04	0.07			
	510	0.02	0.04	0.07			
	835-B	0.00	0.00	0.00			
	910	0.08	0.16	0.27			
	Subtotal	**0.61**	**1.28**	**2.18**		**6200**	**8.9**
Total		**14.49**	**30.42**	**51.72**		**27400**	**39.5**

[1] The analysis compared turnout capacity with maximum day(average hour) demand, assuming peak hour demand is met from storage.

[2] Turnout capacity was based on standard ClaVal sizes and flow calculations. It is assumed that the meter is capable of conveying flow equal to the sum of the valve capacities at each turnout, and that all valves at each turnout are open during normal operation.
[3] Standby turnouts from adjacent water agencies are not included.

Table 8-3A Bear Gulch System
Comparison of Pump Station Capacity and Existing Zone Demand

Zone Pumping Into	Zones Included	Existing Average Day, Average Hour Demand (MGD)	Existing Maximum Day, Average Hour Demand (MGD)	Existing Pump Station Capacity						Surplus or (Deficient) Capacity for Maximum Day (MGD)
				Pump(s)	Design Flow (gpm)	Firm Capacity [1] (mgd)		Total Capacity (mgd)		
						(gpm)	(MGD)	(gpm)	(MGD)	
400 and 815	400	1.15	2.41							
	470	0.09	0.20							
	319-B	0.18	0.38	PMP-004-C	1900					
	590	1.76	3.69	PMP-004-I	2000					
	675-A	0.14	0.29	PMP-004-F	2200					
	805	0.13	0.27	PMP-004-G	1500					
	660	0.37	0.78	PMP-004-H	2600					
	715	0.38	0.80	PMP-020-A	500					
	815	0.37	0.77	PMP-020-B	500					
	All Supported Zones	0.86	1.81							
	Subtotal	5.43	11.40			8600	12.38	11200	16.13	0.98
590	590	1.76	3.69	PMP-005-J	1920					
	805	0.13	0.27	PMP-005-K	1950					
	675-A	0.14	0.29	PMP-005-L	1950					
	660	0.37	0.78	PMP-005-M	1950					
	715	0.38	0.80	PMP-005-N	1950					
	815	0.37	0.77	PMP-018-A	400					
	All Supported Zones	0.85	1.79							
	Subtotal	4.00	8.39			8170	11.76	10120	14.57	3.37
660	660	0.37	0.78							
	815	0.37	0.77	PMP-008-B	400					
	680	0.01	0.01	PMP-008-C	700					
	560	0.02	0.04	PMP-008-D	1200					
	440	0.07	0.14	PMP-008-E	600					
	655	0.02	0.04	PMP-020-A	500					
	510	0.02	0.04	PMP-020-B	500					
	910	0.08	0.16							
	835-B	0.00	0.00							
	715	0.38	0.80							
	835-B	0.00	0.00							
	910	0.08	0.16							
	675-B	0.03	0.07							
	750	0.08	0.17							
	960	0.06	0.13							
	Los Trancos Zones	0.12	0.24							
	Subtotal	1.70	3.56			2700	3.89	3900	5.62	0.33
715	715	0.38	0.80							
	835-B	0.00	0.00	PMP-013-B	800					
	910	0.08	0.16	PMP-013-C	800					
	675-B	0.03	0.07							
	750	0.08	0.17							
	960	0.06	0.13							
	Los Trancos Zones	0.12	0.24							
	Subtotal	0.75	1.57			800	1.15	1600	2.30	(0.42)
795-1	795-1	0.02	0.05							
	795-2	0.00	0.00	PMP-006-A	155					
	850	0.01	0.01	PMP-006-B	250					
	1025	0.06	0.13							
	Subtotal	0.09	0.19			155	0.22	405	0.58	0.03
805[2]	640	0.09	0.18							
	805	0.13	0.27	PMP-023-A	300					
	880	0.01	0.01	PMP-023-B	300					
	Subtotal	0.22	0.46			300	0.43	600	0.86	(0.03)
815	815	0.37	0.77							
	680	0.01	0.01	PMP-014-A	300					
	560	0.02	0.04	PMP-017-A	200					
	440	0.07	0.14	PMP-020-A	500					
	655	0.02	0.04	PMP-020-B	500					
	510	0.02	0.04	PMP-021-A	700					
	910	0.08	0.16							
	835-B	0.00	0.00							
	Subtotal	0.57	1.20			1500	2.16	2200	3.17	0.96

Table 8-3A Bear Gulch System
Comparison of Pump Station Capacity and Existing Zone Demand

Zone Pumping Into	Zones Included	Existing Average Day, Average Hour Demand (MGD)	Existing Maximum Day, Average Hour Demand (MGD)	Existing Pump Station Capacity: Pump(s)	Design Flow (gpm)	Firm Capacity [1] (mgd) (gpm)	Firm Capacity [1] (mgd) (MGD)	Total Capacity (mgd) (gpm)	Total Capacity (mgd) (MGD)	Surplus or (Deficient) Capacity for Maximum Day (MGD)
835-A	835-A	0.04	0.09	PMP-024-A	200					
	1090	0.03	0.06	PMP-024-B	200					
	Subtotal	0.07	0.15			200	0.29	400	0.58	0.14
960	960	0.06	0.13	PMP-026-A	250					
	750	0.08	0.17	PMP-026-B	250					
	Subtotal	0.14	0.30			250	0.36	500	0.72	0.06
1025	795-2	0.00	0.00							
	800	0.01	0.02	PMP-007-B	250					
	850	0.01	0.01	PMP-007-C	650					
	1025	0.06	0.13							
	Subtotal	0.08	0.16			250	0.36	900	1.30	0.20
1055	1055	0.02	0.05							
	1265-1	0.03	0.07	PMP-033-A	180					
	1265-2A	0.01	0.01	PMP-033-B	165					
	1265-2B	0.01	0.02							
	1265-2C	0.00	0.00							
	1435	0.01	0.03							
	1600	0.02	0.04							
	1890	0.01	0.03							
	Subtotal	0.12	0.24			165	0.24	345	0.50	0.00
1090				PMP-025-A	200					
	1090	0.03	0.06	PMP-025-B	200	200	0.29	400	0.58	0.23
1265-1	1265-1	0.03	0.07							
	1265-2A	0.01	0.01	PMP-035-A	136					
	1265-2B	0.01	0.02	PMP-035-B	137					
	1265-2C	0.00	0.00							
	1435	0.01	0.03							
	1600	0.02	0.04							
	1890	0.01	0.03							
	Subtotal	0.09	0.19			136	0.20	273	0.39	0.00
1600	1435	0.01	0.03							
	1600	0.02	0.04	PMP-036-A	135					
	1890	0.01	0.03	PMP-036-B	140					
	Subtotal	0.04	0.09			135	0.19	275	0.40	0.10
1890	1890	0.01	0.03	PMP-038-A	75					
				PMP-038-B	75	75	0.11	150	0.22	0.08

Hydropneumatic Zones [3]

Zone Pumping Into	Zones Included	Existing Maximum Day, Peak Hour Demand (mgd)	Existing Maximum Day, Average Hour, Plus Fire Flow (mgd)	Existing Pump Station Capacity: Pump(s)	Design Flow (gpm)	firm (gpm)	Firm Capacity [1] (mgd)	total gpm	Total Capacity (mgd)	Surplus or (Deficient) Capacity for Maximum Day (mgd)
470	470	0.33	2.36	PMP-011-A	200					
				PMP-011-B	150					
	Subtotal	0.33	2.36	PMP-011-C	400	350	0.50	750	1.08	(1.85)
640[4]	640	0.31	2.34	PMP-015-A	275	0	0.00	275	0.40	(2.34)
675-A	675-A	0.49	2.45	PMP-019-A	450					
				PMP-019-B	500	450	0.65	950	1.37	(1.80)
880	880	0.02	2.17	PMP-022-A	100					
				PMP-022-B	100	100	0.14	200	0.29	(2.03)
910	910	0.27	2.32	PMP-017-B	320					
	835-B	0.00	0.00	PMP-017-C	320					
	Subtotal	0.27	2.32	PMP-027-A	350	640	0.92	990	1.43	(1.40)

[1] Firm Capacity = Capacity with largest pump excluded. If multiple pump stations serve the area, the single largest pump among all pumps is excluded.

[2] Analysis of zone 805 includes zone 640, based on the assumption that pump station 15 Woodside Knolls is not operating.

[3] Hydropnematic pump stations must be able to provide the peak hour flow and maximum day (average hour) plus fire flow. For these zones, the greater of the two demand conditions is maximum day plus fire flow.

[4] Zone 640 can be supplied by zone 805 via 2-inch PRV with a 0.30 mgd capacity. The PRV could reduce pumping capacity deficiency from 2.30 mgd to 2.00 mgd.

Table 8-3B Bear Gulch System
Comparison of Pump Station Capacity and Buildout Zone Demand

Zone Pumping Into	Zones Included	Buildout Average Day, Average Hour Demand (MGD)	Buildout Maximum Day, Average Hour Demand (MGD)	Existing Pump Station Capacity						Surplus or (Deficient) Capacity for Maximum Day (MGD)
				Pump(s)	Design Flow (gpm)	Firm Capacity [1] (mgd)		Total Capacity (mgd)		
						(gpm)	(MGD)	(gpm)	(MGD)	
400 and 815	400	1.25	2.63							
	470	0.09	0.20							
	319-B	0.18	0.38	PMP-004-C	1900					
	590	1.93	4.05	PMP-004-I	2000					
	675-A	0.14	0.30	PMP-004-F	2200					
	805	0.13	0.27	PMP-004-G	1500					
	660	0.41	0.86	PMP-004-H	2600					
	715	0.41	0.87	PMP-020-A	500					
	815	0.41	0.85	PMP-020-B	500					
	All Supported Zones	0.87	1.83							
	Subtotal	5.82	12.23			8600	12.38	11200	16.13	0.15
590	590	1.93	4.05	PMP-005-J	1920					
	805	0.13	0.27	PMP-005-K	1950					
	675-A	0.14	0.30	PMP-005-L	1950					
	660	0.41	0.86	PMP-005-M	1950					
	715	0.41	0.87	PMP-005-N	1950					
	815	0.41	0.85	PMP-018-A	400					
	All Supported Zones	0.86	1.80							
	Subtotal	4.28	8.99			8170	11.76	10120	14.57	2.77
660	660	0.41	0.86							
	815	0.41	0.85	PMP-008-B	400					
	680	0.01	0.01	PMP-008-C	700					
	560	0.02	0.04	PMP-008-D	1200					
	440	0.07	0.14	PMP-008-E	600					
	655	0.02	0.04	PMP-020-A	500					
	510	0.02	0.04	PMP-020-B	500					
	910	0.08	0.16							
	835-B	0.00	0.00							
	715	0.41	0.87							
	835-B	0.00	0.00							
	910	0.08	0.16							
	675-B	0.03	0.07							
	750	0.08	0.17							
	960	0.06	0.13							
	Los Trancos Zones	0.12	0.24							
	Subtotal	1.80	3.79			2700	3.89	3900	5.62	0.10
715	715	0.41	0.87							
	835-B	0.00	0.00	PMP-013-B	800					
	910	0.08	0.16	PMP-013-C	800					
	675-B	0.03	0.07							
	750	0.08	0.17							
	960	0.06	0.13							
	Los Trancos Zones	0.12	0.24							
	Subtotal	0.78	1.64			800	1.15	1600	2.30	(0.49)
795-1	795-1	0.02	0.05							
	795-2	0.00	0.00	PMP-006-A	155					
	850	0.01	0.01	PMP-006-B	250					
	1025	0.06	0.13							
	Subtotal	0.09	0.19			155	0.22	405	0.58	0.03
805[2]	640	0.09	0.18							
	805	0.13	0.27	PMP-023-A	300					
	880	0.01	0.01	PMP-023-B	300					
	Subtotal	0.22	0.47			300	0.43	600	0.86	(0.03)
815	815	0.41	0.85							
	680	0.01	0.01	PMP-014-A	300					
	560	0.02	0.04	PMP-017-A	200					
	440	0.07	0.14	PMP-020-A	500					
	655	0.02	0.04	PMP-020-B	500					
	510	0.02	0.04	PMP-021-A	700					
	910	0.08	0.16							
	835-B	0.00	0.00							
	Subtotal	0.61	1.28			1500	2.16	2200	3.17	0.88

Table 8-3B Bear Gulch System
Comparison of Pump Station Capacity and Buildout Zone Demand

Zone Pumping Into	Zones Included	Buildout Average Day, Average Hour Demand (MGD)	Buildout Maximum Day, Average Hour Demand (MGD)	Existing Pump Station Capacity: Pump(s)	Design Flow (gpm)	Firm Capacity [1] (mgd) (gpm)	Firm Capacity [1] (mgd) (MGD)	Total Capacity (mgd) (gpm)	Total Capacity (mgd) (MGD)	Surplus or (Deficient) Capacity for Maximum Day (MGD)
835-A	835-A	0.04	0.09	PMP-024-A	200					
	1090	0.03	0.06	PMP-024-B	200					
	Subtotal	0.07	0.15			200	0.29	400	0.58	0.14
960	960	0.06	0.13	PMP-026-A	250					
	750	0.08	0.17	PMP-026-B	250					
	Subtotal	0.14	0.30			250	0.36	500	0.72	0.06
1025	795-2	0.00	0.00							
	800	0.01	0.02	PMP-007-B	250					
	850	0.01	0.01	PMP-007-C	650					
	1025	0.06	0.13							
	Subtotal	0.08	0.16			250	0.36	900	1.30	0.20
1055	1055	0.02	0.05							
	1265-1	0.03	0.07	PMP-033-A	180					
	1265-2A	0.01	0.01	PMP-033-B	165					
	1265-2B	0.01	0.02							
	1265-2C	0.00	0.00							
	1435	0.01	0.03							
	1600	0.02	0.04							
	1890	0.01	0.03							
	Subtotal	0.12	0.24			165	0.24	345	0.50	0.00
1090				PMP-025-A	200					
	1090	0.03	0.06	PMP-025-B	200	200	0.29	400	0.58	0.23
1265-1	1265-1	0.03	0.07							
	1265-2A	0.01	0.01	PMP-035-A	136					
	1265-2B	0.01	0.02	PMP-035-B	137					
	1265-2C	0.00	0.00							
	1435	0.01	0.03							
	1600	0.02	0.04							
	1890	0.01	0.03							
	Subtotal	0.09	0.19			136	0.20	273	0.39	0.00
1600	1435	0.01	0.03							
	1600	0.02	0.04	PMP-036-A	135					
	1890	0.01	0.03	PMP-036-B	140					
	Subtotal	0.04	0.09			135	0.19	275	0.40	0.10
1890	1890	0.01	0.03	PMP-038-A	75					
				PMP-038-B	75	75	0.11	150	0.22	0.08

Hydropneumatic Zones [3]

Zone Pumping Into	Zones Included	Buildout Maximum Day, Peak Hour Demand (mgd)	Buildout Maximum Day, Average Hour, Plus Fire Flow (mgd)	Existing Pump Station Capacity: Pump(s)	Design Flow (gpm)	firm (gpm)	Firm Capacity [1] (mgd)	total gpm	Total Capacity (mgd)	Surplus or (Deficient) Capacity for Maximum Day (mgd)
470	470	0.34	2.36	PMP-011-A	200					
				PMP-011-B	150					
	Subtotal	0.34	2.36	PMP-011-C	400	350	0.50	750	1.08	(1.85)
640[4]	640	0.31	2.34	PMP-015-A	275	0	0.00	275	0.40	(2.34)
675-A	675-A	0.50	2.46	PMP-019-A	450					
				PMP-019-B	500	450	0.65	950	1.37	(1.81)
880	880	0.02	2.17	PMP-022-A	100					
				PMP-022-B	100	100	0.14	200	0.29	(2.03)
910	910	0.27	2.32	PMP-017-B	320					
	835-B	0.00	0.00	PMP-017-C	320					
	Subtotal	0.27	2.32	PMP-027-A	350	640	0.92	990	1.43	(1.40)

[1] Firm Capacity = Capacity with largest pump excluded. If multiple pump stations serve the area, the single largest pump among all pumps is excluded.

[2] Analysis of zone 805 includes zone 640, based on the assumption that pump station 15 Woodside Knolls is not operating.

[3] Hydropnematic pump stations must be able to provide the peak hour flow and maximum day (average hour) plus fire flow. For these zones, the greater of the two demand conditions is maximum day plus fire flow.

[4] Zone 640 can be supplied by zone 805 via 2-inch PRV with a 0.30 mgd capacity. The PRV could reduce pumping capacity deficiency from 2.30 mgd to 2.00 mgd.

- All three of the hydropneumatic zones in the system have adequate firm capacity for peak hour demands, but cannot provide the maximum day plus fire flow demand. The original design of these zones was not based the current fire flow criterion. Zone 640 has PRV supply from Zone 805 (2-inch PRV with maximum capacity of 0.30 mgd), which reduces capacity deficiency from 2.34 mgd to 2.04 mgd.

Options for pump station improvements are further discussed in Section 8.11.2, in conjunction with consideration of replacement needs based on age and condition. Conceptual locations for future pump station improvements are discussed at a conceptual master planning level of detail; siting studies have not been conducted as part of the master plan. The potential locations for additional pumping capacity are generally assumed to be at existing Cal Water owned pump station locations. Due to the developed nature of the Bear Gulch District, there are few potential new sites for such uses. Specific storage sites will be identified in subsequent Cal Water siting and predesign studies for project implementation.

Some agencies provide pumping and storage capacity to allow time of use pumping to reduce energy costs. In such cases, pump stations may be sized for 150 percent of the maximum day demand. This sizing allows for operating the pump station during a 16-hour period, and keeping the pumps off for 8 hours during the day (6-hour peak energy cost period plus an hour on either end as an operational cushion). With time-of-use pumping, a larger amount of reservoir storage is needed to store the water for use during the "pumps off" period, i.e., the required operational storage volume is increased by the amount that must be stored daily to make up for the period when the pumps are not operating.

The Cal Water performance criteria are not based on the designing the system with pumping and storage capacity to allow time of use pumping on the maximum day. The Cal Water criteria are based on pumping at the average daily rate on the maximum day. Evaluations for other agencies and for Cal Water have indicated it is generally not cost-effective to build new facilities solely to allow for time-of-use pumping on maximum and near-maximum days during the highest demand periods. It is typically a very long payback period before annual energy savings would recover the capital cost expenditures for new facilities sized to meet this criterion.

However, time of use pumping could be used during lower demand periods in the summer when there is available capacity at the facilities based on the master plan sizing for the average flow on the maximum day. During the winter, there is typically no significant differential in time of use electricity rates.

The District is particularly interested in time-of-use pumping at Station 4, which is their largest pump station. A conceptual evaluation was done of the pumping and

storage capacity requirements for time-of-use operation at this station, as summarized below:

Conceptual Evaluation of TOU Pumping at Station 4 [1]								
Level of Demand	***Required Pumping Capacity*** [1] ***(mgd)***				***Required Operational Storage to Support TOU (MG)*** [2]			
Pumping Duration	**24 hr**	**20 hr**	**18 hr**	**16 hr**	**24 hr**	**20 hr**	**18 hr**	**16 hr**
Available Pumping Capacity per Master Plan Criteria: 12.4 mgd								
Maximum Day (buildout at 2.1 x average day)	12.4	14.9	16.5	18.6	0	2.1	3.1	4.1
Average Monthly during Summer (July, August, September at 1.6 x average day)	9.5	11.3	12.6	14.2	0	1.6	2.4	3.1
Average Monthly during June and October (at 1.4 x average day)	8.3	9.9	11.0	12.4	0	1.4	2.0	2.8

(1) To meet the master plan pumping capacity criterion of the average hour on the maximum day will require 12.4 mgd pumping capacity to the portion of the service area served by Stations 4 and 20. The majority of the pumping capacity is at Station 4. The TOU conceptual evaluation was simplified by assuming that all pumping occurred at Station 4.

(2) This operational storage is the amount required in storage to replace the volume that would have been pumped during the "pumps off" period of TOU operation, i.e., the amount that must be available in storage and pumped out at a higher rate during the shorter duration TOU pumping period.

The existing firm pumping capacity for the area served by Station 4 is 12.4 mgd, which is adequate to meet the master plan criterion to provide pumping capacity equivalent to the average hourly on the maximum demand day (at 2.1 x average day). With this existing capacity, it would be possible to operate Station 4 on an 18 to 20-hour pumping schedule during average summer days during July, August and September (at 1.6 x average day). During hotter days when demands are closer to maximum day, pumping would exceed 20 hours per day. In order to reduce the pumping duration, pump station capacity improvements would be needed. During June and October (at 1.4 x average day), 16-hour pumping would be possible. During all other months, it would be possible to operate the pump station for fewer hours.

Assuming the existing pumping capacity, a total of 2 to 3 MG of operational storage capacity will be needed to support TOU operations during those periods when there is available excess capacity. This operational storage is the amount required in storage to replace the volume that would have been pumped during the "pumps off" period of TOU operation, i.e., the amount that must be available in storage and pumped out at a higher rate during the shorter duration TOU pumping period. For TOU pumping, the operational storage component should handle the TOU needs, without affecting emergency storage or fire reserves. In addition, the operational storage must be adequate to meet hourly fluctuations in daily demands for the demand period under consideration.

It is assumed that this storage capacity will be provided from storage located at the Station 5 site. There is existing storage capacity of 1.35 mgd in the Intermediate tanks at Station 5, where Pump Station 4 is located. This existing storage is not adequate to accommodate TOU pumping.

At buildout, a total of 3.6 mgd is needed for the storage service area served from the Intermediate tanks (0.8 MG operational, 1.6 MG emergency, 0.7 MG fire reserve). In addition, the low zone 220, which has no existing storage, needs up to 14 mgd at buildout (4.5 MG operational, 8.6 MG emergency, 0.6 MG fire reserve). It may be possible to locate some of this zone 220 storage at Station 5 and backfeed to zone 220.

The available excess operational storage for TOU after allowing for daily demand fluctuations for the will be on the order of 0.8 MG for the Intermediate tank area, and up to 3.4 MG for 220 storage if all storage for 220 is located at Station 5.

8.6 Storage Capacity Evaluation

Distribution system storage is comprised of the following three components: operational (balancing) storage, emergency supply, and fire reserves. The total recommended storage is comprised of operational storage at 25 percent of the maximum day demand, emergency storage at one average day demand, plus fire reserve. These criteria are consistent with those in Cal Water's other San Mateo Peninsula service areas. For the Bear Gulch system, the total recommended storage is about 1.9 average demand days (equivalent to about 0.9 maximum day demand).

Table 8-4A summarizes the existing storage available and the amount of storage needed for existing and buildout conditions. There is little difference in the additional storage required for existing versus buildout demands due to the small future increase in demands.

Tables 8-4B and 8-4C provide detailed breakdowns by area for existing and buildout of the average and maximum day zone demands, the required storage for each component (operational, emergency, fire), and the additional storage needed to meet the requirements.

There is little difference in the additional storage required for existing versus buildout demands due to the small future increase in demands. For long-term planning, it is assumed that operational storage is needed even for zones that are supplied directly from SFPUC turnouts. As discussed in the Section 5 performance criteria, it is assumed that SFPUC may not continue to allow peaking off its system in the long-term; therefore, operational storage should be provided to meet peaking needs.

Table 8-4A
Bear Gulch System
Storage Evaluation Summary

Service Area	Reservoir Serving Area	Existing Storage (MG)	Additional Storage Needed (MG)		Key Findings
			Existing	Buildout	
220	Lake (T-002-T1, T2)[2]	0.00	12.66	13.74	This zone requires most of the additional storage. Most SFPUC turnouts feed this zone. Potential location for additional storage is station 2, Bear Gulch Yard area.
265	None - PRV zone from 400	0.00			Zone 319-B can utilize storage from zone 400 if a connection between the two zones is made at Alameda de Las Pulgas between Helena and Nassau. About 150 ft of pipeline and a PRV would be needed. Potential location for additional storage may be station 5 if space is available.
319-A	None - supplied directly from SFPUC Alpine turnout	0.00			
319-B	None - PRV zone from 400	0.00			
319-C	None - supplied directly from SFPUC Woodside turnout	0.00			
400	Intermediate (T-005-T6, T8, T9)	1.35			
470	None - Hydropneumatic from 400	0.00			
Subtotal		1.35	1.65	1.81	
395	None - PRV zone from 475	0.00			When replacing tanks, assume upgrade with larger size. Another option to provide some of the additional storage may be to utilize surplus storage in zone 660.
475-A	None - PRV zone from 590	0.00			
475-B	None - PRV zone from 590	0.00			
500	None - PRV zone from 590	0.00			
525	None - PRV zone from 590	0.00			
590	Woodside Reservoir (T-016-T1), Ridgeway (T-019-T1, T2), Coombsville (T-006-T1)	2.23			
675-A	None - Hydropneumatic from 590	0.00			
Subtotal		2.23	1.35	1.62	
660	Ormondale (T-029-T1, T2, T3), Arrowhead (T-021-T1, T2)	2.35	0.00	0.00	Surplus storage of 1.2 MG can be back fed to zone 590 through normally closed valves at station 8.
640	Hydropneumatic from 590 at Station 15 Woodside Knolls T-015-T1	0.00			Adequate storage
805	Canada (T-022-T1)	0.45			
880	None - Hydropneumatic from 805	0.00			
Subtotal		0.45	0.06	0.07	
835-A	Woodside Oaks (T-025-T1)	0.1	0.15	0.15	Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
1090	Summit (T-031-T1)	0.15	0.07	0.07	Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
795-1	Woodside Highland (T-007-T1)	0.10	0.11	0.12	Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
800	None - PRV zone from 1025	0.00			Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
850	None - PRV zone from 1025	0.00			
1025	Wayside (T-032-T1)	0.25			
795-2	None - PRV zone from 1025	0.00			
Subtotal		0.25	0.05	0.05	
715	Alpine Hills (T-017-T1)	0.25			If connection exists between station 26 discharge and suction, surplus storage from Portola tank (zone 960) can be used to reduce storage need in zone 715/675B by 0.6 MG (reduce from 0.9 to 0.3 MG additional storage). No connection shown on station 26 drwg. Would also require 0.6 mgd increase in station 26 pumping capacity.
675-B	None - PRV zone from 715	0.00			
Subtotal		0.25	0.92	0.97	
750	None - PRV zone from 960	0.00			Portola tank has surplus storage that could potentially be used for zone 715/675B, assuming pump capacity at station 26 were increased by 0.6 MGD.
960	Portola (T-030-T1)	1.00			
Subtotal		1.00	0.00	0.00	
440	None - PRV zone from 680	0.00			Small amount of total storage required. When replacing tank, assume upgrade with larger tank.
560	None - PRV zone from 680	0.00			
680	Ladera (T-028-T1)	0.20			
Subtotal		0.20	0.48	0.48	

Table 8-4A
Bear Gulch System
Storage Evaluation Summary

Service Area	Reservoir Serving Area	Existing Storage (MG)	Additional Storage Needed (MG)		Key Findings
			Existing	Buildout	
510	None - PRV zone from 655	0.00			Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
655	None - PRV zone from 815	0.00			
815	Westridge (T-027-T1)	0.75			
835-B	None - PRV zone from 910	0.00			
910	None - Hydropneumatic from 815	0.00			
Subtotal		0.75	0.17	0.23	
1055	Los Trancos (T-033-T1), Sunrise (T-034-T1)	0.09	0.00	0.00	Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
1265-1	Bonita (T-036-T1)	0.13			Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
1265-2A	None - PRV zone from 12651	0.00			
1265-2C	None - PRV zone from 12651	0.00			
Subtotal		0.13	0.12	0.12	
1435	Old Spanish (T-037-T1)	0.06	0.00	0.00	Fire flow reserve is held in zone 1600, Vista Verde tank.
1265-2B	None - PRV zone from 1600	0.00			Very small amount of total storage required. When replacing tank, assume upgrade with larger tank.
1600	Vista Verde (T-038-T1)	0.21			
Subtotal		0.21	0.01	0.01	
1890	Pony Tracks (T-039-T1)	0.28	0.00	0.00	Adequate storage
Total		9.94	17.78	19.41	

(1) Single zones were assigned a fire reserve amount based on the highest flow required for land uses within the zones. For tanks serving an area comprised of multiple zones, fire reserves were assigned based on critical land use for the larger zones with 0.1 mgd demand or greater. Fire reserve for very small zones were aggregated. The minimum fire reserve assigned to an area was 1,500 gpm for 2 hours.

(2) When treatment plant is operating, Lake tanks (0.75 mg) are used for disinfection contact time and not available for distribution system storage.

Table 8-4B
Bear Gulch System
Breakdown of Storage Requirements for Existing Conditions

Storage Criteria: Operational storage at 0.25 times maximum day demand; Emergency storage at 1 times average day demand; plus Fire Reserve
Total Storage = 1.9 times average day demand
0.9 times maximum day demand

Service Area	Reservoir Serving Area	Existing Average Day Demand (MGD)	Existing Maximum Day Demand (MGD)	Maximum Fire Flow Requirement (gpm)[1]	Length of Fireflow (hrs)	Storage Requirements (MG)				Existing Storage (MG)	Storage Deficit (MG)	Storage Surplus (MG)	Total Additional Storage Needed (MG)
						Operational (at 25% of max day demand)	Emergency (as one average day demand)	Fire Reserve	Total Storage Needed				
220	Lake (T-002-T1, T2)[2]	7.89	16.56	3500	3	4.14	7.89	0.63	12.66	0.00	12.66	0.00	12.66
265	None - PRV zone from 400	0.01	0.03	0	0	0.01	0.01	0.00	0.02	0.00			
319-A	None - supplied directly from SFPUC Alpine turnout	0.05	0.11	0	0	0.03	0.05	0.00	0.08	0.00			
319-B	None - PRV zone from 400	0.18	0.38	1500	2	0.10	0.18	0.18	0.46	0.00			
319-C	None - supplied directly from SFPUC Woodside turnout	0.01	0.02	0	0	0.01	0.01	0.00	0.02	0.00			
400	Intermediate (T-005-T6, T8, T9)	1.15	2.41	3000	3	0.60	1.15	0.54	2.29	1.35			
470	None - Hydropneumatic from 400	0.09	0.20	0	0	0.05	0.09	0.00	0.14	0.00			
Subtotal		1.49	3.14			0.78	1.49	0.72	3.00	1.35	1.65	0.00	1.65
395	None - PRV zone from 475	0.01	0.02	0	0	0.00	0.01	0.00	0.01	0.00			
475-A	None - PRV zone from 590	0.04	0.08	0	0	0.02	0.04	0.00	0.05	0.00			
475-B	None - PRV zone from 590	0.04	0.07	0	0	0.02	0.04	0.00	0.05	0.00			
500	None - PRV zone from 590	0.01	0.02	0	0	0.01	0.01	0.00	0.02	0.00			
525	None - PRV zone from 590	0.01	0.02	0	0	0.01	0.01	0.00	0.01	0.00			
590	Woodside Reservoir (T-016-T1), Ridgeway (T-019-T1, T2), Coombsville (T-006-T1)	1.76	3.69	3000	3	0.92	1.76	0.54	3.22	2.23			
675-A	None - Hydropneumatic from 590	0.14	0.29	0	0	0.07	0.14	0.00	0.21	0.00			
Subtotal		1.99	4.19			1.05	1.99	0.54	3.58	2.23	1.35	0.00	1.35
660	Ormondale (T-029-T1, T2, T3), Arrowhead (T-021-T1, T2)	0.37	0.78	3000	3	0.20	0.37	0.54	1.11	2.35	0.00	1.24	0.00
640	Hydropneumatic from 590 (Woodside Knolls T-015-T1)	0.09	0.18	0	0	0.05	0.09	0.00	0.13	0.00			
805	Canada (T-022-T1)	0.13	0.27	1500	2	0.07	0.13	0.18	0.38	0.45			
880	None - Hydropneumatic from 805	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.00			
Subtotal		0.22	0.46			0.12	0.22	0.18	0.51	0.45	0.06	0.00	0.06
835-A	Woodside Oaks (T-025-T1)	0.04	0.09	1500	2	0.02	0.04	0.18	0.25	0.1	0.15	0.00	0.15
1090	Summit (T-031-T1)	0.03	0.06	1500	2	0.01	0.03	0.18	0.22	0.15	0.07	0.00	0.07
795-1	Woodside Highland (T-007-T1)	0.02	0.05	1500	2	0.01	0.02	0.18	0.21	0.10	0.11	0.00	0.11
800	None - PRV zone from 1025	0.01	0.02	0	0	0.00	0.01	0.00	0.01	0.00			
850	None - PRV zone from 1025	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.00			
1025	Wayside (T-032-T1)	0.06	0.13	1500	2	0.03	0.06	0.18	0.28	0.25			
795-2	None - PRV zone from 1025	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00			
Subtotal		0.08	0.16			0.04	0.08	0.18	0.30	0.25	0.05	0.00	0.05
715	Alpine Hills (T-017-T1)	0.38	0.80	3000	3	0.20	0.38	0.54	1.12	0.25			
675-B	None - PRV zone from 715	0.03	0.07	0	0	0.02	0.03	0.00	0.05	0.00			
Subtotal		0.41	0.87			0.22	0.41	0.54	1.17	0.25	0.92	0.00	0.92

Table 8-4B
Bear Gulch System
Breakdown of Storage Requirements for Existing Conditions

Storage Criteria: Operational storage at 0.25 times maximum day demand; Emergency storage at 1 times average day demand; plus Fire Reserve
Total Storage = 1.9 times average day demand
0.9 times maximum day demand

Service Area	Reservoir Serving Area	Existing Average Day Demand (MGD)	Existing Maximum Day Demand (MGD)	Maximum Fire Flow Requirement (gpm)(1)	Length of Fireflow (hrs)	Storage Requirements (MG)				Existing Storage (MG)	Storage Deficit (MG)	Storage Surplus (MG)	Total Additional Storage Needed (MG)
						Operational (at 25% of max day demand)	Emergency (as one average day demand)	Fire Reserve	Total Storage Needed				
750	None - PRV zone from 960	0.08	0.17	0	2	0.04	0.08	0.00	0.13	0.00			
960	Portola (T-030-T1)	0.06	0.13	1500	2	0.03	0.06	0.18	0.27	1.00			
Subtotal		0.14	0.30			0.08	0.14	0.18	0.40	1.00	0.00	0.60	0.00
440	None - PRV zone from 680	0.07	0.14	3000	3	0.03	0.07	0.54	0.64	0.00			
560	None - PRV zone from 680	0.02	0.04	0	0	0.01	0.02	0.00	0.03	0.00			
680	Ladera (T-028-T1)	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.20			
Subtotal		0.09	0.19			0.05	0.09	0.54	0.68	0.20	0.48	0.00	0.48
510	None - PRV zone from 655	0.02	0.04	0	0	0.01	0.02	0.00	0.03	0.00			
655	None - PRV zone from 815	0.02	0.04	0	0	0.01	0.02	0.00	0.03	0.00			
815	Westridge (T-027-T1)	0.37	0.77	1500	2	0.19	0.37	0.18	0.74	0.75			
835-B	None - PRV zone from 910	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00			
910	None - Hydropneumatic from 815	0.08	0.16	0	0	0.04	0.08	0.00	0.12	0.00			
Subtotal		0.48	1.02			0.25	0.48	0.18	0.92	0.75	0.17	0.00	0.17
1055	Los Trancos (T-033-T1), Sunrise (T-034-T1)	0.02	0.05	0	0	0.01	0.02	0.00	0.04	0.09	0.00	0.05	0.00
1265-1	Bonita (T-036-T1)	0.03	0.07	1500	2	0.02	0.03	0.18	0.23	0.13			
1265-2A	None - PRV zone from 12651	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.00			
1265-2C	None - PRV zone from 12651	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00			
Subtotal		0.04	0.09			0.02	0.04	0.18	0.24	0.13	0.12	0.00	0.12
1435	Old Spanish (T-037-T1)	0.01	0.03	0	0	0.01	0.01	0.00	0.02	0.06	0.00	0.03	0.00
1265-2B	None - PRV zone from 1600	0.01	0.02	0	0	0.00	0.01	0.00	0.01	0.00			
1600	Vista Verde (T-038-T1)	0.02	0.04	1500	2	0.01	0.02	0.18	0.21	0.21			
Subtotal		0.03	0.05			0.01	0.03	0.18	0.22	0.21	0.01	0.00	0.01
1890	Pony Tracks (T-039-T1)	0.01	0.03	1500	2	0.01	0.01	0.18	0.20	0.28	0.00	0.08	0.00
TOTAL		13.38	28.10			7.02	13.38	5.31	25.72	9.94	17.78	2.01	17.78

(1) Single zones were assigned a fire reserve amount based on the highest flow required for land uses within the zones. For tanks serving an area comprised of multiple zones, fire reserves based on critical land use were assigned for the larger zones with 0.1 mgd demand or greater. Fire reserve for very small zones were aggregated. The minimum fire reserve assigned to an area was 1,500 gpm for 2 hours.

(2) When treatment plant is operating, Lake tanks (0.75 MG) are used for disinfection contact time and not available for distribution system storage.

Table 8-4C
Bear Gulch System
Breakdown of Storage Requirements for Buildout Conditions

Storage Criteria: Operational storage at 0.25 times maximum day demand; Emergency storage at 1 times average day demand; plus Fire Reserve
Total Storage = 1.9 times average day demand
0.9 times maximum day demand

Service Area	Reservoir Serving Area	Buildout Average Day Demand (MGD)	Buildout Maximum Day Demand (MGD)	Maximum Fire Flow Requirement (gpm)[1]	Length of Fireflow (hrs)	Storage Requirements (MG): Operational (at 25% of max day demand)	Storage Requirements (MG): Emergency (as one average day demand)	Storage Requirements (MG): Fire Reserve	Storage Requirements (MG): Total Storage Needed	Existing Storage (MG)	Storage Deficit (MG)	Storage Surplus (MG)	Total Additional Storage Needed (MG)
220	Lake (T-002-T1, T2)[2]	8.60	18.05	3500	3	4.51	8.60	0.63	13.74	0.00	13.74	0.00	13.74
265	None - PRV zone from 400	0.01	0.03	0	0	0.01	0.01	0.00	0.02	0.00			
319-A	None - supplied directly from SFPUC Alpine turnout	0.05	0.11	0	0	0.03	0.05	0.00	0.08	0.00			
319-B	None - PRV zone from 400	0.18	0.38	1500	2	0.10	0.18	0.18	0.46	0.00			
319-C	None - supplied directly from SFPUC Woodside turnout	0.01	0.02	0	0	0.01	0.01	0.00	0.02	0.00			
400	Intermediate (T-005-T6, T8, T9)	1.25	2.63	3000	3	0.66	1.25	0.54	2.45	1.35			
470	None - Hydropneumatic from 400	0.09	0.20	0	0	0.05	0.09	0.00	0.14	0.00			
Subtotal		1.60	3.36			0.84	1.60	0.72	3.16	1.35	1.81	0.00	1.81
395	None - PRV zone from 475	0.01	0.02	0	0	0.00	0.01	0.00	0.01	0.00			
475-A	None - PRV zone from 590	0.04	0.08	0	0	0.02	0.04	0.00	0.05	0.00			
475-B	None - PRV zone from 590	0.04	0.08	0	0	0.02	0.04	0.00	0.06	0.00			
500	None - PRV zone from 590	0.01	0.02	0	0	0.01	0.01	0.00	0.02	0.00			
525	None - PRV zone from 590	0.01	0.02	0	0	0.01	0.01	0.00	0.01	0.00			
590	Woodside Reservoir (T-016-T1), Woodside Knolls (T-015-T1), Ridgeway (T-019-T1, T2), Coombsville (T-006-T1)	1.93	4.05	3000	3	1.01	1.93	0.54	3.48	2.23			
675-A	None - Hydropneumatic from 590	0.14	0.30	0	0	0.07	0.14	0.00	0.22	0.00			
Subtotal		2.17	4.56			1.14	2.17	0.54	3.85	2.23	1.62	0.00	1.62
660	Ormondale (T-029-T1, T2, T3), Arrowhead (T-021-T1, T2)	0.41	0.86	3000	3	0.22	0.41	0.54	1.16	2.35	0.00	1.19	0.00
640	Hydropneumatic from 590 (Woodside Knolls T-015-T1)	0.09	0.18	0	0	0.05	0.09	0.00	0.13	0.00			
805	Canada (T-022-T1)	0.13	0.27	1500	2	0.07	0.13	0.18	0.38	0.45			
880	None - Hydropneumatic from 805	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.00			
Subtotal		0.22	0.47			0.12	0.22	0.18	0.52	0.45	0.07	0.00	0.07
835-A	Woodside Oaks (T-025-T1)	0.04	0.09	1500	2	0.02	0.04	0.18	0.25	0.1	0.15	0.00	0.15
1090	Summit (T-031-T1)	0.03	0.06	1500	2	0.01	0.03	0.18	0.22	0.15	0.07	0.00	0.07
795-1	Woodside Highland (T-007-T1)	0.02	0.05	1500	2	0.01	0.02	0.18	0.22	0.10	0.12	0.00	0.12
800	None - PRV zone from 1025	0.01	0.02	0	0	0.00	0.01	0.00	0.01	0.00			
850	None - PRV zone from 1025	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.00			
1025	Wayside (T-032-T1)	0.06	0.13	1500	2	0.03	0.06	0.18	0.28	0.25			
795-2	None - PRV zone from 1025	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00			
Subtotal		0.08	0.16			0.04	0.08	0.18	0.30	0.25	0.05	0.00	0.05

Table 8-4C
Bear Gulch System
Breakdown of Storage Requirements for Buildout Conditions

Storage Criteria: Operational storage at 0.25 times maximum day demand; Emergency storage at 1 times average day demand; plus Fire Reserve
Total Storage = 1.9 times average day demand
0.9 times maximum day demand

Service Area	Reservoir Serving Area	Buildout Average Day Demand (MGD)	Buildout Maximum Day Demand (MGD)	Maximum Fire Flow Requirement (gpm) (1)	Length of Fireflow (hrs)	Storage Requirements (MG)				Existing Storage (MG)	Storage Deficit (MG)	Storage Surplus (MG)	Total Additional Storage Needed (MG)
						Operational (at 25% of max day demand)	Emergency (as one average day demand)	Fire Reserve	Total Storage Needed				
715	Alpine Hills (T-017-T1)	0.41	0.87	3000	3	0.22	0.41	0.54	1.17	0.25			
675-B	None - PRV zone from 715	0.03	0.07	0	0	0.02	0.03	0.00	0.05	0.00			
Subtotal		0.45	0.94			0.23	0.45	0.54	1.22	0.25	0.97	0.00	0.97
750	None - PRV zone from 960	0.08	0.17	0	2	0.04	0.08	0.00	0.13	0.00			
960	Portola (T-030-T1)	0.06	0.13	1500	2	0.03	0.06	0.18	0.27	1.00			
Subtotal		0.14	0.30			0.08	0.14	0.18	0.40	1.00	0.00	0.60	0.00
440	None - PRV zone from 680	0.07	0.14	3000	3	0.03	0.07	0.54	0.64	0.00			
560	None - PRV zone from 680	0.02	0.04	0	0	0.01	0.02	0.00	0.03	0.00			
680	Ladera (T-028-T1)	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.20			
Subtotal		0.09	0.19			0.05	0.09	0.54	0.68	0.20	0.48	0.00	0.48
510	None - PRV zone from 655	0.02	0.04	0	0	0.01	0.02	0.00	0.03	0.00			
655	None - PRV zone from 815	0.02	0.04	0	0	0.01	0.02	0.00	0.03	0.00			
815	Westridge (T-027-T1)	0.41	0.85	1500	2	0.21	0.41	0.18	0.80	0.75			
835-B	None - PRV zone from 910	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00			
910	None - Hydropneumatic from 815	0.08	0.16	0	0	0.04	0.08	0.00	0.12	0.00			
Subtotal		0.52	1.10			0.27	0.52	0.18	0.98	0.75	0.23	0.00	0.23
1055	Los Trancos (T-033-T1), Sunrise (T-034-T1)	0.02	0.05	0	0	0.01	0.02	0.00	0.04	0.09	0.00	0.05	0.00
1265-1	Bonita (T-036-T1)	0.03	0.07	1500	2	0.02	0.03	0.18	0.23	0.13			
1265-2A	None - PRV zone from 12651	0.01	0.01	0	0	0.00	0.01	0.00	0.01	0.00			
1265-2C	None - PRV zone from 12651	0.00	0.00	0	0	0.00	0.00	0.00	0.00	0.00			
Subtotal		0.04	0.09			0.02	0.04	0.18	0.24	0.13	0.12	0.00	0.12
1435	Old Spanish (T-037-T1). PRV zone from 1600	0.01	0.03	0	0	0.01	0.01	0.00	0.02	0.06	0.00	0.03	0.00
1265-2B	None - PRV zone from 1600	0.01	0.02	0	0	0.00	0.01	0.00	0.01	0.00			
1600	Vista Verde (T-038-T1)	0.02	0.04	1500	2	0.01	0.02	0.18	0.21	0.21			
Subtotal		0.03	0.05			0.01	0.03	0.18	0.22	0.21	0.01	0.00	0.01
1890	Pony Tracks (T-039-T1)	0.01	0.03	1500	2	0.01	0.01	0.18	0.20	0.28	0.00	0.08	0.00
TOTAL		14.49	30.42			7.61	14.49	5.31	27.40	9.94	19.41	1.95	19.41

(1) Single zones were assigned a fire reserve amount based on the highest flow required for land uses within the zones. For tanks serving an area comprised of multiple zones, fire reserves based on critical land use were assigned for the larger zones with 0.1 mgd demand or greater. Fire reserve for very small zones were aggregated. The minimum fire reserve assigned to an area was 1,500 gpm for 2 hours.
(2) When treatment plant is operating, Lake tanks (0.75 MG) are used for disinfection contact time and not available for distribution system storage.

Key findings include:

- A total of 19 MG of additional storage capacity is needed for the entire Bear Gulch system, in order to fully meet the performance criteria for the master plan as established in Section 5. The key reason for the large amount needed is that the emergency storage criterion is more stringent than previous criteria, in order to improve supply reliability. In general, the system as a whole has adequate operational storage. The emergency storage criterion for the master plan is to provide one average day demand. The typical requirement of other agencies is to provide emergency storage adequate for at least an 8-hour supply/power outage on the maximum demand day, which is equivalent to about 0.7 average day demand in the Bear Gulch system. It is anticipated that the required additional storage will be phased in over time to improve supply reliability.

- Zone 220 is served directly from SFPUC turnouts, and has distribution storage available at the Lake tanks, when the treatment plant is not operating. When the plant is on, the tanks are used for disinfection contact time and are not available for distribution storage. There is also some available (excess) storage capacity located in higher zones under existing conditions that can backfeed to the 220 zone. To meet all the performance criteria, a total of 13.7 MG of distribution storage would be needed for buildout conditions (without counting the existing Lake tanks). Potential locations for additional storage include Station 2 at the Bear Gulch yard, or near the existing Lake tanks. Another option would be to locate storage in a higher zone, such as at Station 5, and backfeed into the 220 zone at the Bear Gulch yard. The District's current budget includes 5 MG new storage at Station 5 with a PRV to zone 220. As an alternate option for providing some of the emergency storage component, Cal Water could consider local surface water treated at the Bear Gulch WTP as emergency supply. However, this option depends on availability of raw water supply in the Bear Gulch Reservoir, usable treatment plant capacity which will require distribution system improvements as discussed in Section 8.10.1, and providing backup power at the plant. For purposes of this master plan, the improvement recommendations and budget placeholders assume that all additional storage is provided by tanks.

- About 1.8 MG of additional storage is needed in the storage area comprised of zones 265, 319-A, 319-B, 319-C, 400 and 470 that is currently served from the Intermediate tanks and SFPUC turnouts. Zone 319-B was considered in the same service area as zone 400, though with the existing configuration, Zone 319-B cannot utilize storage available to zone 400. However, a 150 foot pipeline and PRV installed between the two zones would enable 319-B to utilize storage from zone 400. The pipeline would be on Alameda de las Pulgas between Helena and Nassau. A potential location for additional storage in zone 400 is at Station 5 where the existing Intermediate tanks are located.

- About 1.6 MG additional storage is needed in zone 590. Surplus storage of 1.0 MG in zone 660 could back feed into zone 590 through a PRV installed at the location of normally closed valves at pump station 08. If this is done, additional storage required in zone 590 is reduced to 0.6 MG, which could be provided by replacing existing older tanks with larger ones.
- About 1.0 MG additional storage is needed at Alpine Hills tank, which supplies zone 715. One option may be to use surplus storage in Zone 960 to offset a portion of this deficit. Zone 960 has 0.06 MG of surplus storage at Portola tank, which could supplement zone 715 if a bypass connection is made between the discharge and suction side of station 26, reducing additional storage needed in Alpine tank from 0.97 to 0.37 MG. This would also require adding 0.6 mgd pumping capacity at station 26 to move water into Portola tank for zone 715.
- Surplus storage of 0.08 MG at Pony Tracks in zone 1890 can be utilized in zone 1600 and 1265-1 if a bypass at pump station 38 is installed. Supply from Pony Track tank can be delivered to zone 1600, and then via PRVs through a series of zones including 1265-2B, 1265-1, and 1265-2A. Additional storage needs would reduce from 0.12 MG to 0.05 MG at zone 1265-1 and from 0.01 MG to 0 MG in zone 1600.
- There are also a few smaller zones that require a very small amount of additional storage, which could be met by upsizing the tanks when they are replaced due to age/condition. Some very small zones have adequate operational and emergency storage, but do not have adequate fire reserves to meet the master plan fire flow criteria which are more stringent than current criteria.

Options for storage improvements are further discussed in Section 8.11.3, in conjunction with consideration of replacement needs based on age and condition. Conceptual locations for future storage improvements are discussed at a conceptual master planning level of detail; siting studies have not been conducted as part of the master plan. The potential locations for additional storage are generally assumed to be at existing Cal Water owned pump station or reservoir locations, where pipeline infrastructure already exists. Due to the developed nature of the Bear Gulch District, there are few potential new sites for such uses. Specific storage sites will be identified in subsequent Cal Water siting and predesign studies for project implementation.

8.7 PRV Capacity Evaluation

For the pressure reducing station evaluation, existing capacity available in each zone served solely by PRVs was compared with required capacity. Total valve capacity must be adequate to supply peak hour on the maximum day, and also fire flow during the average hour on the maximum day. Typically, one or more smaller valves meet normal demands, with a larger valve(s) to provide fire flow if needed. Fire flow valve(s) operate infrequently and are backup for the normal duty valves.

Table 8-5 compares existing valve capacity with demands under peak hour and maximum day plus fire flow conditions. Valve capacity is based on Cla-Val globe style operating at its maximum continuous flow rate. Globe style valves are assumed for all PRVs, though smaller PRVs less than 2-inches may be the direct acting type.

Key findings include:

- All 25 zones supplied solely by PRVs have adequate PRV capacity for peak hour flows on maximum demand day through buildout.
- For 8 zones, the PRV capacity is adequate for both peak hour on maximum day demand, and to provide fire flow during an average hour of maximum day demand.
- For 15 zones, the PRV capacity is not adequate to provide fire flow during an average hour of maximum day demand, since the original design of these zones was not based on the current fire flow criterion. These zones are 265, 395, 440, 475-A, 475-B, 500, 510, 525, 655, 680, 795-2, 850, 1265-2A, 1265-2C, and 1435. These zones are relatively small, with an average day demand less than 0.08 mgd each.

PRV improvements to address these deficiencies are contained in the Section 9 plan recommendations.

8.8 Pipeline System Evaluation

This section discusses the evaluation of the existing pipeline system under normal demand conditions, and for maximum day plus fire flow. For these evaluations, all the SFPUC turnouts were operating to supply the system.

8.8.1 Normal Demand Conditions with Supply from SFPUC Only

The capacity evaluation of the existing pipeline system was based on the pressure, velocity and headloss criteria shown below for various normal demand conditions.

Type of Pipeline	*Demand Condition*	*Minimum Pressure (psi)*	*Maximum Pressure (psi)*	*Maximum Velocity (fps)*	*Maximum Headloss (ft/kft)*
Pipelines (equal to or greater than 18-inch diameter)	Average Day	50	125	3	--
	Peak Hour on Maximum Day	40	--	5	3
Distribution Pipelines (less than 18-inch diameter)	Peak Hour on Maximum Day	40	--	7	10

Table 8-5 Bear Gulch System
Evaluation of Pressure Reducing Station Capacity - Zones Served Solely from PRVs

PRV Zone	PRV Station [1]	Location	Existing No. of Valves	Size of Existing Valves (in)	Maximum Valve Capacity (mgd) [2]	Existing: Peak Hour Demand on Maximum Day (mgd)	Existing: Average Hour Demand on Maximum Day Plus Fire Flow (mgd)	Buildout: Peak Hour Demand on Maximum Day (mgd)	Buildout: Average Hour Demand on Maximum Day Plus Fire Flow (mgd)
265	PRV-400-265-1	Polhemus Ave. and Kilroy Way	1	4	1.15	0.04	2.19	0.04	2.19
319-B	PRV-400-319-1	Santa Cruz Blvd. and Palo Alto Way	1	4	1.15				
	not in model [3]	Santa Cruz Blvd. and Palo Alto Way	1	2	0.30				
	PRV-400-319-3	Sharon Rd. and Cloud Ave.	1	4	1.15				
	319-B Subtotal		3	-	2.6	0.65	2.54	0.65	2.54
395	PRV-475-395-1	Oakhaven Way	1	2	0.30	0.03	2.18	0.03	2.18
440	PRV-560-440-1	Durazno and Mira Way	1	6	2.59				
	PRV-815-440-1	Alpine Rd. and La Mesa Way	1	4	1.15				
	440 Subtotal		2	-	3.74	0.23	4.46	0.23	4.46
475-A	PRV-590-475-1	Woodside Dr. and Lynn Way	1	3	0.66				
	PRV-590-475-2	Woodside Dr. and Kenmore Way	1	3	0.66				
	Pass-through flow to zone 395		na	na	na				
	475-A Subtotal		2.00	-	1.32	0.16	2.25	0.16	2.25
475-B	PRV-590-475-3	Eleanor and Lakeview Dr.	1	2	0.30	0.13	2.23	0.13	2.24
500	PRV-590-500-1	Woodside Dr. and Brookwood Rd.	1	3	0.66	0.04	2.18	0.04	2.18
510	PRV-655-510-1	Westridge Dr. and Alamos Way	1	4	1.15	0.07	2.20	0.07	2.20
525	PRV-590-525-1	Woodside Dr. and Sheridan Way	1	3	0.66	0.03	2.18	0.03	2.18
560	PRV-680-560-1	Gabarda Way and Pecora Way	1	1.5	0.18				
	PRV-680-560-2	Gabarda Way and Pecora Way	1	6	2.59				
	PRV-680-560-3	Coquito Way and Coquito Ct.	1	4	1.15				
	PRV-680-560-4	Pecora Way and Conil Way	1	4	1.15				
	Pass-through flow to zone 440		na	na	na				
	560 Subtotal		4	-	5.07	0.30	2.33	0.30	2.33
655	PRV-815-655-1	Westridge Dr. and Bolivar Dr.	1	4	1.15				
	Pass-through flow to zone 510		na	na	na				
	655 Subtotal		1	-	1.15	0.13	2.24	0.14	2.24
675-B	PRV-715-675-1	Portola Rd. and Grove Dr.	1	4	1.15				
	PRV-715-675-2	Portola Rd. and Grove Dr.	1	4	1.15				
	675-B Subtotal		2	-	2.3	0.11	2.23	0.11	2.23
680	PRV-815-680-1	La Mesa Way south of Coquito	1	4	1.15				
	PRV-815-680-2	La Mesa Way at Sta. 28 Ladera Tank	1	4	1.15				
	Pass-through flow to zone 560								
	680 Subtotal		2	-	2.30	0.28	2.32	0.28	2.32
750	PRV-960-750-1	Saddleback at Sta. 26	1	4	1.15	0.30	2.33	0.30	2.33
795-2	PRV-1025-7952-1	Wayside Rd.	1	4	1.15	0.00	2.16	0.00	2.16
800	PRV-1025-800-1	Approx: Old La Honda and Montecito	1	6	2.59	0.03	2.18	0.03	2.18
835-B	PRV-910-835-1	Targus Ct. off of Golden Oak	1	4	1.15				
	PRV-910-835-2	Targus Ct. off of Golden Oak	1	4	1.15				
	835-B Subtotal		2	-	2.3	0.00	2.16	0.00	2.16

Table 8-5 Bear Gulch System
Evaluation of Pressure Reducing Station Capacity - Zones Served Solely from PRVs

PRV Zone	PRV Station [1]	Location	Existing No. of Valves	Size of Existing Valves (in)	Maximum Valve Capacity (mgd) [2]	Existing: Peak Hour Demand on Maximum Day (mgd)	Existing: Average Hour Demand on Maximum Day Plus Fire Flow (mgd)	Buildout: Peak Hour Demand on Maximum Day (mgd)	Buildout: Average Hour Demand on Maximum Day Plus Fire Flow (mgd)
850	PRV-1025-850-1	Russell Ave and Santa Maria Ave	1	2	0.30	0.01	2.16	0.01	2.16
960 PRV Subzone 1 [4]	PRV-960-960-1	Valley Oak and Ohlone	1	6	2.59				
	PRV-960-960-2	Valley Oak and Ohlone	1	2	0.30				
	Pass-through flow to 960 PRV Subzone 2								
	960 Subzone 1 Subtotal		2	-	2.89	0.07	2.20	0.07	2.20
960 PRV Subzone 2 [4]	PRV-960-960-3	Valley Oak and Acorn	1	6	2.59	0.02	2.17	0.02	2.17
1055 PRV Subzone [4]	PRV-1055-1055-1	Oak Forest PRV	1	8	4.46				
	PRV-1055-1055-2	Oak Forest PRV	1	2	0.30				
	1055 Subzone Subtotal		2	-	4.76	0.02	2.17	0.02	2.17
1265-2A	PRV-12651-12652-3	PRV at 1021 Ramona Rd.	1	4	1.15				
	PRV-12651-12652-4	PRV at 1021 Ramona Rd.	1	2	0.30				
	1265-2A Subtotal		2	-	1.45	0.02	2.17	0.02	2.17
1265-2B	PRV-1600-12652-1	PRV at 160 Vista Verde St.	1	6	2.59				
	PRV-1600-12652-2	PRV at 160 Vista Verde St.	1	3	0.66				
	1265-2B Subtotal		2	-	3.25	0.03	2.18	0.03	2.18
1265-2C	PRV-12651-12652-1	PRV at 1015 Los Trancos Rd.	1	2	0.30				
	PRV-12651-12652-2	PRV at 1021 Ramona Rd.	1	2	0.30				
	1265-2C Subtotal		2	-	0.60	0.01	2.16	0.01	2.16
1435	PRV-1600-1435-1	Joaquin Rd near Spanish Tank	1	4	1.15	0.05	2.19	0.05	2.19

[1] Naming convention for PRV-xxx-yyy-#, xxx=Upstream Zone, yyy=Downstream Zone, #=number of PRVs in with same uptream and downtream zone.
[2] Valve Capacity is based on "Cla-Val" globe style pressure reducing valve operating at its maximum continuous flow rate. Smaller 2-inch PRVs may be direct acting type.
[3] Per schematic and system map, a 4" AND 2" PRV exist at Santa Cruz and Palo Alto. Per GIS and wall map, only a 2" exists.
[4] PRV subzones are small service areas with very little demand that are fed by a PRV, yet considered to be part of the zone upstream of the PRV.

A steady state simulation representing peak hour on the maximum day was conducted to check flow and pressure conditions. This analysis was based on normal supply conditions with SFPUC turnouts operating, firm capacity of pump stations operating, and reservoirs operating within the top 25% of capacity. Pressures were evaluated at all nodes with demands, i.e., service nodes. Velocity and headloss were evaluated for all pipelines in the system.

Pressure is the key criterion for evaluating the existing pipeline system. Existing pipes that provide adequate pressures in the system are not identified for improvement solely due to not meeting the maximum velocity and headloss criteria. Cal Water can use the headloss/velocity information if the pipes require replacement for leaks or breaks, to evaluate whether a larger diameter pipe may be warranted to reduce headlosses.

For peak hour on the maximum day at buildout, Figure 8-1 shows locations of nodes that did not meet minimum pressure criteria, and pipes with high headloss and high velocity that exceeded the performance criteria. Non-service nodes near tanks were removed for clarity. At the scale of the map, nodes that appear to be near tanks are either in a different zone than the tank or have service demands.

The major issue identified in the hydraulic analysis for normal conditions is in Woodside Hills in the northwest part of zone 400 that has high headloss pipelines that causes low pressures. Otherwise, the pipeline system has adequate hydraulic capacity for buildout peak hour demands under normal conditions. However, some pipeline improvements have also been identified to increase system reliability, e.g., being able to serve large portions of the service area from more than one critical delivery location. Pipeline improvements that consider capacity, reliability and replacement needs are discussed in Section 8.11.4, and contained in the Section 9 plan recommendations. A more detailed discussion of the hydraulic analysis results for normal conditions is provided below.

As indicated on Figure 8-1, under normal conditions, one area does not meet minimum pressure criteria due to undersized pipes, while several areas do not meet minimum pressure criteria due to high elevation within a zone. These areas include:

- Two low pressure areas occur along the southwestern edge of zone 220, which borders zone 400. Elevations along this boundary are the highest in zone 220, which results in the low pressures. Typically, pressures are marginally lower than the target criterion of 40 psi, which may not adversely affect customers. Potential re-zoning of these two low pressure areas is discussed below:
    - One area consists of one block of services in Zone 220 on Avy between Alameda de las Pulgas and Cloud Avenue that ranges between 35 and 38 psi. This block could be rezoned to 400 by installing a new zone boundary valve at

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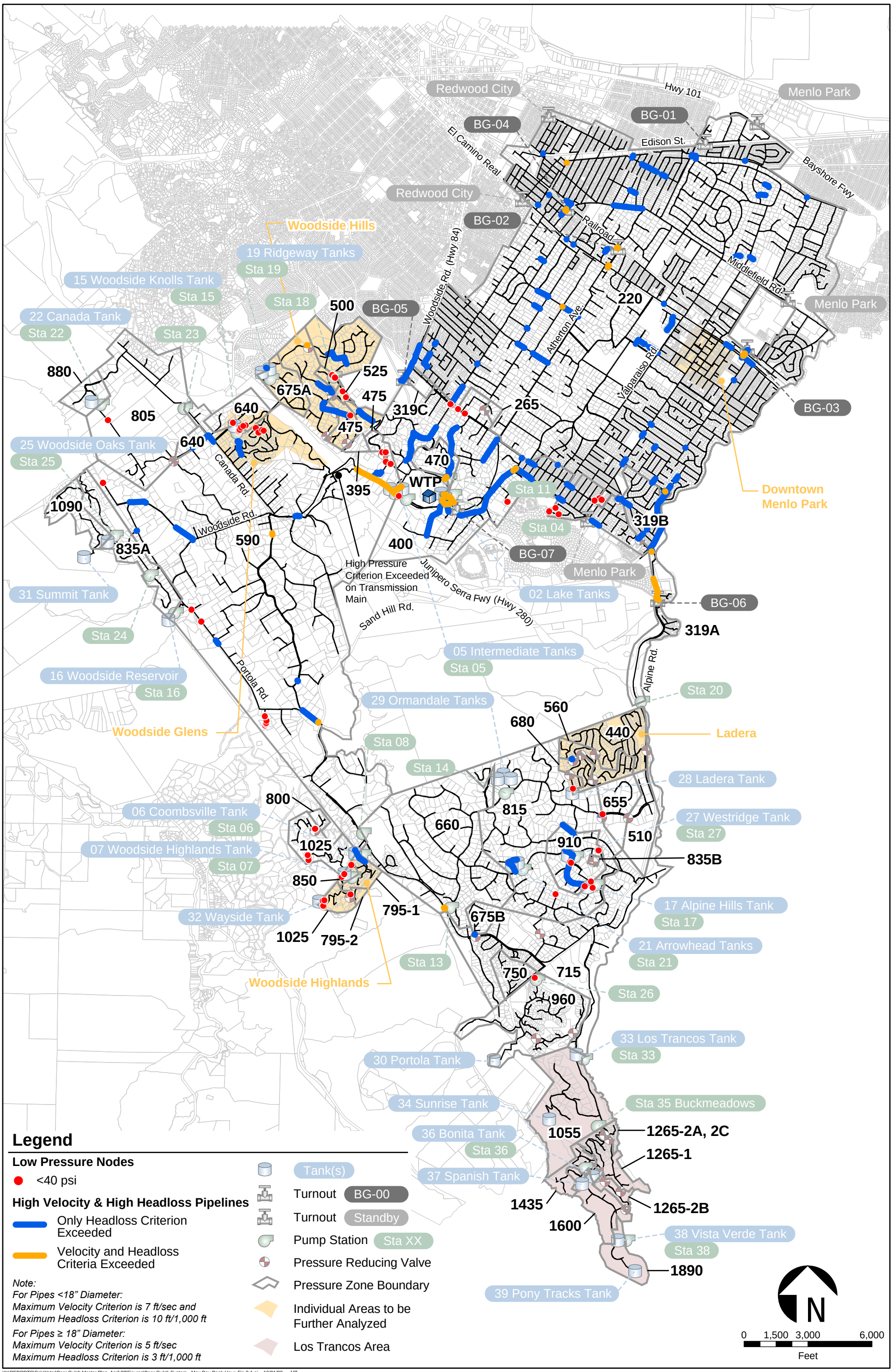

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Figure 8-1
Bear Gulch System
Maximum Day, Peak Hour
High Velocity, High Headloss and Low Pressures

Cloud Avenue and opening a normally closed valve at Alameda de las Pulgas. These minor improvements would result in higher static pressures of almost 80 psi in that block, based on a zone hydraulic gradeline of 400 feet.

- The second low pressure area at Stockbridge Avenue and Alameda de las Pulgas is at 130 feet elevation, which is a static pressure of 39 psi for services in the 220 zone on Stockbridge near the zone 400 boundary. Rezoning this area to zone 400 would require extending a zone 400 pipeline north along Stockbridge from Alameda de las Pulgas, and would increase the static pressure in that area to almost 120 psi. Therefore, rezoning is not recommended.

- Woodside Hills, the area of zone 400 northwest of State Highway 84, has low pressures during peak hour maximum day demand conditions due to high elevations and undersized pipes. This area is fed by two undersized parallel pipelines, a 4-inch and a 6-inch pipeline along High Road, with headlosses of about 30 feet per 1,000 feet. A PRV from zone 590 on Harcross Road also supplies this area of zone 400. The Woodside Hills area was also analyzed in more detail for localized improvements, as discussed in Appendix K.

- Pressure in the 20-inch pipeline on Atherton Avenue, between Alameda de las Pulgas and Fairview Avenue, falls below the minimum pressure criteria of 40 psi at peak hour of maximum demand day, as shown on Figure 8-1, as well as the minimum pressure criteria of 50 psi on an average demand day for transmission pipelines greater than 18 inches.

- Due to high elevations, low pressures occur in zone 590 in the Woodside Glens neighborhood near Jane Drive and Alta Mesa Road, near the boundary of zone 640. The Woodside Glens area was analyzed in more detail for localized improvements, as discussed in Appendix K.

- Low pressure occurs in zone 1025 on Upper Lake Road, due to relatively high elevations as compared to the zone grade line (HGL). With a zone HGL of 1025 feet and about 940-foot elevations along Upper Lake Road, static pressure with zero system demand is 37 psi, which is lower than the criterion. This area is just north of the Woodside Highlands neighborhood.

- Low pressure occurs in zone 795-1 near Santa Maria Avenue and Russell Avenue, due to relatively high elevations as compared to the zone grade line.

A few localized lower pressure nodes may occur at high elevations in the system near zone boundaries or at tops of hills/ridges during the peak hour on the maximum day. An example is in the southern part of zone 815 at the end of Adair Lane near Sausal Drive. In hilly locations, where topography is steep, very few customers are typically affected, and the services may be from un-modeled service laterals at lower elevations

that provide higher pressure. For isolated locations, where the marginal pressures are due to high elevation not pipeline restrictions, pipeline improvements will not improve pressures.

If customer complaints about localized low pressures should occur in the future, a case-by-case investigation should be undertaken to field check actual service pressures and ground elevations, and to determine the most effective solution for the specific location. If near a higher zone, it may be possible to re-connect the area to a higher zone pipeline. If the number of affected customers at a location is small, Cal Water may already have or could negotiate a "low pressure" agreement with the customers based on high service elevation, and/or recommend that the homeowner install a small customer-owned booster pump at the service.

The system was evaluated for high pressure as well. The Cal Water high pressure criterion applies to transmission pipelines 18 inches or greater. On average day, pressure in pipelines 18 inches or greater must be less than 125 psi. Due to low elevation, this criterion is not met on about 1600 feet of transmission pipelines along Highway 84 that cross Interstate Highway 280. Pressures are greater than 125 psi on average demand day.

For distribution pipelines less than 18 inches, no high pressure criterion has been established by Cal Water. There are localized areas within the distribution system (less than 18 inch pipelines) where pressures are above 125 psi due to low elevations relative to the zone grade line.

There are several options that Cal Water could consider for areas where there are customer complaints regarding high pressures:

- Plumbing code for new construction requires PRVs for pressures greater than 80 psi. One option may be to require PRV retrofits on older services that may not have one. This is a simple and effective technique, and does not affect the Cal Water system.

- Some of the high pressure areas occur along a non-looped pipeline that is lower in elevation than the rest of the zone, such as Manzanita Way in zone 590, Hayfields Road in zone 1025, Joaquin Road in zone 1435, and a 6-inch branch off Old Spanish Trail in zone 1600. In such cases, it may be possible to install a PRV along the main to reduce pressures downstream (with adequate capacity and/or bypass provided for fire flows).

- High pressures also occur on the east side of zone 715, around Old Alpine Road and Golden Oak Drive. This area could be isolated with PRVs on the two roads, creating a new zone served by two PRVs.

- Where high pressure localized areas are near zone boundaries, rezoning may be an option to reduce high pressures. For example, Cherokee Way between Cherokee Court and Cervantes Drive contains pipelines from both zones 660 and 815. If service from zone 815 causes excessive pressures, lower pressures service from zone 660 could be utilized.

- Meadowood Drive between Navajo Place and Pinon Drive in zone 815 has high pressures. An option would be to rezone this area to the lower, adjacent zone 660 using isolation valves at the appropriate locations.

- Particularly, in the Los Trancos subsystem, pockets of high pressure exist due to large elevation differences within a single zone; the low elevation areas experience high pressures. Any of the options discussed above could be utilized, depending on the specific location and need, which would be determined on a case-by-case basis.

Pressure results from the hydraulic analysis are based on node elevations obtained from Digital Elevation Models (DEMs) derived from USGS topographic maps. The DEMs have a resolution of about 33 feet. In hilly locations with steep topography, this level of topographic mapping may not accurately reflect actual service elevations. Actual ground elevations should be field verified before implementation of improvements, as part of the preliminary design process.

8.8.2 Maximum Day with Fire Flow

A fire flow analysis of the entire system was conducted using the H2OMAP fire flow simulator module. The analysis was done for buildout maximum day conditions with the reservoirs at 75% full, and with the pump stations and SFPUC turnouts operating.

Appendix I contains a report of the results for the Bear Gulch system showing the available fire flow at 20 psi residual pressure at all modeled service nodes. For the analysis, all service nodes in the zone were required to maintain at least 20 psi under fire flow conditions, which is the recently adopted revised Waterworks Standards (as described in the Section 5 performance objectives). These service nodes are not hydrant locations. Some of the service nodes are on pipelines that would not have hydrants. It should be noted that these analysis results are based on model calculations and may not be reasonable or achievable in the field.

Below are the fire flows required by the local fire agencies for new development.

Single family residential and duplexes Building area < 3,600 SF: Building area between 3,600 SF and 11,300 SF: Building area > 11,300 SF	 1,000 gpm for 2 hours Ranges between 1,500 gpm to 2,750 gpm for 2 hours [1] Minimum 3,000 gpm [1]
Medium density multiple family residential	2,000 gpm for 2 hours
High density multiple family residential and schools	2,500 gpm for 2 hours
Commercial	3,000 gpm for 3 hours
Industrial	3,500 gpm for 3 hours

[1] With fire sprinklers, fire flow may be reduced by up to 50% if approved by Fire Department.

The existing system was developed prior to the current fire flow standards. Cal Water is not required to undertake upgrades to the existing system to meet the new standards. However, Cal Water does use the information on the available fire flow when designing pipeline replacement projects.

Pressure at fire flow locations depends on the available head in the zone as well as the headloss in the system and the flow required. However, in general, the required fire flow amounts would likely not be met in areas with:

- Small diameter dead-end pipes, generally less than 6-inch diameter;
- 8-inch diameter dead-end pipes serving high ground elevation areas or very long dead-end segments;
- Loops of 4-inch diameter pipes at the zone periphery located away from supply sources.

Based on the fire flow simulation, general locations with inadequate fire flows are identified below.

- In the largest demand zone 220, which consists of 60 percent of total demand, only eight percent of the nodes cannot provide a fire flow of at least 1,000 gpm. These nodes are scattered throughout the zone and are typically at small diameter pipelines of 4 inches or less, or at small diameter branches.
- In the second largest demand zone 590, which consists of 14 percent of total demand, 22 percent of the nodes cannot provide a fire flow of at least 1,000 gpm. Clusters of low fire flow capability occur in the following areas:

- Woodside Glens, one of the five areas analyzed in more detail as discussed in Appendix K.
- Woodside Hills, one of five areas analyzed in more detail as discussed in Appendix K.
- The northwest part of zone 590, north of Woodside Road (Highway 84) and west of Albion Avenue; and
- Along Portola Road west of Mountain Home Road.

- In zone 400, the third largest zone with 8.5 percent of total demand, 19 percent of the nodes cannot provide a fire flow of at least 1,000 gpm, while maintaining a minimum of 20 psi throughout the rest of the zone. Low static pressure in the Woodside Hills area, due to high elevation on the northwest side of the zone, prevents higher fire flows to be achieved in other parts of zone 400.
- In zone 1025, over 89% of the nodes cannot provide a fire flow of at least 1,000 gpm, while maintaining a minimum of 20 psi throughout the rest of the zone. This occurs because of the high elevation/low pressure area along Hayfields Road, which is the constraining location.
- Many of the smaller zones fed by PRVs show low fire flow capacity, which is consistent with the PRV capacity evaluation. Many zones do not have adequate PRV capacity to provide maximum day demand plus fire flows per the master plan fire flow criteria.

8.9 Reliability Evaluation

This section conceptually evaluates the ability of the existing system to handle potential outages of SFPUC turnouts, and to convey water from various emergency connection locations. In addition, there is a discussion of back-up power requirements for pump stations.

Section 8.10 discusses the ability of the existing system to accommodate potential future local supply sources that may be implemented in the long-term and would also provide additional supply reliability.

8.9.1 Alternative Scenarios with Loss of SFPUC Turnouts

In the Bear Gulch system, seven SFPUC turnout locations supply the entire system:

- BG-01, located at Bay and Marsh Road, has a 12-inch PRV and a 12-inch butterfly valve feeding zone 220.

- BG-02, located at Atherton Depot, has a 10-inch butterfly valve feeding zone 220 that is opened only during high demand periods when the other turnouts cannot keep up with demand.

- BG-03, located on El Camino Real near Middle Ave, has a two 6-inch and one 12-inch PRV feeding zone 220.

- BG-04, located at 5th and Glendale, has a 6-inch PRV feeding zone 220.

- BG-05, located at Woodside and Bonsen Court, feeds zone 319-C directly and zone 220 through a 12-inch PRV.

- BG-06, located at Alpine Road and Stowe Lane, feeds zone 319-A directly and zone 220 through a 10-inch PRV at Lemon and Oak, and also supplies suction pressure to pump station 20.

  Zone 319-B is bounded by Santa Cruz Avenue, Sand Hill Road, Oak Avenue, Lemon Avenue and Sharon Avenue. This area is hydraulically isolated from zone 319-A, which is along Alpine Road and includes Alpine turnout, BG-06. As shown in Figure 8-4, Alpine turnout BG-06 serves zone 220 via PRV at Lemon and Oak, and supplies suction pressure to pump station 20. The turnout does not serve zone 319-B, which is west of Sand Hill Road and Oak Avenue.

- BG-07, located at Bear Gulch yard, supplies suction to pumps 04-G and 04-H, though valve configuration enables BG-07 to supply any station 04 pump. This turnout also feeds zone 220 via one 12-inch and one 16 inch PRV, and mixes with treatment plant effluent downstream of ammonia injection, and on the suction side of pumps 04 -C, 04-F, and 04-I.

The seven turnouts into the Bear Gulch system are located on three major sets of pipelines: BG-01 is on Bay Division pipelines 1 and 2; BG-02, -03, and -04 are on the Palo Alto pipeline; and BG-05, -06, -07 are on Bay Division pipelines 3 and 4.

Several scenarios were evaluated to determine how water could be moved throughout the distribution system if specific SFPUC pipeline outages were to occur. This evaluation assumes that these key supply facilities would only be out of service for either planned maintenance or an emergency. It is assumed that planned maintenance would occur only during low demand (e.g., winter) periods, and that emergency measures would be immediately taken to alert customers to reduce demands if emergency outages occurred during higher demand periods.

The conceptual evaluation identifies potential opportunities for system modifications that would enhance supply reliability. The evaluation is based on review of normal system operations, and conceptual identification of potential changes that would be needed. As part of implementation of any modifications, hydraulic analysis should be

conducted to confirm the selected locations and improvements. The hydraulic model can be used to perform detailed hydraulic analyses of selected scenarios subsequent to the master plan.

A schematic is provided for each scenario that shows the key facilities for distributing water to all major service areas, and potential modifications to normal operations. The same base schematic and color scheme is used for all the figures to facilitate comparison. The colors on each figure highlight the key facilities addressed in the particular scenario.

- Red shows facilities assumed to be out-of-service;
- Blue are proposed modifications to provide alternate supply to some areas during the emergency outage scenario addressed in the figure; and
- Dashed gray facilities are proposed modifications not needed for that scenario.

Based on the evaluation, key improvements to increase reliability include

- Increasing conveyance capacity between the treatment plant and/or the Bear Gulch yard turnout to zone 220. As discussed further in Section 8.10.1, this would be by means of either a PRV from the discharge of pump station 04 to zone 220, or a low head pump from the suction side of pump station 04 to zone 220.
- A PRV at Santa Cruz Avenue and Sand Hill Avenue that would allow flow from zone 400 into zone 319-A.
- A booster pump from zone 220 to zone 319-A along Oak Avenue, between Lemon Avenue and Vine Street.

SFPUC Bay Division Pipelines 1 and 2 Out of Service

If Bay Division pipelines 1 and 2 are out of service, the Bay and Marsh Road turnout BG-01 would no longer provide supply, as illustrated on Figure 8-2. Turnouts elsewhere in the low zone on other SFPUC pipelines (BG-02, -03, -04, and -05) would increase flows to meet system demands. Because 5 of 6 turnouts that feed zone 220 are still in service in this scenario, changes in system operation are not needed under these conditions.

SFPUC Palo Alto Pipelines Out of Service

If the Palo Alto pipeline were out of service, turnouts at Atherton Depot (BG-02), El Camino Real (BG-03), and 5th and Glendale (BG-04) would no longer provide supply, as illustrated on Figure 8-3. Flow would be taken from remaining in-service turnouts in zone 220. BG-01 at Bay and Marsh will be the only turnout in the northern part of zone 220. Additional supply would be provided by the turnouts along Bay Division

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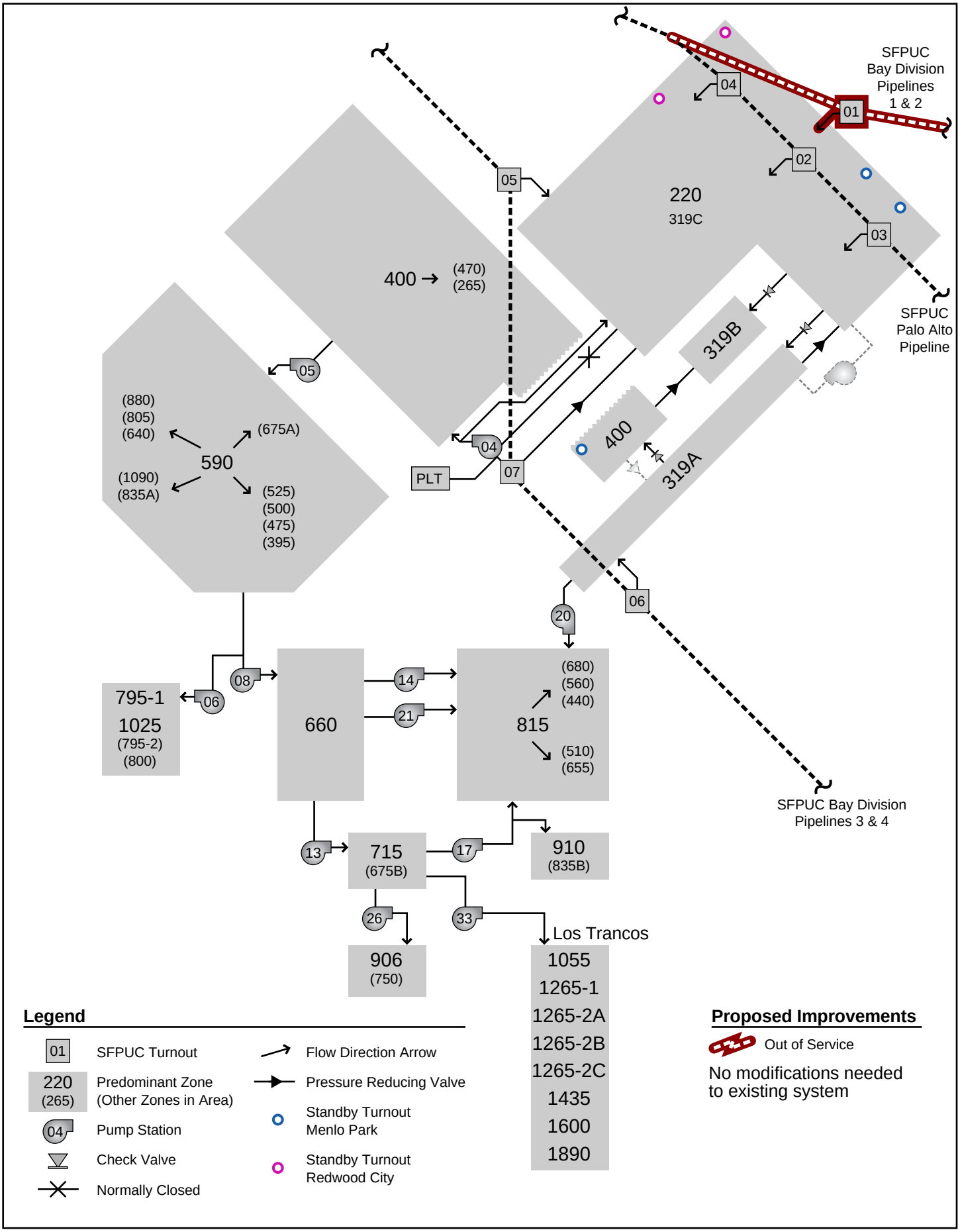

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Figure 8-2

Bear Gulch System Reliability Analysis
SFPUC Bay Division Pipelines 1 & 2 Out of Service

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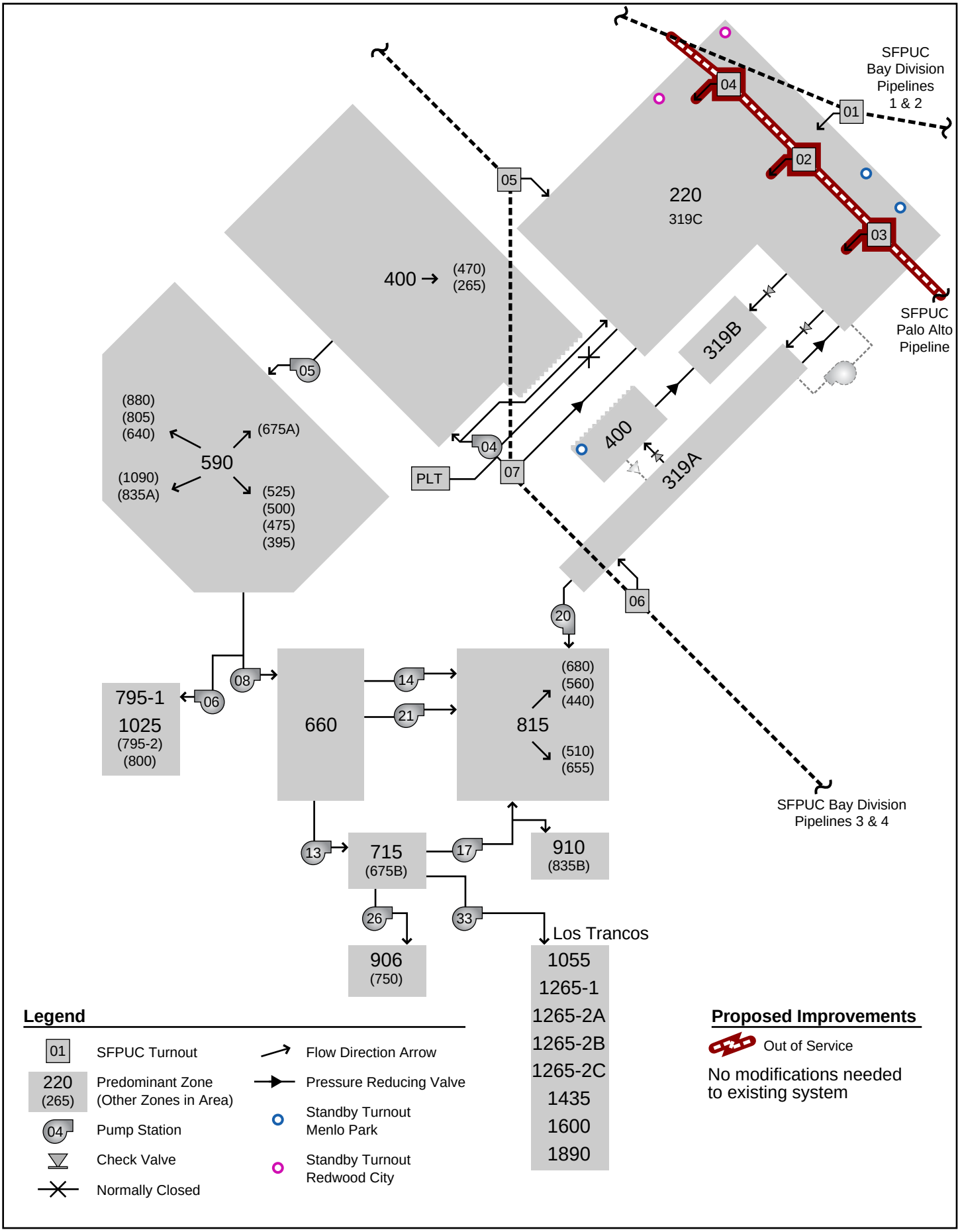

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Figure 8-3
Bear Gulch System Reliability Analysis
SFPUC Palo Alto Pipelines Out of Service

pipelines 3 and 4 (BG-05, BG-06, and BG-07). Changes in system operation are not needed under these conditions.

SFPUC Bay Division Pipelines 3 and 4 Out of Service

Turnouts on Bay Division pipelines 3 and 4 include BG-05 (Woodside and Bonsen), BG-06 (Alpine), and BG-07 (Bear Gulch Yard). If a service disruption in the pipelines causes the three turnouts to go out of service, several operational changes will be necessary to be able move water to the entire system, as illustrated on Figure 8-4.

Supply would come from the turnouts in the northern part of zone 220. Without the Alpine Road turnout BG-06, pump station 20 would no longer have suction pressure to supply Portola Valley. Both pump stations 08 and 20 are necessary to meet summer demand conditions. Without pump station 20, the southern part of the Bear Gulch system, which includes zones 715, 815, 910 and 960 would be served solely from the west side of Bear Gulch, via Portola pump station 08 in zone 590.

Without pressure in zone 319-A from the Alpine turnout BG-06, a check valve from zone 220 to 319-A at Oak Knoll Lane and Oak Avenue would open up. This would provide pressure equivalent to the low zone hydraulic grade line, which would not be at a high enough grade line for the suction side of pump station 20. The following two options could provide necessary pressure in zone 319-A (Alpine) when BG-06 is not in service:

1) PRV from zone 400 at Santa Cruz and Sand Hill which will provide pressure for zone 319-A as well as suction pressure for pump station 20. Currently there is a check valve allowing flow from 319-A to zone 400, see Figure 8-4. The PRV will improve reliability for the southern part of the Bear Gulch system assuming the intermediate tanks in zone 400 remains balanced and pump station 04 continues operation. Suction pressure at pump station 04 is provided by the Bear Gulch yard turnout and/or the treatment plant.

2) Booster pump from zone 220 on Oak Avenue, between Lemon Avenue and Vine Street, depending on site conditions. At Lemon and Oak is a PRV from zone 319-A to zone 220, as shown in Figure 8-4. There is an existing check valve between the two zones at Oak and Oak Knoll Lane, and two existing normally closed valves at the intersection of Oak and Vine Street. A temporary booster pump, with suction side in zone 220, will supply zone 319-A, and provide the proper suction pressure for pump station 20.

If turnout BG-07 at Bear Gulch yard is also out of service during this scenario, pumps at station 04 that received suction pressure exclusively from the turnout (pumps 04-G and 04-H) can be reconfigured to receive suction pressure from either the treatment plant, or zone 220 via normally closed valves. Reconfiguration would involve opening/closing valves to reroute flows.

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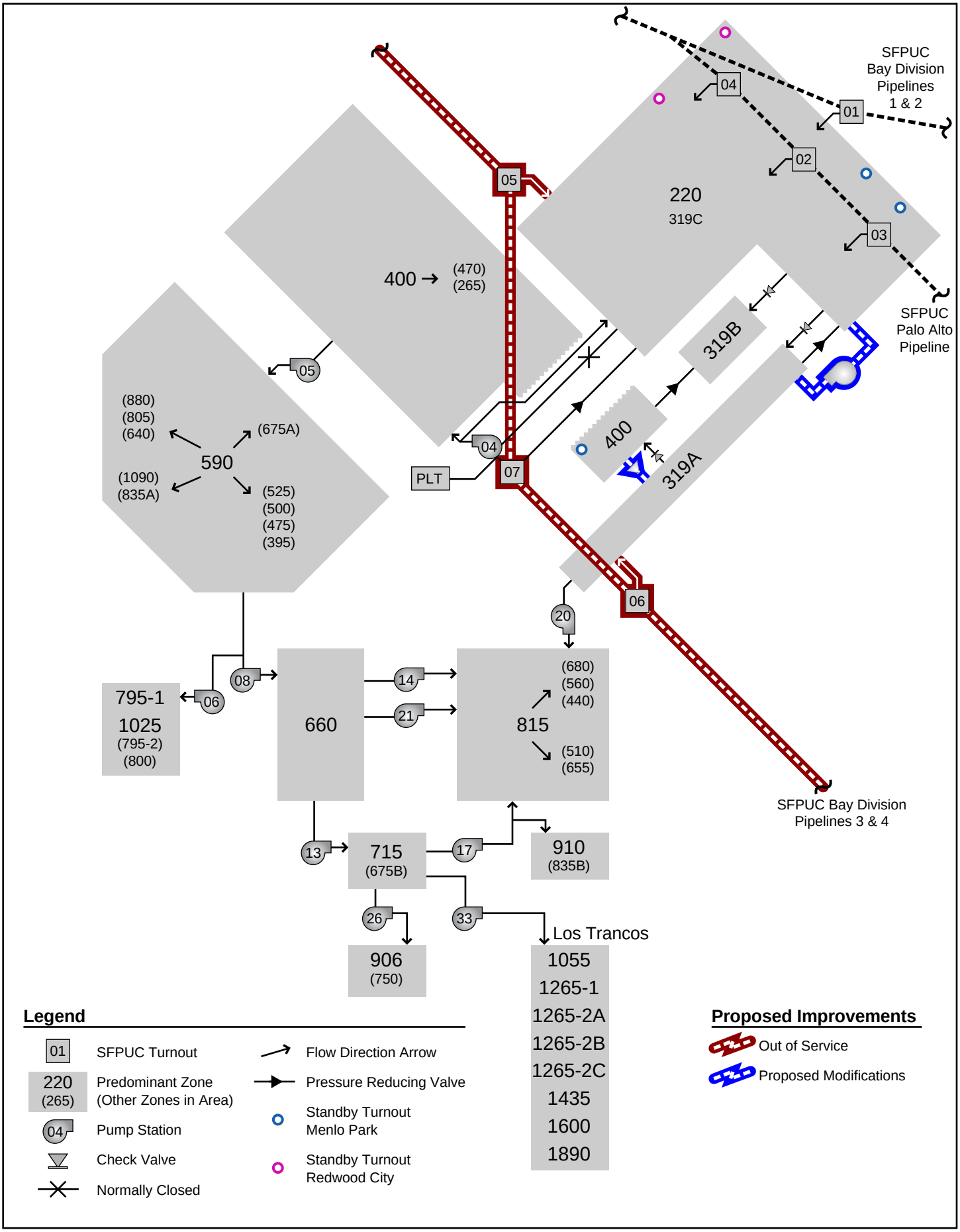

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Figure 8-4

Bear Gulch System Reliability Analysis
SFPUC Bay Division Pipelines 3 & 4 Out of Service

As discussed in Section 8.10, implementing both a PRV at Santa Cruz and Sand Hill and a booster pump along Oak Avenue would help move water from the water treatment plant to Portola Valley via zone 220. These improvements would allow more treatment plant water to be delivered into the system under low demand conditions. There are multiple benefits to implementing both improvements.

8.9.2 Standby Connections with Other Agencies

In an emergency, water may be available through emergency connections depending on the terms of the agreements with Cal Water, and assuming the adjacent agency has not been affected by the specific emergency condition.

There are five standby turnouts in the Bear Gulch system. Three are from Menlo Park while two are from Redwood City. Four of the five standby turnouts are in the low zone, while one from Menlo Park is connected to zone 400. If any one or a combination of the low zone standby turnouts is the only available supply, system operations would be similar to the scenario where Bay Division pipelines 3 and 4 are out of service. If the Menlo Park turnout in zone 400 is the only available supply, zone 319-A would lose pressure.

Providing service from the standby turnouts would be similar to the scenario with SFPUC Bay Division Pipelines 3 and 4 being out of service, which is discussed in Section 8.9.1. The same improvements should be implemented as discussed in Section 8.91., including: 1) Install a PRV at Santa Cruz and Sand Hill from zone 400, and 2) Install a booster pump from zone 220 to zone 319-A along Oak Avenue.

8.9.3 Backup Power for Pump Stations

Currently, with respect to emergency backup capabilities, the District has two portable booster pumps. In addition, it has new backup generators at Stations 5, 20, 27 and 35; and older backup generators at Stations 33, 36, and 38. The District is currently focusing on implementing backup for Stations 2 and 4 at the Bear Gulch Operations Center and treatment plant.

As discussed in the Section 6 performance criteria, backup power for pump stations should have a capacity to provide the firm capacity of the pump station. On-site generators would be considered for critical stations meeting any one of the following criteria:

1) Largest facility providing water to a pressure zone or service area;
2) Facility providing sole supply to multiple zones or service areas;
3) Facility providing water from supply turnout;
4) Facility providing water from key groundwater wells (e.g., capacity, quality, location).

Plug-in portable generators should be considered for less critical facilities.

Table 8-6 identifies critical pump stations based on the above criteria. The table screens each pump station against the above criteria. The "Total" column in the table shows the number of criteria met at each station.

Table 8-6 Bear Gulch System Critical Pump Stations

Pump Station	***Critical Pump Stations***				
	Largest Facility	***Sole Source to Multiple Zones***	***From Turnout***	***From WTP or Future Supplies***	***Total***
Lower BG Creek					0
Station 04	1	1	1	1	4
05 Intermediate	1	1	0	1	3
06 Coombsville	1	1	0	0	2
07 Woodside Highlands	1	0	0	0	1
08 Portola Booster	1	1	0	0	2
11 Alta Vista Booster	1	0	0	0	1
Station 13	1	0	0	0	1
Station 14	0	0	0	0	0
15 Woodside Knolls	1	0	0	0	1
16 Woodside Reservoir	0	0	0	0	0
17 Alpine Hills - Serves Zone 815	0	0	0	0	0
17 Alpine Hills - Serves Zone 910	0	0	0	0	0
Station 18	0	0	0	0	0
19 Ridgeway	1	0	0	0	1
Station 20	0	0	1	1	2
Station 21	1	0	0	0	1
22 Canada	1	0	0	0	1
Station 23	1	1	0	0	2
Station 24	1	1	0	0	2
25 Woodside Oaks	1	0	0	0	1
Station 26	1	1	0	0	2
27 Westridge	1	0	0	0	1
33 Los Trancos	1	1	0	0	2
35 Buck Meadows	1	1	0	0	2
36 Bonita	1	1	0	0	2
Station 38	1	0	0	0	1

Stations meeting the most criteria are pump station 04 which meets all four, and pump station 05 which meets three of four criteria. During a power outage, service at pump station 04 can be maintained with pump 04-D, which is an emergency pump

that includes an on-site diesel generator. Pump station 05 has an emergency generator with provision for two emergency pump hookups.

Pump station 20, which has an existing backup generator, meets two out of four criteria for being supplied by a turnout, BG-06 Alpine Rd. It is a key facility, although not the sole facility, for serving the southwestern portion of the system. In addition, as discussed in Section 8.11.2, it is a location considered for future expansion.

Eight pump stations meet two of four criteria. Seven of these eight stations meet the same two criteria; "largest facility in zone" and "sole source to multiple zones". Pump stations include 06 Coombsville, 08 Portola Valley, 23 (unnamed), 24 (unnamed), 26 (unnamed), 33 Los Trancos, 35 Buck Meadows, and 36 Bonita. These stations should have portable generator hookups and access to a portable generator. If there is an area wide power failure due to an earthquake for example, there should be enough generators to maintain system service. Assuming that not all stations will lose power at the same time, four additional emergency generators is a reasonable amount of standby equipment, which would assume that about half of the stations may be affected at any one time.

Other stations warrant an emergency generator for the reasons noted below, although meeting only the "largest facility in zone" criterion, according to the table. These include:

- As discussed in Section 8.11.2, Stations 8 and 13 are candidates for relocation and combining functions at a single location. An emergency generator should be considered, especially for a combined single location.
    - Pump station 8 serves most of the southern part of the Bear Gulch District. Supply to the south part of the district goes through either station 8 or 20, the majority being from station 8.
    - Pump station 13 feeds zone 715 from zone 660. Though pump station 13 is not the sole source of supply because the zone can be supplied by a 6-inch PRV from zone 815 at Veronica Place and Antonio Court, it is a major source.

Pump station 21 is a major supply into zone 815, although not the sole supply. With only 0.75 MG storage at Westridge tank in zone 815, the 2 MG of storage at Arrowhead tanks on the suction side of pump station 21 may be necessary during an emergency.

Eight stations meet one out of four criteria because they are the largest pump stations feeding the zone. These stations are less critical than the ones discussed above, since they are not the sole source of supply. No improvements are recommended at these

stations; the need for such improvements should be re-evaluated in future master plan updates.

8.10 Ability to Accommodate Local Supply Options

This section evaluates the ability of the existing distribution system to accommodate local supply sources identified in Section 7 to provide greater supply reliability, such as greater use of local surface water, future groundwater wells, future desalination (reverse osmosis) supply, and future recycled water. If the distribution system is adequate to accommodate a variety of sources then Cal Water will have greater flexibility to deal with future supply uncertainties.

8.10.1 Local Surface Water Supply

As discussed in Section 7. 3, the Bear Gulch District has the only existing local surface supply of the Cal Water San Mateo Peninsula service areas. The hydraulic model of the distribution system was used to investigate expanding the distribution system area that can be effectively served by the treatment plant. If the area served from the plant is expanded, a larger demand could be served to better utilize available supply. In addition, raw water supply improvements are also needed, which are described in Section 7.3.

In order to maximize surface water production, the most advantageous period of time to operate the treatment plant is the winter and early spring when surface water supply is available. During higher demand periods, there is sufficient demand in the area that can be served from the plant to utilize all the treated local surface supply. During lower demand periods, when more local surface supply is available, the demands in the portion of the system that can currently effectively be served from the plant are too low to utilize all the available local water. If the area that can be served from the plant during low demand periods is expanded, the available local surface supply during the winter rainy season could be more effectively used.

Currently the minimum winter demand day in the Bear Gulch District is about 5.5 mgd, which is similar to the delivery capacity of the plant. The hydraulic analysis evaluated how the distribution system could be supplied solely from the plant in order to meet up to 6 mgd of system demand during the winter. During higher demand periods, the District is already able to utilize all the water that can be produced by the plant. Therefore, the minimum winter demand is considered as critical operating condition for optimizing use of the WTP.

Currently treated water from the plant is pumped at Station 4 to the 400 and higher zones. The plant water is not at a high enough hydraulic gradeline to serve the 220 zone, which is the largest zone. The current practice to convey water from the plant to the 220 zone utilizes a portable PRV located on the discharge side of Station 4 connected to piping in the Bear Gulch Yard, with the PRV setting at 10 psi (216 HGL).

The hydraulic evaluation of the distribution system identified improvements to allow up to 6 mgd of treated surface water from the plant to be effectively used in the distribution system during the winter. With these improvements, the full plant capacity can be utilized during low demand periods assuming that adequate raw water supply is available from either directly from diversions or from Bear Gulch reservoir storage. The key elements are being able to utilize more water in the 220 zone, which has most of the system demand. The analysis was based on utilizing only treated water from the plant to meet all demands, with no SFPUC supply.

Below are several options that would allow the plant to be effectively used up to its 6 mgd capacity during the winter. The plan recommendations in Section 9 contain a placeholder for implementation of the required improvements. Subsequent to the master plan, more detailed analyses and predesign should be done to finalize the selection. The options are described below, and are shown on Figure 8-5:

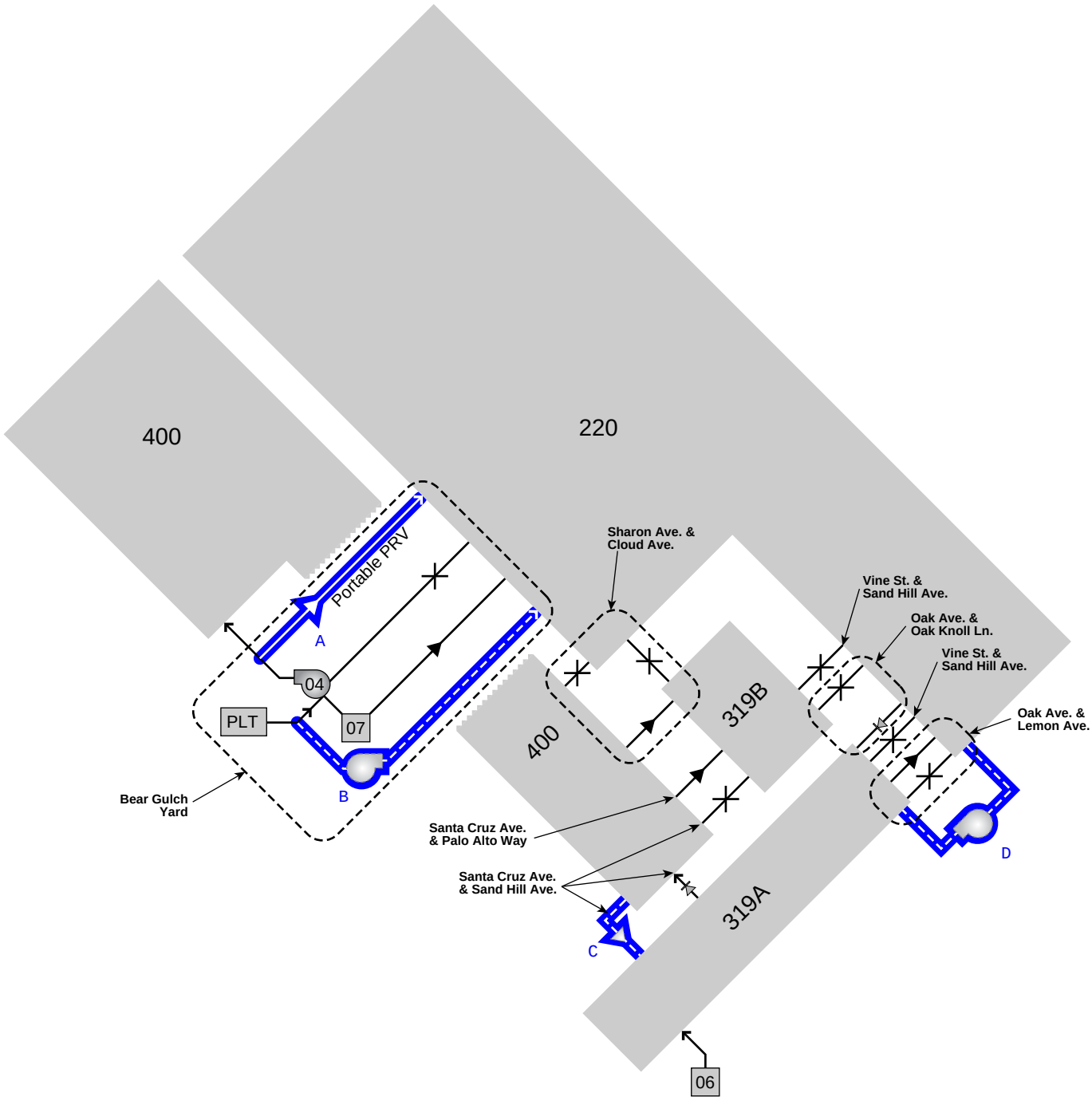
Permanent PRV Connection to Zone 220 at Station 4

With this option, the current temporary arrangement would be made permanent. Treated water from the plant will be pumped through Station 4, and then be conveyed to zone 220 via a PRV connection on the discharge side of Station 4. This would require minimal improvements.

In order to increase flow from the plant, the PRV setting must be increased above its current setting of 10 psi (HGL of 216 feet). For the hydraulic analysis, the PRV setting in Bear Gulch yard feeding zone 220 from the discharge of pump station 04 was set to 25 psi, or HGL 250 feet, which provides a higher grade line than PRVs from the SFPUC turnouts. This essentially turned off supply from the turnouts, with all supply being provided by the treatment plant. With a PRV setting of 25 psi, the hydraulic analysis showed the full treatment plant capacity could be delivered to the system during low demand periods, essentially serving the entire system from the plant on the minimum demand day.

A key consideration with raising the HGL of water delivered from the plant was to provide adequate service pressures at the top of the 220 zone, while not over-pressurizing the low elevations. With a PRV setting of 25 psi for water delivered from the plant and no supply from the turnouts, normal pressures could be provided at the high elevations in the 220 zone, while the service pressures at the lowest elevations in the 220 zone were essentially the same as with SFPUC supply.

Currently, pumps 04-C (1900 gpm), 04-F (2200 gpm), and 04-I (2000 gpm) are configured to draw suction from the treatment plant. The combined pumping capacity is adequate to deliver the plant's full capacity. The combined capacity of all three pumps is 6,100 gpm, or 8.8 mgd. With the largest of the three pumps out of service, the capacity is 5.6 mgd.



Legend

- 01 — SFPUC Turnout
- 220 (265) — Predominant Zone (Other Zones in Area)
- 04 — Pump Station
- Check Valve
- Normally Closed
- Flow Direction Arrow
- Pressure Reducing Valve

Alternatives

- Proposed Modifications
- A Increase PRV Setting into Zone 220
- B Low Head Pump from Treatment Plant into Zone 220
- C Install PRV from Zone 400 to Zone 319A (Alpine)
- D Install Pump from Zone 220 into Zone 319A (Alpine)

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Figure 8-5
Bear Gulch System
Local Surface Water Delivery Area Analysis

Pumps 04-G and 04-H that draw suction directly from the turnout BG-07 should not operate because the turnout competes with treatment plant output. When system demands increase to where plant supply cannot maintain Intermediate tank levels in zone 400, these pumps should turn on. This operating plan would prioritize supply from the treatment plant until system demands exceed plant capacity.

When system demands exceed the plant capacity, then supply must be provided from the SFPUC turnouts, which would be activated by the pressure drop at the turnout. The relative amount of supply from the turnouts versus the treatment plant is sensitive to pressure settings at the plant PRV and the turnouts. As discussed below, it is recommended that SCADA controls be implemented at the turnouts to allow better balancing of supplies.

Low Head Pump at Station 4 to Convey Flow to Zone 220

Rather than pumping from Station 4 to Zone 400 and then breaking head through a PRV into zone 220, low head pumps could be installed to pump directly from the plant to zone 220. This would provide more efficient operations and have lower energy costs over time, but would require pump station improvements. As discussed in Section 8.5, with respect to time-of-use pumping, it is typically not cost-effective to construct facilities solely based on long-term energy costs, i.e., the payback period is typically very long.

There is no available excess capacity at Station 4 during summer peak demand periods; so it is anticipated that a new station would be constructed at the Bear Gulch Yard to convey flows from the plant to zone 220. Because there is currently no storage in zone 220, a hydropneumatic tank system would be needed to control pressures and flows into the 220 zone. The station should be sized to provide low winter demands to zone 220 of 3.5 mgd to 4 mgd (about 2400 – 2800 gpm), e.g., 2 duty pumps of 1200 – 1400 gpm each, plus 1 standby pump of the same size. These would be low head pumps relative to the existing pumps at Station 4.

Another option would be to replace some of the existing Station 4 pumps with variable frequency drive pumps selected to better control pumping to different areas. The goal would be to select pumps that would allow the existing Station 4 facility to pump to both the 400 zone and the 220 zone during winter low demand periods, when its full capacity is not needed for the 400 and higher zones. During higher demand periods, all Station 4 pumps would be needed for zone 400 and higher zones. However, during the higher demand periods, there is sufficient demand in the system that the connection to the 220 zone is not needed.

"Blending" of Higher Pressure Water and Lower Pressure Water

As suggested by the District staff, a potential alternative to a low head pump would be to mix the relatively high pressure supply from SFPUC turnout BG-07 with the relatively low pressure supply from the treatment plant. The goal would be to

produce a combined flow with a hydraulic grade line adequate to feed zone 220, i.e., similar in gradeline to that provided either a PRV connection from Station 4 or a low head pump.

At a conceptual level, it is considered possible and would involve a configuration of piping/reducers/valves that would produce the proper pressure and velocity conditions by constricting flow (venturi effect). The discharge pressure and relative contribution (mix ratio) from each source would be considered in determining the appropriate mix from the two sources for the combined flow. As the relative contribution from the higher pressure turnout water increases, the pressure of the combined flow would also increase. Detailed hydraulic analysis and predesign effort would be needed to develop a specific configuration and confirm its feasibility.

A drawback of this option is that it is counterproductive to maximizing treatment plant output, since it would require use of SFPUC supply.

Additional Options to Convey Water from Plant to Other Zones

Other options to increase the flexibility for moving plant water into the distribution system, particularly into the southern portion of the system via pump station 20, include:

- PRV at Santa Cruz and Sand Hill, which would deliver water from zone 400 to zone 319-A and the suction side of pump station 20.
- Booster pump on Oak Avenue near Lemon Avenue would further improve treatment plant out flow by allowing supply from zone 220 to reach zone 319-A, which is the suction side of pump station 20.

As discussed in the Section 8.9.1 reliability evaluations, both improvements noted above are also recommended to reliably move water through the system in the event of an outage of Bay Division Pipelines 3 and 4. These improvements provide multiple benefits, and are included in the Section 9 plan recommendations.

SCADA Controls to Balance Supplies

The District must be able to control the PRVs at the SFPUC turnouts in order to optimize deliveries from the treatment plant in low demand periods. Unless the turnouts are turned off or very low, they will restrict delivery of plant water to the 220 zone. The SCADA improvements should be implemented regardless of whether a PRV connection, low head pump, or other means is used to deliver plant water to zone 220.

The District's seven connections to the SFPUC system are currently manually operated. District staff makes adjustments to the PRV settings seasonally to balance SFPUC and local surface water supplies. SCADA controls could help to optimize the

balance between SFPUC and local surface supplies while eliminating the labor/time required for manually adjusting PRV settings at each of the seven turnout locations.

If automated controls were installed on the PRVs on the Cal Water side of the SFPUC connections, it would allow for more efficient operational changes to fully utilize plant production capability. Combined with pressure and flow monitoring feedback signals, automatic PRV controls would allow staff to efficiently and quickly balance flows among individual SFPUC turnouts and local surface supplies. This would enable the district to fully utilize the plant during the winter when surface supplies are higher, while meeting system demands.

8.10.2 Future Groundwater Wells

As discussed in Section 7.6, the water bearing sediments in the Bear Gulch District area are generally located northeast of approximately Alameda de las Pulgas. Section 7.6 identifies 2 to 4 production wells of about 120 gpm each as a potential future supply source. Depending on the specific sites and characteristics, these wells may pump directly into the distribution system with individual wellhead treatment or to a centralized treatment/blending facility prior to distribution. Specific well sites have not been identified and will require future siting studies.

Due to the small individual well capacity, the wells could be located at any suitable sites near the larger pipelines in the zone and adequate conveyance capacity would be available. Individual wells should discharge into a minimum of 8-inch or larger pipes. If two or more wells are clustered in a wellfield, a minimum of 12-inch or larger pipe should be selected.

A potential option was evaluated to convey groundwater from future wells to the Bear Gulch water treatment plant. This would require construction of a long pipeline through developed areas, since the identified promising sites are located about 2.5 to 4 miles from the plant. There are existing parallel treated pipelines in Atherton Avenue from El Camino Real to the plant, which were evaluated to see if one could be converted to a groundwater (raw water) conveyance pipeline. However, both pipelines are needed as distribution system pipelines in order to maintain adequate pressures in Zone 220, especially in the higher elevation areas near zones 400 and 319. Therefore, this is not an option for a raw water conveyance pipeline.

8.10.3 Future Desalination (RO) Supply

As discussed in Section 7, potential future desalination (reverse osmosis [RO] supply) is a long-term supply option. It is a longer-term measure that could be implemented in the future if determined to be cost-effective relative to the cost of other supply components. This component may be more cost-effective at a regional level for the three Cal Water San Mateo County peninsula service areas. The most cost effective location for future RO supply will be determined as part of an upcoming integrated

water supply planning study for all the Cal Water San Mateo Peninsula service areas. For example, the San Mateo system and South San Francisco systems are adjacent to the Bay, which would provide an unlimited raw water supply source. In the San Mateo system, there may potentially be an option for use of the existing wastewater treatment plant outfall for brine discharge.

Raw water supply to an RO treatment system in the Bear Gulch area could be supplied from either the Bay or from brackish (poor quality) groundwater within the service area. The Bear Gulch service area does not abut the Bay. Providing raw water supply from the Bay, which is unlimited supply, would require extensive raw water supply improvements to convey the Bay water to an RO facility located within the Bear Gulch service area. Utilizing brackish or poor quality groundwater within the service area would be a limited supply, due to potential groundwater basin impacts, and could conflict with the proposed use of better quality groundwater as another supply component.

The existing Bear Gulch distribution system could accommodate future RO supply deliveries, e.g., potential locations of RO supply delivery points that would be compatible with existing distribution system and minimize/eliminate the need for distribution system improvements. These potential locations would be on the large diameter transmission mains in zone 220 that convey supply from the SFPUC turnouts into the system. If future RO supplies were delivered to this low zone transmission grid, it would replace SFPUC supply and could be accommodated without impacting operations. Specific locations would be identified as part of more detailed feasibility and siting studies, if a future RO supply project were identified for implementation in the Bear Gulch District as an outcome of the integrated supply planning study.

8.10.4 Future Recycled Water Supply

Future recycled water use will not significantly affect required distribution system improvements. The recycled water demand that would replace potable use is a very small percentage of the ultimate demand. Future use of recycled water to replace potable use by Cal Water customers for irrigation and industrial uses would reduce potable demands. The timing and extent of reduction would depend on how a recycled water project may actually be implemented.

8.11 Replacement Guidelines

In general, the Bear Gulch system facilities are well maintained, although old with respect to typical useful life expectancies. This section summarizes guidelines regarding useful life and replacement priorities for Cal Water's use in their replacement program.

Appendix J shows the Property Condition Report developed by Bear Gulch District staff for its pump stations and reservoirs. The report summarizes the condition of each station including exterior features, pumps, storage tanks, electrical and SCADA systems and other aspects of the station.

8.11.1 Useful Life Expectancies

Table 8-7 summarizes the typical range of useful life assumptions for major water system components, based on CDM's review of the literature, engineering judgment and our experience with similar water systems. Table 8-7 also shows the life expectancies that Cal Water uses for depreciation purposes.

Table 8-7
Useful Life Expectancies

Item	*Typical Ranges for Useful Life (years)*	*Cal Water Metro Area Service Life (years)*[1]
Pipelines (Ranges shown assume good design, fabrication, installation, and maintenance. These are overall system-wide ranges. Timeframe may be shorter in specific areas, if leak/repair history indicates recurring problems in areas.)		
Asbestos cement (ACP)	50 minimum, could be 80 to 100 under excellent conditions.	80
Plastic (PVC)	50 minimum, could be 100 under excellent conditions.	
Cast iron (CIP), ductile iron (DIP), steel Non-corrosive soil Moderately corrosive soil Corrosive to extremely corrosive soil	 100 50 – 75 with proper cathodic protection 25 – 50 with proper cathodic protection	
Appurtenances		
Valves	25	34[2]
Water Service Meters	15 – 20	
Fire Hydrants	25 – 50	
Storage Facilities		
Steel tanks	40 – 60 (with periodic repainting)	48
Pump Stations		
Structures	40 - 50	34
Pumps & mechanical equipment	20 – 25	
Electrical	10 - 20	
Instrumentation (telemetry)	7 - 10	
Electrical backup generator	20 – 25	

[1] Cal Water 2000 Depreciation Studies: depreciation curves based on useful life derived fro Cal Water assets – the values are differentiated by region.
[2] Assumed the same as pump station life.

The useful life estimates are an indicator of when rehabilitation or replacement may be needed. Generally, rehabilitation of major facilities would be done unless it was more cost effective to replace them.

It should be noted that there is little "hard" data available, in general, on the useful life expectancies of facilities. Many variables determine the actual service life of specific facilities, such as the design, installation, maintenance procedures, and local conditions. Utilities typically base estimates of future renewal and replacement improvements using information on actual condition of the facilities, such as leak/break records for pipelines, and field assessments of pump stations and tanks.

8.11.2 Pump Stations

Table 8-8 summarizes the ages of the existing pump stations, and their pumps and motors. The table also shows the results of pump efficiency tests conducted by Cal Water for those pumps tested during the last 4 years. The shaded facilities exceed Cal Water's expected service life of 34 years. Appendix J shows the Property Condition Report conducted by the District staff for pump stations. The report summarizes the condition of the station including exterior features, pumps, storage tanks, electrical and SCADA systems and other aspects of the station.

Priorities for rehabilitation/replacement based on age should consider whether the zone has backup supply or backup pump, how often the facility is used, and the frequency of maintenance. Typically, the mechanical and electrical equipment will require major rehabilitation or replacement; while often structures can be maintained and repaired.

Below is a discussion of replacement priorities that also consider capacity and reliability needs. Key pump stations are discussed first, including Stations 4, 8 and 13, and 20; followed by discussion of the other stations. Conceptual locations for future improvements are discussed at a conceptual master planning level of detail; siting studies have not been conducted as part of the master plan. The potential locations are generally assumed to be at existing Cal Water owned sites. Due to the developed nature of the Bear Gulch District, there are few potential new sites for such uses. Specific sites will be identified in subsequent Cal Water siting and predesign studies for project implementation.

Station 4

Station 4 supplies zone 400 and upper zones including 590, 660, 715, 815 and 910. In addition, it supplies all zones including the 220 zone via a temporary PRV, when the treatment plant is operating.

The motor in pump 04-C is 48 years old while the pump in 04-D, the emergency backup, is 41 years old. Pumps 04-F, 04-G, 04-H, and 04-I are relatively new. Sufficient pump capacity exists for buildout conditions for this station. The older pumps at this key station should be evaluated for potential rehabilitation / replacement.

Table 8-8
Pump Stations - Bear Gulch System [1]

Pump Station Number	Pump ID	Year Station Constructed [2]	Age of Station (yrs)	Pump Install Date	Pump Age [1] (years)	Motor Install Date	Motor Age [1] (years)	Pump Efficiency [3] (%)	Property Condition Report	
									SCADA	Pump Station
02	PMP-002-B	1976	32	1/1/1976	32	1/1/1976	32	na	Not reported	Not reported
	PMP-002-C	1976	32	1/1/1976	32	3/6/2001	7	na		
	PMP-002-D	1976	32	1/1/1976	32	1/1/1976	32	na		
04	PMP-004-C	1960	48	1/1/1990	18	6/30/1960	48	48.4	Old	Okay
	PMP-004-D	1967	41	8/1/1967	41	4/12/2002	6	na	Manual Controls	Okay
	PMP-004-F	1992	16	4/29/1992	16	4/29/1992	16	39.5	Old	Okay
	PMP-004-G	1992	16	4/29/1992	16	4/29/1992	16	60.2		
	PMP-004-H	1992	16	4/29/1992	16	4/29/1992	16	53.1		
	PMP-004-I							39.3		
05	PMP-005-J	2003	5	6/11/2003	5	6/11/2003	5	na	Old	New
	PMP-005-K	2003	5	6/11/2003	5	6/11/2003	5	na		
	PMP-005-L	2003	5	6/11/2003	5	6/11/2003	5	na		
	PMP-005-M	2003	5	6/11/2003	5	6/11/2003	5	na		
	PMP-005-N	2003	5	6/11/2003	5	6/11/2003	5	na		
06	PMP-006-A	1969	39	7/17/1969	39	7/17/1969	39	na	Old	Old
	PMP-006-B	1969	39	7/17/1969	39	7/17/1969	39	na		
07	PMP-007-B	1969	39	7/17/1969	39	7/17/1969	39	na	Okay	Old
	PMP-007-C	1978	30	10/1/1978	30	10/1/1978	30	na		
08	PMP-008-B	1956	52	1/1/1956	52	1/1/1956	52	47.3	Old	Poor
	PMP-008-C	1956	52	1/1/1956	52	1/1/1956	52	na		
	PMP-008-D	1969	39	4/1/1969	39	4/1/1969	39	na		
	PMP-008-E							45.4		
11 Hydropneumatic	PMP-011-A	1990	18	7/17/1990	18	7/17/1990	18	na	Old	Poor
	PMP-011-B	1951	57	7/1/1951	57	7/1/1951	57	na		
	PMP-011-C	2001	7	3/6/2001	7	3/6/2001	7	na		
13	PMP-013-B	1998	10	8/27/1998	10	8/27/1998	10	na	Okay	Old
	PMP-013-C	1964	44	5/21/1964	44	5/21/1964	44	38.8		
14	PMP-014-A	1953	55	3/25/1953	55	3/25/1953	55	na	Old	Poor
15 Hydropneumatic	PMP-015-A	1953	55	10/1/1953	55	10/1/1953	55	na	Old	Okay
16	PMP-016-A	1956	52	1/1/1956	52	6/1/1984	24	52.1	Okay	Poor

Table 8-8
Pump Stations - Bear Gulch System [1]

Pump Station Number	Pump ID	Year Station Constructed [2]	Age of Station (yrs)	Pump Install Date	Pump Age [1] (years)	Motor Install Date	Motor Age [1] (years)	Pump Efficiency [3] (%)	Property Condition Report	
									SCADA	Pump Station
17 (B, C Hydropneumatic)	PMP-017-A	1956	52	1/1/1956	52	1/1/1956	52	na	Okay	Okay
	PMP-017-B	1956	52	1/1/1956	52	1/1/1956	52	na		
	PMP-017-C	1962	46	5/1/1962	46	5/1/1962	46	na		
18	PMP-018-A	1957	51	9/1/1957	51	9/1/1957	51	32.2	Old	Okay
19 Hydropneumatic	PMP-019-A	1957	51	10/1/1957	51	10/1/1957	51	na	Okay	Okay
	PMP-019-B	1994	14	7/18/1994	14	7/18/1994	14	74.4		
20	PMP-020-A	1994	14	7/21/1994	14	7/21/1994	14	81.7	Okay	Okay
	PMP-020-B	1993	15	7/16/1993	15	7/16/1993	15	74.8		
21	PMP-021-A	1960	48	7/1/1960	48	7/1/1960	48	47.5	Good	Okay
22 Hydropneumatic	PMP-022-A	1977	31	3/1/1977	31	9/23/2002	6	na	Okay	Okay
	PMP-022-B	1977	31	3/1/1977	31	3/1/1977	31	na		
23	PMP-023-A	1994	14	11/23/1994	14	11/23/1994	14	59.2	Okay	Okay
	PMP-023-B	1989	19	6/1/1989	19	6/1/1989	19	na		
24	PMP-024-A	1974	34	1/1/1989	19	1/11/1974	34	na	Okay	Okay
	PMP-024-B	1989	19	1/1/1989	19	12/18/2002	6	na		
25	PMP-025-A	1974	34	1/1/1989	19	2/19/1974	34	na	Okay	Okay
	PMP-025-B	1974	34	1/1/1989	19	2/19/1974	34	na		
26	PMP-026-A	1977	31	3/1/1977	31	3/1/1977	31	77.4	Good	Okay
	PMP-026-B	1977	31	3/1/1977	31	3/1/1977	31	na		
27 Hydropneumatic	PMP-027-A	1985	23	3/1/1985	23	3/1/1985	23	na	New	Okay
33	PMP-033-A	Data for Los Trancos was not provided. If Cal Water provides data, CDM will insert into this table.						44.0	Good	Good
	PMP-033-B							53.6		
35	PMP-035-A							65.8	Good	Okay
	PMP-035-B							65.4		
36	PMP-036-A							75.1	Good	Okay
	PMP-036-B							77.2		
38	PMP-038-A							56.7	Good	Good
	PMP-038-B							na		

[1] Ages as of June 2008

[2] "Year Station Constructed" date assumed to be the earlier of the pump or motor installation dates

[3] Overall pump efficiency and PUC rating from pump tests conducted over the last 4 years (information provided by Cal Water). The PUC ratings are generally good to very good for ratings of 65% and above, fair for ratings between about 50 to 65%, and low to very low for ratings below 50%.

Note: Shaded facilities are at or older than Cal Water's expected service life of 34 years.

Improvements at the pump station should consider the options discussed in Section 8.10.1 that would allow more water from the Bear Gulch treatment plant to be effectively used in the 220 zone.

Stations 8 and 13

Stations 8 and 13 serve the southern portion of the service area on the west side. Stations 8 and 13 are both old and require improvement. There is an opportunity to combine these two stations into a single facility, as discussed below.

Pump station 8, along with station 20, feeds the southern part of Bear Gulch system, drawing suction from zone 590. It is one the more critical pump stations. Pumps 08-B and 08-C are 52 years old, and pump 08-D is 36 years old. These pumps are over Cal Water's expected service life of 34 years. Per the District's Property condition report (Appendix J), this station is in poor condition, with packing leaks, a need for cleaning and a likely need for lubrication. The general condition of controls is old and the panel board needs cleaning and maintenance. Paint on the pumps is poor, and the building exterior is poor and peeling. In general, the building is in poor condition. The site is also in a poor location, and the District would like to re-locate it.

Pump station 13 feeds zone 715 from zone 660 and is a critical pump station that contributes to the delivery of treatment plant water to the southern parts of the Bear Gulch system. Pump 13-B is 10 years old, while 13-C is relatively old, 44 years old. Additional capacity is needed at pump station 13 (0.42 mgd for existing demands; 0.49 mgd by buildout).

Because station 8 is in a poor location and in such poor condition, District staff has considered combining stations 8 and 13 into a single facility, located at station 13 or at a new site between stations 8 and 13. Currently station 8 pumps from zone 590 into zone 660; then station 13 pumps from zone 660 into 715. A combined facility would include one set of pumps supplying zone 660, and another set supplying zone 715.

For conceptual master planning purposes, it is assumed that the combined facility would be located at the existing station 13 site, which is 5,900 feet south of station 8. Siting studies subsequent to the master plan would be needed to determine the specific location, which may be anywhere between the two existing stations. A suction pipeline extension of up to 5,900 feet from the 590 zone to the combined facility at station 13 would be required. In addition, transmission pipeline improvements are needed in zone 590 in order to provide adequate suction pressures.

Supply is delivered from station 5 to station 8 via transmission lines along Moore Road, Woodside Road, Mountain Home Road and Portola Road (total distance of about 26,200 feet). Station 13 is another 5,900 feet south of station 8. Ground elevation at station 13 (505 foot elevation) is about 100 feet higher than at station 8 (405 foot elevation).

Between station 5 and the potential combined facility at station 13, some pipeline improvements will be needed to reduce transmission headlosses and maintain sufficient suction pressure, and to extend the suction pipeline from zone 590. For conceptual planning purposes, 20 psi was selected as a conservative minimum required pressure at the suction side of the combined facility. The following pipeline improvements would be needed:

- 2,500 feet of 12-inch pipeline on Moore Road between station 5 and Woodside Road should be upsized to 24-inch pipeline.
- 9,000 feet of 8-, 10- and 12-inch pipeline on Mountain Home Road between Vintage Court and station 8 should be upsized to 16-inch pipeline. Some of these improvements are also included as part of the Section 8.11.4 major pipeline replacement projects.
- Up to 5,900 feet of new 16-inch pipeline between station 8 and 13 on Portola Road that would be the new suction pipeline extension to the combined facility from zone 590.

With these improvements, hydraulic model results show that pressure would be 76 psi at the existing station 8 site, and 27 psi at the suction side of the potential combined facility at station 13. When the combined pump station is implemented, new pumps for the station 8 service area should be selected based on the new head conditions. It is anticipated that several pumps would be installed to provide flexibility in flow rates (another option would be to use VFDs).

The pumping capacity analysis in Section 8.5 assumes that the largest pump at Station 8 is out of service, and that both pumps at Station 20 are operating. Assuming one large pump at station 8 as standby, a combination of two 500 gpm pumps, and two 800 gpm pumps (one as a standby) would provide the required firm capacity, in conjunction with operating the two existing 500 gpm pumps at station 20.

To provide additional reliability for the southern portion of the District area, firm capacity at station 8 could be sized to supply the entire southern area without station 20 operating. This will require 3.8 mgd (2,640 gpm) firm capacity from station 8 only at buildout maximum day for zones 660, 715, 815, 960, Ladera (680, 560, 440), and Los Trancos (1055, 1265, 1435, 1600, 1890). Adding an additional 800 gpm pump at station 8 would provide the required additional firm capacity. With improvements mentioned above (upsized 24-inch pipelines at Moore Road and 16-inch pipelines along Mountain Home Road and Portola Road), suction pressure at the existing station 8 site would be 60 psi. The potential combined facility at station 13 would have a suction pressure of 13 psi.

With the transmission pipeline improvements in zone 590, hydraulic conditions will improve for filling of Coombsville tank. The existing zone 660 pipeline along Portola Road would remain in place to serve existing zone 660 customers, for backfeeding into the Coombsville tank if needed, and to allow delivery of surplus storage from zone 660 into 590.

Station 20

Station 20, supplied by SFPUC Alpine Road turnout BG-06, feeds zone 815 from zone 319-A. In addition, it will be able to convey local treatment plant water after implementation of improvements identified in Section 8.10. 1 for a PRV at Santa Cruz and Sand Hill Road to deliver water from zone 400 to zone 319-A and to the suction side of station 20. This PRV would also increase system reliability in the event of an outage of Bay Division Pipelines 3 and 4, as discussed in Section 8.9.1.

The overall condition of pump station 20 is listed as "okay" in the District's Property Condition Report. The two 500 gpm pumps were installed 14 and 15 years ago.

Station 20, in conjunction with station 8, serves the southern portion of the District. Some options were considered, as discussed below, that would increase supply reliability to this area and/or potentially improve operations.

With the current system configuration, station 20 pumps up to zone 815 and then water is delivered to the other zones in the cascade, including zones 815, 910, the Ladera area (including zones 440, 560, 680), and adjacent smaller zones. With the current pressure zone configuration:

- 1.3 mgd firm capacity is needed for buildout maximum day conditions, which will require an additional 500 gpm pump as a standby for added reliability. The Section 8.5 pumping capacity analysis assumed firm capacity at stations 8 and 20, which both serve the southern area, to be with the single largest pump 8D at station 8 as a standby, in accordance with the Section 5 performance criteria for multiple pump stations serving an area, i.e., both pumps at station 20 operating. However, because stations 8 and 20 are critical to the southern area, it is recommended that both stations 8 and 20 have a standby pump.

- The 12-inch discharge pipeline at station 20 is adequately sized for a buildout maximum day flow of 1.3 mgd. The existing 12-inch discharge pipeline can convey 1,100 gpm (1.6 mgd) at 3.0 ft/kft headloss.

To provide a higher level of reliability, station 20 could be sized to supply the entire southern area in the event that station 8 were out of service. The southern area, including all the area normally served by both station 8 and station 20 would require 3.8 mgd (2,640 gpm) for maximum day buildout conditions. Additional capacity at station 20 could be provided to meet maximum demand day of 3.8 mgd (2,640 gpm)

for the entire southern area, in the event that the entire area were served from station 20 without station 8 operating. Key features of this reliability improvement include:

- The existing 24-inch suction header at station 20 can accommodate additional pumps (at existing blind flanges - one 6-inch, two 8-inch, and one 12-inch), in addition to the two existing pumps, which are connected to a single 18-inch flange. Each existing pump has a design flow of 500 gpm. In addition to the two existing 500 gpm pumps, four additional 550 gpm pumps would be needed for buildout maximum day demands, with one of the 550 gpm pumps serving as the standby pump. Other pump combinations to provide flexibility in varying flow rates could be considered during predesign.

- The existing suction pipeline is a 24-inch, sufficient to handle 3.8 mgd. Headloss would be 0.5 ft/kft in a 24-inch pipeline with 3.8 mgd flowrate and a C-value of 130.

- The existing 12-inch discharge line in Alpine Road would be upsized to 24-inch diameter to match suction side pipeline capacity. Improvements include: 4,600 ft of existing 12-inch along Alpine Road between station 20 and Westridge Drive would be upsized to 24-inch main, and 4,100 feet of existing 12-inch on Westridge Drive between Alpine and Cervantes would be upsized to 18-inch main. The 24-inch pipeline will provide flexibility to potentially move water from station 20 directly to the Los Trancos area in the future.

- The following modifications would also be needed to the current configuration to move water from a station 20 source into parts of the system not now served by station 20. These improvements have been identified at a conceptual master planning level and will require more detailed investigation to confirm whether additional pipeline improvements may be needed to maintain current pressures under this mode of operation. These improvements include:

    - In order to deliver supply to zone 660 from zone 815, bypass PRVs would be needed at pump stations 14 and 21.

    - In order to deliver supply to zone 715 from zone 815, there is an existing 6-inch PRV at Veronica Place and Antonio Court that is capable of a 2.6 mgd flow rate. This PRV capacity is more than adequate to meet both maximum day (average hour) demand of 1.2 mgd for zones 715, 960, and Los Trancos. Storage is available in zone 715 serving that portion of the system to meet peak hour needs and fire flows. There are some relatively small diameter pipelines on both the upstream and downstream sides of the PRV (Antonio Court – 500 feet of 6-inch and 1,200 feet of 8-inch between PRV and 815 loop; Veronica Place – 25 feet of 6-inch and 550 feet of 8-inch that connect to 715 loop). Headlosses at 1.2 mgd flow rate are 53 ft/kft through 6-inch pipeline and 13

ft/kft through 8-inch pipeline. At a minimum, the six-inch pipelines along Antonio Court and Veronica Place should be upsized to 8-inch pipelines. Alternatively, additional PRVs could be installed at the existing check valves between zone 815 and 715 to deliver flow into the system at various locations rather than a single point. Check valves are located along 6-inch pipelines at two locations: Sausal Drive and Golden Oaks; and Minoca Court and Golden Oak.

Another option considered in the evaluation is to modify the pumping configuration at station 20 and have a set of low pumps that would pump directly to zone 440; as well as the high head pumps to zone 815. Zone 440 is currently at the end of a cascade of PRV zones beginning at zone 815 (from 815 via PRV to 680, from 680 via PRV to 560, and then by PRV to 440). The District has experienced issues in the past with regulator "bounce".

Currently, the fire storage for zone 440 is by gravity from zone 680 storage, Ladera tank; there is no storage located in zone 440. Therefore, zone 440 would become a hydropneumatic zone (or would require VFD pumps). As a hydropneumatic zone, required pumping capacity should be provided to meet peak hour demand on the maximum day. It is assumed that fire storage would continue to be provided from zone 680 by gravity via the existing PRVs, which would become standby PRVs. It would not be cost-effective to provide fire pump capacity for zone 440 through the hydropneumatic station.

The amount of pumping capacity for zone 440 that is currently provided by station 20 is for non-fire demands (average hour on the maximum day), which are very small. It would be possible to utilize the existing 12-inch pipeline in Alpine Road as a dedicated pipeline for zone 440, assuming that a new transmission pipeline is constructed for delivery of water to zone 815. This option does not appear to offer significant advantages over the current configuration. However, it is discussed further in the more detailed evaluation of the Ladera area, which is in Appendix K.

In conjunction with the option for low head pumps to zone 440, it was also evaluated whether zones 440 and 510 could be combined. Zone 510 is a small zone supplied by zone 815 via PRV located on Westridge Drive, just west of Alpine Road. Ground elevations at customer services range approximately between 237 and 367 feet in zone 440 and between 319 and 420 feet in zone 510. If the zones were combined into a single zone and operated at a grade line of 510 feet, pressure in the former zone 440 areas would increase by 30 psi. Maximum pressure in the combined zone would increase to about 120 psi in the lowest elevations of zone 440, which would be a significant increase over existing pressures. Combining the zones would require creating a 900 foot long easement and pipeline connection from South Balsamina in zone 440 to the existing 2-inch line extending north from Westridge Drive. In

addition to the high pressures, this option would be difficult to implement due to the easement requirements for the connection and the existing 2-inch line in zone 510 appears to be in a private road. Therefore, it is not recommended for implementation.

Other Pump Stations

Additional priorities for potential rehabilitation/replacement for booster pump stations based on age and amount of demand served are discussed below in order of highest to lowest priority:

- Pump station 16 is used to pump water out of the Woodside Reservoir to meet demands in Zone 590 (tank does not operate by gravity flow). The pump at station 16 is 52 years old, which is over Cal Water's expected service life. Per the property condition report, District staff indicated poor condition overall, with noise and vibration issues, possible heating issues, and a need for cleaning, lubrication and a pump evaluation. Control panel boards were in need of cleaning and maintenance. Paint on the pumps and on the building exterior and interior was in poor condition. This station is expected to be improved during the upgrade of Woodside reservoir.

- Pump station 14 is one of four pump stations feeding zone 815, although not the primary feed into the zone. The pump draws suction from Ormondale tanks and is necessary to provide turnover in the tanks. Being 44 years old and in poor condition, the pump should be evaluated for rehabilitation/replacement.

- Pump Station 21: Pump 21-A is 48 years old and is the lead pump into zone 815 during the winter, when treatment plant water is maximized. This pump station is in okay condition according to the property condition report. Because it exceeds the useful expected life, it should be evaluated for potential rehabilitation/replacement.

- Pump Station 24: Pumps 24-A, 25-A and 25-B are at the expected useful service life. Pump 24-A is in okay condition, while pumps 25-A and 25-B are in poor condition. They serve relatively small zones, 835A and 1090 in the south end of the Bear Gulch system. These pumps should be evaluated for potential rehabilitation/replacement.

- Coombsville station 06 serves the Woodside Highland area, which includes zones 795 and 1025. The pump station is in "old" condition according to the property condition report. Pumps are 39 years old should be evaluated for potential rehabilitation/replacement.

- Pump Station 07: Woodside Highland pump 07-B serves zone 1025, in "old" condition, and is 39 years old. Because it exceeds the expected useful life by 5 years, it should be evaluated for potential rehabilitation/replacement.

- Pump Station 17: Pump 17-A is 52 years old, in okay condition, and feeds zone 815. This station is one of four pump stations feeding zone 815 and is the not the primary feed into the zone. Station 20, which is relatively new, is the lead pump into the zone during the summer while station 21 leads in the winter. Pump 17-A is usually the second or third pump in the operating sequence.

- Pump station 18 feeds zone 590 from the northwest side of zone 400. It is used occasionally in the summer during high demands. It is 51 years old and in "okay" condition per the property condition report. One consideration is to take it out of service and allow Station 5 to supply water to zone 590 without the occasional boost from station 18. Hydraulic analysis indicates that the 8-inch pipeline along Lindebrook Road and part of Jane Drive would need to be upsized if station 18 is removed from service and station 5 is used meet all zone demand. With the increased flow, the pipeline has headlosses of about 10 to 11 feet per 1000 feet. About 5,000 feet of this 8-inch pipeline, which helps convey water to Ridgeway tanks and to the north side of zone 400 in the Woodside Hills area, should be upsized to a 12-inch. Appendix K contains more discussion of potential improvements from a more detailed analysis of several individual areas, including Woodside Glens.

Hydropneumatic zones have adequate capacity to meet normal peaking needs. However, the stations need additional capacity to provide fire flows to their service zones according to the master plan criteria. Rehabilitation/replacement of hydropneumatic pumps should also evaluate the hydropneumatic tank condition and size. The hydropneumatic tanks should be sized to limit cycling to no more than 4 to 6 cycles per hour. Below is a discussion of the hydropneumatic pump stations:

- Pump station 11: Pump 11-B, which was installed in 1951, feeds a relatively small hydropneumatic zone, 470. Pumps 11-A and 11-C were installed 18 and 7 years ago, respectively. The station needs an additional 1.85 mgd capacity to meet maximum day plus fire flow for buildout conditions. The property condition report indicated the station being in poor condition, with packing leaks, in need of cleaning, and likely in need of lubrication. Pump 11-B should be evaluated for rehabilitation/replacement.

- Pump station 15 serves a small hydropneumatic zone, zone 640, which is also served by a PRV from zone 805. During winter, the 0.03 MG Woodside Knolls reservoir at station 15 is drained and taken out of service such that zone 640 is served solely by the PRV. The District is considering taking station 15 permanently out of service for several reasons, including relatively small reservoir volume, added operations and maintenance costs and facility age. At 55 years, the pump, motor and tank exceed the expected service life and are in okay condition. As discussed in the following paragraph, station 15 can be taken out of service permanently, if PRV improvements are made.

- With pump station 15 permanently taken out of service, zone 640 would have to be supplied solely by a PRV from zone 805. The existing 2-inch PRV has adequate capacity to provide the buildout peak hour flow. However, an additional 6-inch PRV is required to provide the master plan fire flow plus maximum day demand. The District noted that pipes near the PRV are fragile and that leaks are commonly created when valves are closed too quickly. As part of PRV improvements, replacement of poor condition pipelines in the area should also be evaluated. Pump station 23 would need 0.03 mgd additional capacity to meet pumping requirements in zone 640. If these improvements are made, Station 15 can be taken out of service. More detailed hydraulic evaluations should be done as part of predesign to identify specific pipeline improvements to undertake in conjunction with the PRV improvements, and to confirm pressures in the affected zones.

- Pump Station 17: Pumps 17-B and 17-C are 52 and 46 years old. The two pumps, along with pump 27-A, feeds zone 910. An additional 1.4 mgd of capacity is required for buildout maximum day plus fireflow conditions. The relatively new pump 27-A is the lead pump into the zone. The property condition report indicated the station being in okay condition. Pumps 17-B and 17-C are past their useful life expectancy and should be evaluated for rehabilitation/replacement. As part of this project, consideration could be given to consolidating all pumping capacity at station 27, which is a newer station, if the site has sufficient room.

- Pump Station 19: Pump 19-A is 51 years old, while pump 19-B is 14 years old. These pumps serve a relatively small hydropneumatic zone, 675A. The station needs an additional 1.81 mgd capacity to meet maximum day plus fire flow for buildout conditions. The property condition report indicated the station being in ok condition. Pump 19-A should be evaluated for rehabilitation/replacement.

The other pump stations 20 and 27, not discussed above, were reported as "okay", which were determined by CDM to not be as urgently in need of replacement. Therefore, no improvements are included for these stations.

8.11.3 Reservoirs

Table 8-9 summarizes the age of the existing reservoirs, and the most recent painting of interiors and exteriors. Appendix B discusses the findings of the field visits to each reservoir. The shaded facilities exceed Cal Water's expected service life of 48 years.

Cal Water inspects the reservoirs every three to five years and determines whether the tank interior or exterior requires repainting. As noted previously, most of the tanks are older than 40 years and some are older than 60 years, and may soon require major rehabilitation or replacement.

Table 8-9 Bear Gulch System
Age of Existing Reservoirs
(shaded tanks are older than Cal Water service life of 48 years)

Reservoir Number	Name	Volume (gallons)	Tank Type	Year Constructed	Age (years) [1]	Seismic Upgrades per District Data	Comments per 2006 Property Condition Report	Notes Regarding Adequacy of Capacity at Buildout
T-002-T1	Lake	250,000	Ground Level Welded Steel	1937	71	Done	Old, not to current code.	Lake tanks used for treatment plant chlorine contact time. 13.7 MG additional storage needed for zone 220 without counting Lake tanks.
T-002-T2	Lake	500,000	Ground Level Welded Steel	1940	68	Done	Replace with larger tank.	
T-005-T6	Intermediate	100,000	Redwood	1946	62	Not Reported	Okay condition	1.8 MG additional storage needed for zone 400.
T-005-T8	Intermediate	250,000	Ground Level Welded Steel	1951	57	Done	Okay condition	
T-005-T9	Intermediate	1,000,000	Ground Level Welded Steel	1969	39	Accordian Fittings	Okay condition	
T-006-T1	Coombsville	200,000	Ground Level Welded Steel	1941	67	Done	Good condition	1.6 MG additional storage needed at Coombsville, Ridgeway, Woodside Knolls, or Woodside Reservoir for zone 590.
T-007-T1	Woodside Highlands	100,000	Redwood with fiberglass line	1960	48	Not Reported	Per 2006 report, seismic retrofit needed.	0.12 MG additional storage needed for zone 795-1, for fire reserve.
T-015-T1	Woodside Knolls	30,000	Redwood	1953	55	Not Reported	Okay condition.	Serves as suction for station 15 (zone 640). Options discussed in master plan to eliminate station.
T-016-T1	Woodside Res.1	1,000,000	Concrete			Not Reported	Per 2006 report, tank was to be replaced in 2007.	1.6 MG additional storage needed at Coombsville, Ridgeway, Woodside Knolls, or Woodside Reservoir for zone 590.
T-017-T1	Alpine Hills	250,000	Ground Level Welded Steel	1955	53	Done	Okay condition	0.97 MG additional storage needed for zone 715 at Alpine Hills. Surplus of 0.60 MG at Portola tank may offset the need if a bypass from discharge of station 26 to suction side is installed.
T-019-T1	Ridgeway	500,000	Ground Level Welded Steel	1957	51	Done	Good condition	1.6 MG additional storage needed at Coombsville, Ridgeway, Woodside Knolls, or Woodside Reservoir for zone 590.
T-019-T2	Ridgeway	500,000	Ground Level Welded Steel	1967	41	Done		
T-021-T1	Arrowhead	1,000,000	Ground Level Welded Steel	1960	48	Retrofit budgeted in 2008	Good condition	Zone 660 storage surplus of 1.19 MG at Arrowhead and Ormondale is assumed to be available for storage needs at zones 715 and 815.
T-021-T2	Arrowhead	1,000,000	Ground Level Welded Steel	1963	45	Retrofit budgeted in 2008		
T-022-T1	Canada	450,000	Ground Level Welded Steel	1976	32	Accordian Fittings	Okay condition	0.07 MG additional storage needed for zones 805, 880, and 640. This assumes 640 is supplied solely by PRV from 805, and station 15 does not contribute supply.
T-025-T1	Woodside Oaks	100,000	Redwood			Not Reported	Okay condition	0.15 MG additional storage needed for zone 835-A, for fire reserve.
T-027-T1	Westridge	750,000	Ground Level Welded Steel	1993	15	Accordian Fittings	Good condition, graffiti problem.	0.23 MG additional storage needed for zone 815, for emergency.
T-028-T1	Ladera	200,000	Ground Level Welded Steel	1948	60	Done	Good condition. Possibly upgrade tank volume.	0.48 MG additional storage needed for zone 680, for fire reserve.
T-029-T1	Ormondale	100,000	Redwood	1953	55	Needs retrofit	Good condition	Zone 660 storage surplus of 1.19 MG at Arrowhead and Ormondale is assumed to be available for storage needs at zones 715 and 815.
T-029-T2	Ormondale	100,000	Redwood	1954	54	Needs retrofit	Good condition	
T-029-T3	Ormondale	150,000	Ground Level Welded Steel	1973	35	Retrofit budgeted in 2008		
T-030-T1	Portola	100,000	Ground Level Welded Steel	1976	32	Retrofit budgeted in 2008	Good condition	Adequate capacity; has 0.6 MG surplus storage that could potentially be used to offset storage needs in Zone 715/675B.
T-031-T1	Summit	150,000	Redwood		Unknown	Not Reported	Per 2006 report, tank to be replaced in 2006.	0.07 MG additional storage needed for zone 1090, for fire reserve.
T-032-T1	Wayside	150,000	Ground Level Welded Steel	1968	40	Retrofit budgeted in 2008	Good condition	0.05 MG additional storage needed for zone 1025, for fire reserve.
T-033-T1	Los Trancos	10,000			Unknown	Retrofit budgeted in 2008	New bolted steel	Adequate capacity. This tank is a filled by a float valve and is used as a suction reservoir for pump station 33. If the pumps need replacement, consider eliminating reservoir and connecting suction side directly to zone 715.
T-034-T1	Sunrise	75,000	Concrete		Unknown	Not Reported	Good condition	0.13 MG additional storage needed for zone 1055, for fire reserve.
T-036-T1	Bonita	125,000			Unknown	Retrofit budgeted in 2008	New bolted steel	0.12 MG additional storage needed for zone 1265-1, for fire reserve.
T-037-T1	Old Spanish	55,000			Unknown	Retrofit budgeted in 2008	New bolted steel	Adequate capacity.
T-038-T1	Vista Verde	212,000			Unknown	Retrofit budgeted in 2008	New bolted steel	0.01 MG additional storage needed for zone 1600, for fire reserve.
T-039-T1	Pony Tracks	282,000			Unknown	Retrofit budgeted in 2008	New bolted steel	Adequate capacity.

[1] Age as of June 2008

Note: Shaded facilities are at or older than Cal Water's expected service life of 48 years.

The main areas of concern with existing tanks are seismic reliability, and factors contributing to degradation of water quality in the tanks such as single inlet/outlet pipes which reduce tank circulation or coating failures. Rehabilitation/replacement of reservoirs should consider seismic reliability, measures to maintain water quality (turnover) at all reservoirs, cathodic protection for steel reservoirs, and security at all sites.

Table 8-9 also notes if a tank has been seismically retrofitted to anchor it to the foundation and if the tank has accordion fittings (flexible pipe connections). The accordion fittings are intended to reduce the potential for failure of the connection during seismic events. The tanks without anchor bolts rely on friction between the tank and the pad to prevent horizontal movement during a large seismic event. Due to their large diameter relative to height, the tanks are not generally prone to overturning. The primary concern during a seismic event is overall flexing of the tank wall due to sloshing of the water in the tank and some potential movement of the tank, which the accordion fittings flex to accommodate.

General tank condition is noted in the 2006 Property Condition Report column in the table. In the last column are notes regarding the adequacy of capacity and need for additional storage capacity in the zone served by the reservoir. If additional storage capacity is needed in a zone with old facilities, these reservoirs would be good candidates for replacement with larger new facilities. Below is a discussion of replacement priorities that also consider capacity and reliability needs.

Key findings regarding potential reservoir replacement/rehabilitation are noted below. Conceptual locations for future improvements are discussed at a conceptual master planning level of detail; siting studies have not been conducted as part of the master plan. The potential locations are generally assumed to be at existing Cal Water owned sites. Due to the developed nature of the Bear Gulch District, there are few potential new sites for such uses. Specific sites will be identified in subsequent Cal Water siting and predesign studies for project implementation.

- There are several tanks that do not meet required storage due to insufficient fire reserves according to the criteria established for the master plan. Zones served by these tanks tend to have small demands relative to the amount of fire flow needed for residential and/or commercial buildings. Besides Ladera Tank which needs 0.48 MG additional storage, each zone requires less than 0.15 MG of additional storage. Tanks should be evaluated for replacement with increased capacity. Tanks serving zones with little demand, and relatively large fire reserve will require special considerations for design and operations to avoid impacts on water quality, as discussed further below. Zones with insufficient fire reserves include:

- Tanks that exceed Cal Water expected service life of 48 years: Zone 680 (28 Ladera), Zone 795-1 (07 Woodside Highland)

- Tank of unknown age; District condition report indicates replacement needed: Zone 1090 (31 Summit)

- Tanks of unknown age, although District condition report indicates good or new condition: Zone 1055 (34 Sunrise), Zone 1265 (36 Bonita), Zone 1600 (38 Vista Verde)

- Tanks less than Cal Water expected service life: Zone 805 (22 Canada), Zone 835A (25 Woodside Oaks, Zone 1025 (32 Wayside)

■ For zone 715, station 17 Alpine Hill tank, with a current capacity of 0.25 MG, is undersized by 1 MG at buildout conditions. The tank has capacity for operational storage, but not emergency or fire reserve. Though reported in good condition, the tank is 53 years old and should be evaluated for replacement with a larger tank.

- Station 30 Portola tank has 0.60 MG surplus storage that may be credited to zone 715 if a bypass from the discharge to the suction side of pump station 26 is installed. The bypass should connect 12-inch pipelines, bypassing 8-inch pipelines that exist at the discharge of pump station 26. The bypass would occur at the station and require less than 20 feet of additional pipeline.

- The remaining 0.4 MG would be provided by replacement of the existing old tank with a large 0.75 MG tank.

■ Other zones do not meet storage capacity due to insufficient emergency reserves to meet the master plan criterion of one average demand day. Larger zones tend to have inadequate capacity due to this criterion. These zones include: 220, 400, 590, and 815.

- Zone 220 is the largest zone and is supplied directly by SFPUC turnouts. There is no existing storage in this zone (other than the Lake tanks which are used as the treatment plant clearwell when it is operating). Of the 13 MG required storage, 4.5 MG is for operational storage; and 8.6 MG for emergency storage. Possible storage locations include the Bear Gulch yard or station 5. If placed at station 5, a PRV would be needed to reduce pressures to the proper grade line in zone 220. Another option would be to provide ground-level storage in zone 220 with a booster to pump from the tank, if there are any appropriate sites near large diameter mains. When adding storage for zone 220, the design must also consider how the SFPUC turnouts would be controlled to turnover the storage, e.g., flow control.

- Zone 400 requires an additional 1.8 MG storage at buildout for emergency reserves. There are three existing tanks at station 5 that serve zone 400. The largest is 1.0 MG, and is relatively new. The other two, the 62 year old 0.1 MG redwood tank and the 57 year old 0.25 MG steel tank, exceed Cal Water's expected service life. The two older tanks should be evaluated for replacement/upsizing to provide the required additional storage. To replace the two old tanks and provide the additional storage, 2.15 MG of storage is needed.

- For buildout conditions, 1.6 MG additional storage is needed for zone 590 for emergency reserves. Storage facilities in zones 590 have exceeded Cal Water's expected service life; station 6 Coombsville, and station 19 Ridgeway. Station 16 Woodside was to be replaced in 2007.

  - Surplus storage of 1.0 MG in zone 660 could back feed into zone 590 through a PRV installed at the location of normally closed valves at pump station 08. If this is done, additional storage required in zone 590 is reduced to 0.6 MG.

  - Older tanks should be evaluated for replacement with larger tanks to meet the 0.6 MG additional storage requirements.

- In zone 660, the two tanks at Station 21 Arrowhead have the largest storage in the Bear Gulch system at 2 MG total. There is a surplus of 1.0 MG for zone 660 from the Arrowhead and Ormondale tanks (not counting the two old redwood tanks). This surplus can be utilized by zone 590 which has a shortage of 1.6 MG. This surplus would backfeed to zone 590 through normally closed valves at station 8.

  - At 45-48 years old, the Arrowhead tanks are at or near Cal Water's expected service life and should be evaluated for rehabilitation.

  - One Ormondale tank is a 0.15 MG steel tank that is 35 years old. The other two are 0.1 MG redwood tanks that are 54 and 55 years old, and exceed the expected useful life. The storage volume of 0.2 MG from the two redwood tanks was not counted as part of the 1.0 MG surplus. The two redwood tanks can be removed from service, and do not need to be replaced.

- Zone 815 and adjacent smaller zones require an additional 0.23 MG of storage, primarily due to low emergency reserves. The relatively new tank in this zone, station 27 Westridge is 15 years old, in good condition and the only storage in the area.

- Station 2 Lake tanks are 71 and 68 years old, well past expected service life of 48 years. These tanks are used for chlorine disinfection of treatment plant water during the winter when the treatment plant in operating, and as flow through tanks from SFPUC supply during summer when the plant is not operating. They are not considered as distribution storage for zone 220. Due to age, the tanks should be evaluated for replacement/rehabilitation.

- The Los Trancos reservoir at station 33 provides suction pressure to the pumps, which deliver supply to zone 1055. The reservoir is filled from zone 715 by a float valve and has a maximum water level elevation of 591 feet. Approximately 100 feet of head is lost by filling this reservoir from zone 715. The age of Los Trancos system pump were not provided by the District, so remaining service life cannot be determined. If the pumps are in need of replacement, removal of the reservoir should be considered. Instead of float valve and sump operation, the suction side of pump station 33 could be connected directly to zone 715, eliminating the 100 feet loss in HGL and reducing pumping costs. If the reservoir is removed, local pressures at the pump station should be checked to confirm that suction pressures are adequate.

Poor turnover/circulation in reservoirs can adversely affect water quality. As water sits in the tanks and ages, the chloramine residual diminishes and the potential for nitrification increases. Nitrification is principally of concern when detention times in the system are very long. This condition typically tends to occur at reservoirs where demand is low relative to the overall storage volume, e.g., small zones or during winter low demand periods; where hydraulic performance limits turnover in the reservoir; or where adequate mixing does not occur within the tank.

Cal Water currently actively manages reservoirs to maintain adequate turnover and limit potential for nitrification to occur. Most tanks have single inlet/outlet pipelines. Some tanks may turn over but experience poor internal mixing, with greatly varying water quality in different parts of the tank. In general, water quality issues are worse during the winter low demand period. District staff checks reservoir sites weekly for temperature, pH, total chlorine, ammonia, and nitrates.

In addition to operational experience, information on water age in reservoirs can be used to identify reservoirs with potential problems, i.e., higher water age typically means lower turnover and is an indicator of potential water quality problems. The hydraulic model developed for the master plan can be used to evaluate the overall water ages in the system. Although not part of the master plan scope, such evaluations could be conducted subsequent to the master plan.

The appropriate solution for problem locations must be determined on a case-by-case basis, involving more detailed site-specific analysis than the master planning level. It is recommended that subsequent detailed investigations be undertaken to identify

and address specific problem locations and determine the most effective improvements at each location. Depending on the location, a combination of measures may be needed.

Potential measures to increase reservoir turnover typically include structural improvements to provide more flexibility to more rapidly drain storage, or modifying operational practices to reduce detention time. Measures that could be considered include:

- Adding a small jockey pump at the tank to force turnover;
- Changing set points to operate tanks within a smaller volume range during low demand periods if adequate customer pressures and fire service can be maintained;
- Having separate inlet and outlet lines on opposite sides of tank if the zone configuration permits;
- Installing a bypass valve at the pump station that supplies the zone or at a zone gate connection to the lower zone. The bypass valve, typically a hydraulically actuated pressure reducing valve with solenoid open-close capability, could be opened by operators to artificially increase the demand on the reservoir to draw down the reservoir. The valve could be tied into the SCADA system for remote operation.
- Providing SCADA controls on altitude valves to force tanks to turn over automatically.
- Providing automatic controls for ramping SFPUC flows into the system to help force turnover in zones with high SFPUC hydraulic gradeline; or convert turnout PRVs to flow control. Cal Water has experimented in the South San Francisco system with using two-stage PRVs at certain turnouts that would cut SFPUC flows until pressures reached a pre-set lower level that would not jeopardize service and fire flow capability.

For tanks where internal mixing is a contributing issue, below are examples of structural measures or mixing systems that might be considered:

- Inlet/outlet modifications to improve mixing during the tank fill cycle.
- FLYGT mixing pumps are submersible mixing pumps that allow flexibility in positioning and orientation within a tank. FLYGT pumps are well known, and have been used often, in all kinds of applications. This type of mixing has relatively high energy costs compared to the other options below, and installation must be performed inside an empty tank.

- Rotamix system provides mechanical jet mixing with an arrangement of floor-mounted nozzles fed by a pump located outside the tank. The system has relatively low energy costs and relatively high level of reliability because there are no moving parts inside the tank.

- The Tank Shark utilizes nozzles placed within three to five feet of the base of the tank causing an upward flow of water. The nozzle assembly can be suspended from the reservoir roof near an access hatch, or can be dropped and submerged into the tank with cables allowing for remote placement and retrieval. This system requires very low amounts of energy.

- The Tideflex system consists of a duckbill manifold system installed on an inlet/outlet pipe within the tank. The manifold pipe has two sets of duckbill check valves located at opposite ends, with one end conveying water into the tank and the other end conveying water out of the tank. These systems are usually installed in new tanks, although existing tanks can be taken out of service and retrofitted. There are no mechanical parts and no added energy costs with this system, except for the possibility of slightly higher headlosses on the intake side of the tank.

- Solar Bee units are solar powered and float on the water surface with a hose downward to an intake near the reservoir bottom. The units are relatively large and must be lowered through the access hatch (preferred size of 6 X 6 feet, minimum size of 3 x 3 feet). These units would be easier to install and maintain at underground or partially buried tanks, where access is close to ground surface. The solar panels would be installed on the roof or nearby ground surface if adequate exposure.

Baffling systems in distribution storage tanks are not recommended because they tend to increase detention time and encourage plug flow that inhibits mixing.

When new reservoirs are constructed, the design should specifically address minimizing water quality issues by incorporating features to enhance internal mixing, reduce detention times, and increase turnover. General guidelines for designing new reservoirs to minimize water quality problems are contained in an American Water Works Research Foundation study "Water Quality Modeling of Distribution System Storage Facilities", Walter Grayman, et. al., American Water Works Association Research Foundation Report No. 260, published 2000. These guidelines provide design guidance regarding the following items to avoid potential issues: achieving mixed flow rather than plug flow conditions; avoiding baffling; developing turbulent jet during inflow; avoiding stratification; providing mixing time less than fill time; avoiding inlet configurations that inhibit mixing; including sampling ports; and using computational fluid dynamics or scale modeling for complex design.

8.11.4 Pipeline Replacement

Section 4 (Table 4-5) summarizes the existing pipelines by size and material. Based on pipeline age information Cal Water, the older pipelines are typically steel pipes, with an average age ranging from 45 to 66 years. Concrete cylinder pipelines average about 45 years. The newer pipes are typically plastic pipes, with average age of about 12 to 24 years, and cement lined and coated steel pipes, with average age of about 13 years. Plastic pipes average about 12 to 24 years.

As described in Section 5.7, there is both a company-wide program for replacement of all small diameter and steel mains, as well as a District program for specific replacement projects. Improvements related to both programs are discussed below.

For the company-wide program, the highest priorities for replacement are undersized mains less than 6-inch diameter, as well as bare steel mains with a history of leaks and breaks. About 12 percent of the system pipelines are less than 6-inches in diameter; about 2 percent of the total pipelines are bare steel. These pipes are likely in the older parts of the system.

Based on the company-wide planned main replacement program, Table 8-10 summarizes the anticipated replacement lengths for a 50-year replacement period. The recommended improvements in Section 9 include an annual amount for main replacement based on the company-wide program. When pipelines are replaced, a minimum of 6-inch or larger diameter should be used according to the criteria in Section 5, and as needed to meet fire flows.

Table 8-10
Estimated Main Replacement Lengths
for Bear Gulch System per Company-wide Program

Cal Water Replacement Category	***Approximate Length (LF)***
Category A : < 6-inch diameter	200,000
Category B: Steel mains 6-inches and greater in diameter	58,000
Total Length	258,000
Average Annual Replacement Length over 50-Year Period	5,160 LF per year

In addition to the company-wide program, the District has developed a list of specific replacement projects to meet specific needs. The criteria for these projects are described in Section 5.7, and the entire list is contained in Appendix J. Many of these projects are replacements of small diameter pipes and steel pipes, which are also included in the company-wide main replacement program.

Table 8-11 summarizes the major pipeline replacement projects (12-inch and greater replacement diameters) included in Appendix J that go beyond the company-wide program. Some of these major replacement projects are also needed to improve zone pressures and/or for pump station improvements/relocations, as noted in the comments column of the table. The smaller diameter replacement projects identified by the District include replacement of about 24,000 LF of 6-inch pipelines; and 52,000 LF of 8-inch pipelines.

Appendix J also contains lists developed by the District of locations where critical pipelines cross faults and slide-prone areas, and locations of creek crossings. The fault and slide crossing locations are summarized below, as well as their relative importance:

Fault and Slide Crossings		
Importance	***Main Size (inches)***	***Number of Crossings***
Fault Crossings		
High	16	1
	12	4
Medium	12	1
	8	3
	6	2
	4	1
Low	8	1
	6	1
	Total	14
Slide Crossings		
High	18	1
	12	1
Medium	8	5
	6	2
Low	6	1
	4	1
	Total	11

The creek crossing locations are summarized below, as well as their relative importance:

Creek Crossing Locations		
Importance	***Main Size (inches)***	***Number of Crossings***
Creek Crossings		
High	24	1
	16	1
	12	6
	10	1
	8	1
Medium	16	3
	12	3
	10	4
	8	6
	6	1
	4	2
Low	12	1
	8	7
	6	7
	4	2
	2	1
	Total	47

Table 8-11
Major Pipeline Replacement Projects

Zone	Length (feet)	Size (inches)	Location	From - To	Replaces	Comments
590	2,500	16	Mt. Home Rd	Vintage to Sandhill	8" CI	Improve hydraulic capacity in Woodside zone. Needed for station 8 upgrade/relocation.
590	2,835	16	Portola Rd	Old La Honda to Sandhill	6" CI	Improve hydraulic capacity in Woodside zone. Needed for station 8 upgrade/relocation.
590	3,527	16	Portola Rd	South of Old La Honda to Sta 8	8" STL	Improve hydraulic capacity in Woodside zone. Needed for station 8 upgrade/relocation.
590	2,600	16	Woodside Rd	Mt Home To Fox Hollow	12" CI	Improve hydraulic capacity in Woodside zone, replace leaky pipeline.
590	2,600	12	Woodside Rd	Near Bridle to Oak Hills	6" STL	Improve hydraulic capacity in Woodside zone.
590	2,400	12	Manzanita	Winding to Whiskey Hill	6" STL & 6" CI	Improve hydraulic capacity in Woodside zone, replace leaky pipeline, and improve circulation within zone.
220	5,300	12	Walsh Rd	Sergeant to Alameda	10" CI & 8" CI	Replace leaky pipeline. Improve pressures in the intermediate zone.
220	2,800	12	Middlefield	Ravenswood to Linfield	8" STL & 6" CI	Replace leaky pipeline. Improve fire flow.
220	800	12	Bay Rd	Hedge to Greenwood	10" STL & 6" STL	Replace leaky pipeline. Improve fire flow.
220	4,500	12	Tuscaloosa	El Camino Real to Selby Ln	6" CI	Replace leaky pipeline, improve fire flow, improve circulation within zone.
220	3,800	12	Almendral	El Camino Real to Selby Ln	6" CI	Replace leaky pipeline, improve fire flow, improve circulation within zone.
220	700	12	Isabella	El Camino Real to Winchester	4" CI	Replace leaky pipeline, improve fire flow, improve circulation within zone.
220	500	12	Middle Ave	Hermosa to Cotton	8" STL	Replace leaky pipeline, improve fire flow.
220	9,600	12	Stockbridge	El Camino Real to Alameda	6" CI & 2" CI	Replace leaky pipeline, improve fire flow, improve circulation within zone.
220	300	12	Selby Ln	Grisham and across El Camino Real	4" CI	Replace leaky pipeline, improve fire flow, improve circulation within zone.
220	1,250	12	Serrano	Stockbridge to Selby	4" CI	Replace leaky pipeline, improve fire flow, improve circulation within zone.

The high importance crossings are generally those on the larger diameter pipelines that convey water to larger portions of the system, while the low importance crossings are smaller diameter distribution pipes serving small areas (few customers).

For the critical crossings, general recommendations are discussed below, and a placeholder budget is included in the Section 9 plan. The Section 9 plan recommendations assumes that the high importance crossings will be implemented in the near-term, followed by the medium priority as funding allows, and then the low priority crossings. Specific improvements for each location would be determined on a case-by-case basis, based on site investigations and predesign analysis.

Creek crossings would be reinforced by installing isolation valves and hydrants at either side of the crossing that would allow flexible bypass hoses to be used temporarily while damages are being permanently repaired.

For fault and slide crossings, Cal Water should install features that allow temporary service while pipeline damages are being permanently repaired, as discussed below. Design of new and/or replacement pipelines should be based on current industry standards, particularly those applicable to earthquake prone areas such as the San Francisco Bay Area, as discussed below.

A reference document "Seismic Guidelines for Water Pipelines" was published in March 2005 by the American Lifelines Alliance, a public-private partnership to reduce risk to utility and transportation systems from natural hazards and manmade threats. Preparation of the document was chaired by G&E Engineering Systems, a San Francisco Bay Area consulting company; and contributors included representatives from EBMUD, SFPUC, San Diego Water Department, and Los Angeles Department of Water and Power, a well as various universities and consultants. This document contains detailed information on seismic design considerations for water pipelines, as well as emergency preparedness measures to address pipeline outages.

For example, EBMUD has implemented a hazard bypass design for mitigating the many fault and landslide crossings within its service area. This type of bypass can be used for retrofitting existing pipelines or for new construction. There are two approaches depending on the importance of the crossing:

- At key locations where service must be maintained with minimal interruption. The bypass consists of a line isolation valve and a 12-inch diameter connection and manifold assembly, on either side of the defined hazard. For effective implementation, the hazard area should be well defined, so that the improvements are placed outside the hazard zone. Each of the manifolds is configured to accept one or multiple flex hose connections. In the event of a pipeline failure within the bounds of the hazard, the hazard isolation valves are closed to stop leakage at the point of failure. The flex hose(s) is then deployed

across the ground between the two manifold assemblies and serves as a temporary pipe bypass until permanent repairs are made.

- At locations where service disruptions can be accommodated due to redundant pipelines or supply sources. Only the isolation valves are installed without provisions for bypass flows. In the event of a pipeline failure, the pipeline is out of service until repairs are made. The isolation valves prevent loss of water and de-pressurizing the system.

Design of new permanent crossings should consider the following key elements (detailed discussions are contained in the "Seismic Guidelines for Water Pipelines"):

- Potential alternate alignments to avoid the hazard area.
- Provision for redundant facilities if possible.
- Selection of appropriate pipe materials – One of the most important factors for earthquake resistance is ductility of the material. Ductility is the ability of the material to sustain large plastic deformation without failure. Materials of high ductility include ductile iron, welded steel and some plastic. The high ductile pipes must also have flexible joints (see bullet below).
- Selection of appropriate pipe joints – Pipes with flexible and restrained joints perform better than ones with rigid (lead caulk) or non-restrained joints.
    - For welded steel pipes in high seismic/landslide hazard areas, the double lap weld (in some cases) or full penetration weld (preferred) is recommended.
    - Mechanical joints or couplings for use in high seismic/landslide hazard areas include:
        - EBAA-Iron Flex-Tend Joint – provides for vertical and horizontal defection and axial compression and expansion.
        - Sleeve-type mechanical couplings – provide for limited vertical and horizontal deflection.
        - Bellows-type expansion joints – provides for axial, offset, and angular defections.
        - Sleeve-type expansion joints – provides for axial expansion and contraction.

A budget placeholder for reinforcement at fault/slide crossing connections is included in the Section 9 plan recommendations assuming installation of manifolds and temporary hose connections or flexible connections and expansion sleeves. However, this type of connection may not be applicable for all sites. The cost can vary

widely depending on the specific characteristics at a particular crossing. Other measures such as installation of welded steel pipeline or polyethylene (welded) pipes or the ability to isolate the pipelines should be considered on a case-by-case basis during subsequent predesign efforts.

8.11.5 SCADA System

Cal Water is implementing a company-wide program to replace aging monitoring systems with state-of-the-art Supervisory Control and Data Acquisition (SCADA) systems. A typical SCADA system will allow remote control of pump and valve operation including modification of operational set points. Typical operational control features include modification of reservoir level controls, remote operation of pressure switches such as pump start/stop, and remote operation of valves such as to isolate a reservoir or pump station. Typical system monitoring parameters include reservoir levels, well water levels, system pressures, status indicators, and water quality indicators.

The Bear Gulch District staff conducted property condition assessments at each station, which included the SCADA system. (Stations 4, 5, and 11 are not on the list, possibly because Station 4 is in the Bear Gulch yard and Station 5 was recently upgraded.)

Pump operation and tank levels are on the SCADA system for all stations except 11, 15 and 18. Stations where controls were considered "old" in the property condition report are 6, 8, 15, and 18. Control system conditions in other stations were either okay, good, new or not reported on.

8.12 Evaluations of Individual Areas

As part of the master plan, five individual areas were evaluated in more detail. The locations of these areas are shown on Figure 8-1, and include:

- Woodside Highlands
- Woodside Glens
- Woodside Hills
- Ladera
- Downtown Menlo Park

Appendix K contains the more detailed evaluations of these areas. These evaluations address localized issues, such as poor easements (inaccessible, safety issues), slide prone areas, dead ends which impact water quality and hydraulics, precariously routed pipelines, City desires to minimize utility disruption in major downtown streets, and other similar issues.

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Section 9
Plan Recommendations

This section presents plan recommendations for the Bear Gulch District water system. These recommendations are an integrated summary of the water supply recommendations from Section 7 and the distribution system recommendations from Section 8. The plan provides capital costs for proposed facility improvements, and identifies the phasing for all recommendations. The basis for the capital cost estimates is provided at the end of the section.

In developing water supply recommendations, the Bear Gulch District has been analyzed to determine a reasonable water supply approach for this area independent of other Cal Water service areas in San Mateo County. Subsequent to this master plan, Cal Water intends to develop an integrated water supply plan for all of its San Mateo County service areas, which will consider the findings from the separate master plans.

9.1 Recommended Improvements and Phasing

The Bear Gulch District is close to buildout. There is little difference in the requirements for the existing and buildout demand scenarios due to the small future increase in demands. The average day demand at buildout for the Bear Gulch District is projected to increase about 8 percent over existing demand.

Pipeline improvements are recommended in some parts of the existing Bear Gulch distribution system, particularly in the largest zones, in order to strengthen the overall system transmission grid and improve system reliability. Additional storage capacity will be needed; the majority in the three largest storage service areas. Recommendations are included to improve the reliability of water supply to the service area, and the ability to move water throughout the system. The Bear Gulch District contains aging facilities that will need replacement over time.

SFPUC surface water will continue as the primary supply. In addition, a mix of other local supply sources will be utilized. The local sources include local surface water supply, long-term conservation savings as targeted in the Urban Water Management Plan, and use of temporary demand reductions if needed during droughts and emergencies. Conservation savings and demand management are key components of the supply strategy due to the high cost of developing other local supplies.

Development of future groundwater supply is recommended if appropriate opportunities can be identified, in particular to provide a local drought supply since local surface water which is not available in dry years. In the long-term, recycled water and desalination may be potential future options, but should be further evaluated as part of the integrated water supply plan with respect to the most effective implementation at a regional level.

Table 9-1 summarizes the plan recommendations for supply and distribution improvements for the Bear Gulch District, and the estimated capital costs and phasing. Figure 9-1 shows the locations of recommended pipeline improvements, facility relocations, and other key projects. Some recommended improvements are at existing facility locations shown on Figure 4-3 or at sites not yet identified, and are not shown on Figure 9-1. Section 9.2 describes the basis of the capital cost estimates. All costs are in 2008 dollars; costs for future years are not escalated for inflation.

Three timeframes were used to phase the recommendations:

- Near-term (2009 to 2013)
- Intermediate (2014 to 2018)
- Long-Term (2019 to Buildout at 2030)

Within each timeframe, the projects are listed in priority order according to the following types of improvements (listed in highest to lowest priority):

- Enhancing system reliability to move water throughout the system in the event of outages of SFPUC supply turnouts, and to more effectively utilize the District's local surface water treatment plant supply.
- Additional storage capacity to meet the established performance criteria, particularly to increase emergency storage to improve system reliability.
- Additional pumping capacity to meet the established performance criteria, and to provide additional system reliability.
- Additional PRV capacity to meet the master plan fire flow criteria.
- Pipeline capacity improvements to strengthen the transmission grid in key zones that deliver water to the rest of the system, and reinforcement of critical crossings to improve the reliability of the pipeline system.
- Near-term and intermediate implementation of local supply sources to improve supply reliability in the event of short-term reductions in SFPUC surface supply during emergencies or critical droughts: including more effective utilization of local surface supply, implementing Urban Water Management Plan measures for long-term conservation savings, using temporary demand reductions as needed during droughts/emergencies, and installing groundwater wells if sites can be identified.
- Long-term implementation of other local supply measures, such as emergency wells, recycled water and desalination, if feasibility is confirmed by subsequent studies. Implementation of long-term measures would also be based on the outcome of integrated supply planning for Cal Water's San Mateo County systems.
- Replacement of other aging facilities over time including small diameter pipelines, pump stations, reservoirs, and SCADA facilities.

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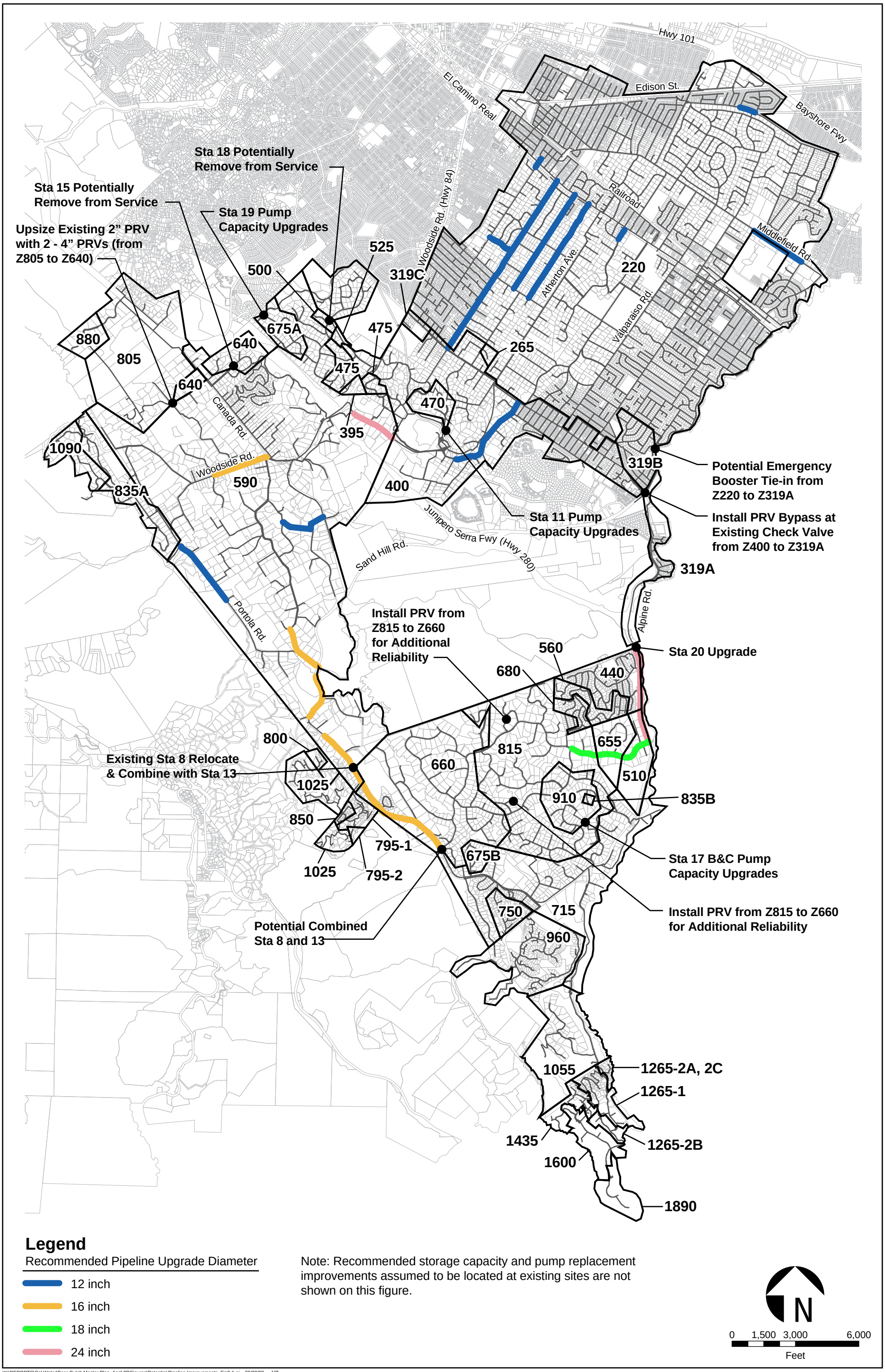

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Figure 9-1
Bear Gulch
Recommended Pipeline Improvements & Major Pump Station Improvements

Table 9-1
Summary of Recommendations for Bear Gulch District

Item	Description	Estimated Total Capital Cost in 2008 $ Million for Near-Term and Intermediate Timeframes	Distribution of Capital Costs in 2008 $ (per year for near-term and intermediate, per timeframe for long-term)										
			Near-Term					Intermediate					Long-Term
			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 - 2030 Buildout
Distribution System Capacity and Reliability (improve system capacity and reliability)													
Improvements to Enhance Supply Reliability and Effectively Utilize Local Surface Supply													
Permanent PRV and pipeline connection from Station 04 discharge to zone 220	Placeholder for improvements to be able to effectively utilize the full capacity of the local surface water treatment plant. Provides emergency supply from either the treatment plant or SFPUC Bay Division pipelines 3 and 4 to zone 220 if SFPUC Bay Division pipelines 1 and 2 and Palo Alto pipelines go out of service.	$0.2		$0.15									
SCADA controls for PRVs at SFPUC turnouts	Automatically control flows from SFPUC turnouts in order to fully utilize treatment plant water. Add PRV setting control and downstream pressure readings at each SFPUC turnout (7 locations).	$1.0		$0.50	$0.50								
Bypass PRV at Santa Cruz and Sand Hill	Reliability improvement to provide suction pressure from zone 400 to pump station 20 if SFPUC turnout at Alpine Road is out of service.	$0.2		$0.15									
Booster pump tie-in at Oak and Oak Knoll	Reliability improvement to provide suction pressure from zone 220 to pump station 20 if SFPUC turnout at Alpine Road is out of service.	$0.2		$0.15									
Storage Capacity and Reliability Improvements													
Storage in Zones Deficient in Fire Reserve Capacity	Additional storage is needed to meet fire reserve requirements according to the master plan criteria in the following tanks: 7 Woodside Highland, 22 Canada, 25 Woodside Oaks, 31 Summit, 32 Wayside, 36 Bonita, and 38 Vista Verde. These zones have small demand relative to the fire requirements. Costs are based on replacement with larger tank; however, dual tanks could be considered if site space is adequate.	$6.0			$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	
Storage for zones 440, 560, and 680 (fire reserve)	At station 28, the 0.2 MG Ladera tank is 60 years old although reported in good condition. It is undersized by 0.48 MG at buildout demand conditions primarily due to fire reserve requirements according to the master plan criteria. Cost assumes replacement with 0.7 MG tank (or dual .35 MG tanks).	$2.0			$0.40	$0.80	$0.80						
Storage for zone 715 (fire and emergency reserve)	Alpine Hills tank T-017-T1 is undersized by almost 1 MG due to both fire flow and emergency capacity at buildout. Though reported in good condition, the tank is 53 years old and should be evaluated for replacement/rehabilitation. Additional storage may be located either at Alpine Hills or elsewhere in zone 715 with similar elevation. Replace existing old tank with new larger 0.75 MG tank. Install bypass at Pump Station 26 to backfeed surplus Portola tank storage of 0.6 MG from zone 960 into zone 715.	$2.0			$0.40	$0.80	$0.80						
Storage for zone 220 (no existing supply; served from SFPUC turnouts)	Construct 13.7 MG storage for this zone which is served directly from SFPUC and has no existing storage. This storage could be located either at the Bear Gulch yard if there is sufficient space, at station 5, or at other appropriate/available sites for gravity flow based on ground elevation or pumped flow from ground-level tanks in zone 220. Cost assumes 3 tanks (2 @ 5 MG, 1 @ 4 MG).	$29.0				$2.00	$2.00	$5.00	$5.00	$5.00	$5.00	$5.00	
Storage for zone 400 (emergency storage)	Zone 400 requires 1.8 MG of additional storage at buildout. The 62 year old 0.1 MG redwood tank and the 57 year old 0.25 MG steel tank at Intermediate station 05 exceed Cal Water's expected service life. The tanks should be evaluated for replacement/upsizing to meet the required additional storage. Budget placeholder assumes replacement of the old tanks with larger tanks.	$6.2					$1.20	$2.50	$2.50				
Storage for zone 590 (emergency storage)	For buildout conditions, 1.6 MG additional storage is needed for zone 590. Storage facilities in zone 590 have exceeded Cal Water's expected service life; station 6 Coombsville, and station 19 Ridgeway. Station 16 Woodside was to be replaced in 2007. Tanks should be evaluated for replacement/rehabilitation for increased capacity to meet storage requirements. Budget placeholder assumes replacement of the old tanks with new larger tanks.	$10.0					$2.00	$4.00	$4.00				
Storage for zone 815 (emergency storage)	Zone 815 and related zones require an additional 0.23 MG of storage, primarily due to low emergency reserves. Cost assumes replacement with a single 1 MG tank or dual 0.5 MG tanks.	$2.5						$0.50	$1.00	$1.00			
Pump Station Capacity and Reliability Improvements													
Portable Backup Generators	Provide portable generator connections for 4 pump stations that meet two of the four criteria for critical pump station: Stations 6,23, 24, and 26. Cost includes purchase of an additional 4 portable generators.	$1.6		$0.40	$0.40	$0.40	$0.40						
Pump Stations 8 and 13	Recommendation to consolidate Stations 8 and 13 at one location (assumed to be the existing Station 13 site). Station 8 is in very poor condition and additional pumping capacity will improve reliability of supply to the southern portion of the system. Station 13 requires additional capacity, and also has an old pump that exceeds the useful life criterion. Cost assumes a combined facility with two sets of pumps - one set for 660 (station 8) and one set for 715 (station 13). Placeholder budget assumes station capacity sized for maximum day demand for entire southern area without station 20, for improved reliability. At a minimum, the station should be sized for the buildout maximum day demand for its current service area plus a standby pump. Required transmission improvements are included below under Pipeline Capacity & Reliability Improvements; these improvements are needed even if the station is sized for its current service area.	$2.2			$0.40	$0.90	$0.90						
Pump Station 20	Placeholder budget included to expand pump station for improved reliability of service to the southern portion of the Bear Gulch District - expand station to be able to provide all supply to the area without Station 8, which will require 3.8 mgd firm capacity (2 existing 500 gpm pumps, 4 additional 550 gpm pumps including one as standby). At a minimum, a standby pump should be added at station 20 for its current service area.	$3.4			$0.60	$1.40	$1.40						
Hydropneumatic Stations - pump capacity upgrades at stations 11, 17, and 19.	Replace existing old pumps and motors at these stations with larger pumps to provide both peak hour and maximum day plus fire flow. Implement associated electrical and telemetry upgrades as needed. Evaluate hydropneumatic tank condition and size as part of the upgrades.	$2.0						$0.50	$0.50	$0.50	$0.50		
PRV Capacity and Reliability Improvements													
PRV Capacity Upgrades	Install an additional large PRV (4" or 6") to provide fire flow capacity during average hour of maximum day in zones 265, 395, 440, 475-A, 475-B, 500, 510, 525, 655, 680, 795-2, 850, 1265-2A, 1265-2C, and 1435. In addition, a 6" PRV from zone 805 to 640 would be needed if station 15 is eliminated. The existing PRVs in these small zones can meet peak hour demands, but cannot provide the required fire flow per the master plan criteria.	$6.4		$1.60	$1.60	$1.60	$1.60						
Pipeline Capacity and Reliability Improvements													
Major Transmission Improvements in 220 Zone	29,500 LF of 12-inch pipeline replacements	$7.1		$0.40	$0.40	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90	$0.90	
Major Transmission Improvements in 590 Zone	11,500 LF of 16-inch pipeline replacements; 5,000 LF of 12-inch pipeline replacements; 1,000 LF of new 12-inch for second highway crossing	$6.4			$0.80	$0.80	$0.80	$0.80	$0.80	$0.80	$0.80	$0.80	
Additional Transmission Improvements in 590 Zone for Combined PS 8 & 13	2,500 LF of 24-inch pipeline replacement in Moore Road from Station 5 to Woodside; 5,900 LF of 16-inch pipeline extension in Portola Road from Station 8 to 13.	$3.0			$1.00	$1.00	$1.00						
Transmission Improvements in Alpine Road and Westridge for PS 20 Expansion	4600 LF of 24-inch replacement pipeline in Alpine Road from Station 20 to Westridge; and 4100 LF of 18-inch replacement pipeline in Westridge from Alpine Road to Cervantes	$3.6						$1.20	$1.20	$1.20			
Reinforcement of Fault & Slide Crossings	Total of 25 Locations: High Importance - 7 locations; Medium Importance - 14 locations; Lower Importance - 4 locations.	$7.0				$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	
Bypasses at Creek Crossings	Total of 47 Locations: High Importance - 10 locations; Medium Importance - 19 locations; Lower Importance - 18 locations.	$7.0				$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	$1.00	

Table 9-1
Summary of Recommendations for Bear Gulch District

Item	Description	Estimated Total Capital Cost in 2008 $ Million for Near-Term and Intermediate Timeframes	Distribution of Capital Costs in 2008 $ (per year for near-term and intermediate, per timeframe for long-term)										
			Near-Term					Intermediate					Long-Term
			2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 - 2030 Buildout
Local Supply Measures (enhance supply capacity, improve supply reliability)													
Water Conservation Measures													
Long term permanent conservation savings	Continue implementation of planned long-term conservation measures per Urban Water Management Plan. Evaluate implementation and effectiveness of planned conservation measures; modify as needed as part of Urban Water Management Plan update process.	Costs for these measures are not facility capital costs.	Conservation program implementation costs as determined in Urban Water Management Plan.					Conservation program implementation costs as determined in Urban Water Management Plan.					Conservation program implementation costs as determined in Urban Water Management Plan.
Temporary demand reductions	Implement temporary demand reductions during emergencies and droughts as outlined in Urban Water Management Plan (Water Shortage Contingency Plan), as needed to address temporary reductions in total supply.												
Local Surface Supply - raw water improvements (Note: Distribution system improvements are addressed in above section of table.)	Near-Term: Conduct detailed studies, using new operation conservation measures for flow diversions and historic creek flow data, to confirm raw water storage capacity needed to fully utilize allowable diversions in normal/wet years. Conduct feasibility/predesign studies to confirm available storage volume in existing Bear Gulch reservoir, and storage improvements that may be needed to increase withdrawal rate and/or drawdown level.	Annual costs included for near-term studies.	$0.10	$0.25	$0.25	$0.25	$0.25						Re-assess long-term needs and costs in future master plan updates.
	Near-Term and Intermediate: Implement raw water pumping and pipeline improvements to increase conveyance capacity from diversion locations to the reservoir and WTP. Placeholders are included for: 1) Station 3 pumping capacity upgrades to double its firm capacity to 9 cfs (5.8 mgd or 4000 gpm); and 2) replacing the existing raw water pipeline (9500 LF of 24-inch and 7800 LF of 30-inch).	$10.0				$1.00	$1.00	$4.00	$4.00				
	Long-Term: Re-evaluate potential supplemental sources of surface water supply and potential drought storage options, as part of regional water supply planning efforts.												
Groundwater	Design and implement an ongoing groundwater monitoring program to develop additional information regarding groundwater resources in the Bear Gulch District using appropriate existing wells in the area identified as favorable for groundwater development. Periodically evaluate the data with respect to overall trends.	Annual costs for monitoring program.	$0.10	$0.10	$0.10	$0.10	$0.10	$0.15	$0.15	$0.15	$0.15	$0.15	Re-assess long-term needs and costs based on monitoring findings.
	Near-Term: Conduct detailed groundwater studies/investigations to confirm the feasibility of implementing wells at specific sites. The studies should confirm expected yield, identify specific locations for wells, evaluate groundwater quality at the sites, and determine treatment requirements. For selected sites, conduct field investigations, including test hole and monitoring well, develop predesign information, and provide preliminary drinking water source assessment information to DPH. Complete an initial study checklist to determine the required environmental documentation.	Annual costs for near-term siting studies, field investigations and predesign studies, and CEQA initial study checklists at 4 sites.		$0.25	$0.25	$0.25	$0.25	.					Re-assess long-term costs in future master plan updates. Conceptual cost of $6.4 million for 4 additional emergency/drought wells (additional 0.7 mgd emergency/drought supply).
	Intermediate: Based on the results of the near-term studies and site investigations, implement up to 4 wells if appropriate locations can be identified, which would provide an annual sustainable supply of up to 0.7 mgd. Costs assume that extensive treatment may be needed to effectively utilize the well supply during emergencies/droughts (if blending with surface water is reduced or not possible).	$6.4 million for 4 wells for 0.7 mgd sustainable supply						$1.60	$1.60	$1.60	$1.60		
	Long-Term: Re-evaluate status of groundwater supply in future master plan updates and determine appropriate long-term actions. Consider implementing additional wells that would function only as emergency/drought supply, if appropriate sites can be identified. Placeholder costs are included for implementation of up to 4 additional wells, which could provide an additional 0.7 mgd supply, based on the same cost assumptions as for the intermediate wells.												
Recycled Water	Near-Term: Continue discussions with Redwood City to determine the conditions and cost for obtaining recycled water supply through the Redwood City system; initiate discussions with Palo Alto regarding their future plans for expansion of their recycled water system and potential partnership with Cal Water.	Annual costs included for near-term and intermediate program-related studies.	$0.10	$0.10	$0.10	$0.10	$0.10	$0.15	$0.15	$0.15	$0.15	$0.15	Conceptual capital cost estimate of about $14 million for recycled water distribution system to serve a "theoretical" average day demand of 0.7 mgd. Capital cost estimate does not include cost for purchase of recycled water supply from Redwood City (which is an operating cost, not a capital cost). Re-assess long-term costs in future master plan updates.
	Intermediate: If near-term discussions indicate that recycled water may potentially be cost-effective, conduct feasibility studies to identify specific customers and refine facility requirements.												
	Long-Term: Re-evaluate implementation of recycled water supply system in future master plan updates.												
Desalination	Near-Term: As part of regional supply planning for all San Mateo County service areas, scope and conduct a conceptual feasibility study to explore siting, technology, and potential partnering options.	Annual costs for program-related studies in near-term and intermediate timeframe. Long-term cost range shown for implementation of a 1 to 2 mgd RO project.	$0.10	$0.10	$0.10	$0.10	$0.10	$0.15	$0.15	$0.15	$0.15	$0.15	$15 million to $30 million for 1 to 2 mgd facility
	Intermediate: If feasible options are identified in the near-term feasibility study, evaluate implementing a pilot study as part of regional supply planning for all the San Mateo County service areas.												
	Long-Term: If confirmed by previous studies and if future conditions indicate it is a cost competitive supply source, an RO treatment facility of either 1 mgd or 2 mgd could be constructed for the Bear Gulch District. The capital cost range is for a 1 to 2 mgd facility that includes ancillary intake, raw water conveyance, treated water conveyance, and disposal facilities.												
Replacement/Rehabilitation Projects													
Reservoir Replacement: Station 02 Lake Tanks	Tanks T-002-T1 and T-002-T2 are 71 and 68 years old, well past expected service life of 48 years. These tanks are used for chlorine disinfection of local treatment plant water during the winter, and as flow through tanks from SFPUC supply during summer when the plant in not operating. Evaluate for major rehabilitation or replacement (cost based on replacement with steel tanks).	$1.5								$0.30	$0.60	$0.60	Re-assess long-term replacement needs in future master plan updated.
Reservoir Replacement: Arrowhead tanks	Arrowhead tanks 1 and 2 (zone 660)should be evaluated for major rehabilitation/replacement. Cost included for replacement.	$4.0								$0.80	$1.60	$1.60	
Pump Station Replacement (listed in priority order) - Replacement costs include pumps and motors, electrical and telemetry.													
Pump Station 4	Pump 04-C and 04-D are over Cal Water's expected service life and should be replaced. Pump 04-D is an emergency backup.	$0.7								$0.70			Re-assess long-term replacement needs in future master plan updated.
Pump Station 16	Pump station 16 is 52 years old, in poor condition.	$0.2								$0.20			
Pump Station 14	Pump station 14 draws suction pressure from Ormondale tanks and is necessary to turn over the tanks. It exceeds expected service life and should be evaluated for replacement/rehabilitation.	$0.2								$0.20			
Pump Station 21	This pump becomes the lead station into zone 815 during winter to maximize treatment plant water usage. It exceeds Cal Water's expected service life and should be evaluated for replacement/rehabilitation.	$0.4									$0.20	$0.20	
Pump Station 17-A	Pump 17-A is 52 years old and exceeds the expected useful life. It is one of four stations that feed zone 815.	$0.2									$0.10	$0.10	
Pump Stations 24 and 25	These pump stations have exceeded expected service life and serve relatively small zones, 835A and 1090; and should be evaluated for rehabilitation/replacement.	$0.6									$0.30	$0.30	
Pump Station 06	This pump station is 39 years old and should be evaluated for rehabilitation/replacement.	$0.3									$0.15	$0.15	
Pump Station 07	One of two pumps at this station is 39 years old and should be evaluated for rehabilitation/replacement.	$0.2									$0.10	$0.10	
Pipeline Replacement per Company-wide Program	Cal Water has a company-wide program for pipeline replacement of pipes less than 6-inch diameter and bare steel pipes. Specific budget amounts for replacement are determined each year based on leak history and system needs. An estimated amount is shown assuming replacement of 5,200 LF per year with minimum 6-inch diameter pipe.	$6.0	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.60	$0.6 annually for 15 years to 2030 = $9 million during Long Term timeframe
SCADA System	Cal Water to provide information for inclusion in plan regarding planned SCADA upgrades/budget amounts for Bear Gulch District.												
TOTALS		$145	$1.0	$4.8	$8.7	$15.8	$19.0	$24.8	$25.3	$17.0	$15.7	$13.6	To be re-assessed in future master plan updates.

Conceptual locations for future improvements are discussed at a conceptual master planning level of detail; siting studies have not been conducted as part of the master plan. The conceptual locations are generally assumed to be at existing Cal Water owned pump station or reservoir locations, where pipeline infrastructure already exists; or within public rights-of-way. Due to the developed nature of the Bear Gulch District, there are few potential new sites. Specific sites and alignments will be identified in subsequent Cal Water siting and predesign studies for project implementation.

More detailed information is provided on costs and phasing for recommendations over the next 5 to 10 years through 2018. These near-term and intermediate actions focus on improving the reliability of the existing supply and distribution system, and providing required capacity in the distribution system to meet the established performance criteria.

The recommended plan provides flexibility for implementation of various long-term steps depending on the outcome of near-term actions. Over the next 5 to 10 years, some uncertainties regarding local supply components should be resolved that will help better identify long-term implementation steps. Then, based on actual conditions in the future, the appropriate long-term pieces can be implemented.

9.2 Basis for Capital Cost Estimates

This section provides the basis of the conceptual planning-level capital cost estimates developed for facility improvements. All costs are in current dollars and are indexed to the Engineering New Records Construction Cost Index for San Francisco (ENR CCI of 9300 as of August 2008).

The estimated capital costs include:

- Construction Cost: Calculated using unit construction costs based on cost data from other CDM projects in the San Francisco Bay area. The unit costs assume a normal (average) construction environment, and do not include such things as significant rock excavation or dewatering, unusual working hours, or exotic construction methods.

- Construction Contingency: Markup of 30 percent of the construction cost, which is intended to account for additional work that may be identified during final design, uncertainties in the bidding climate, and change orders during construction.

- Project Implementation Allowance: Allowance of 40 percent of the total construction cost (construction cost plus construction contingency) to cover the following items:

- Feasibility and siting studies (4%),
- Preliminary and final design engineering, preparation of construction plans and specifications (12%),
- Environmental documentation and permitting (4%),
- Construction services including construction management, construction inspection, engineering support during construction, construction surveying, start-up services, and as-built drawings (10%),
- Project administration, legal support (2%) and Cal Water overhead (8%).

Table 9-2 summarizes unit capital costs for water system improvements. These unit capital costs are based on the construction cost times a total markup of 1.82 for construction contingency and project implementation (markups are compounded). The unit costs are based on previous work conducted or the South San Francisco and Mid-Peninsula master plans, adjusted for the Bear Gulch District area.

For the potential long-term water supply options of desalination and recycled water, placeholder costs are included based on the currently available information. These placeholder costs should be re-evaluated in future updates, as more information becomes available to determine specific facility requirements. The placeholder costs are:

- Recycled water – A long-term capital cost is shown for implementation of a future recycled water pipeline system for the scenario discussed in Section 7, which may potentially serve a maximum (theoretical) recycled water demand of 0.7 mgd. These are capital costs only and do not include annual O&M or the cost to purchase the recycled water supply from Redwood City.

- Desalination with reverse osmosis – Capital costs are based on modular increments (skid-mounted units) assuming potential total ultimate supply of 1 to 3 mgd. A range of capital costs is shown since there are significant uncertainties regarding the specifics of this supply option. The unit capital costs are anticipated to range from about $10 per gallon to $15 per gallon including treatment facilities and allowances for intake, finished water, distribution, and disposal facilities. The range depends on the required extent of the ancillary intake, finished water, distribution, and disposal facilities.

Table 9-2
Unit Capital Costs for Water System Improvements
(August 2008 $) (1)

RESERVOIRS (2)

Capacity (MG)	Concrete		Steel	
	Unit Capital Cost ($ per gallon)	Total Capital Cost ($ per Reservoir)	Unit Capital Cost ($ per gallon)	Total Capital Cost ($ per Reservoir)
0.25	2.70	675,000	2.10	525,000
0.5	2.60	1,300,000	2.05	1,025,000
1	2.55	2,550,000	2.00	2,000,000
1.5	2.45	3,675,000	1.95	2,925,000
2	2.35	4,700,000	1.90	3,800,000
2.5	2.30	5,750,000	1.90	4,750,000
3	2.25	6,750,000	1.80	5,400,000
3.5	2.20	7,700,000	1.75	6,125,000
4	2.15	8,600,000	1.70	6,800,000
5	2.05	10,250,000	1.65	8,250,000

PUMP STATIONS (3)

Total HP	Unit Capital Cost ($ per HP)	Total Capital Cost ($ per Station)	Cost Percentages for Replacement Projects
20	16,500	330,000	Replacement costs estimated as a percentage of the total capital cost for a new pump station: Pumps & motors – 20% Electrical/instrumentation – 30% Pipes, fittings, valves – 20% Building, site work – 30%
40	13,500	540,000	
60	12,000	720,000	
80	11,000	880,000	
100	10,000	1,000,000	
150	9,000	1,350,000	
200	8,000	1,600,000	
300	7,000	2,100,000	
400	6,600	2,640,000	
500	6,200	3,100,000	
600	6,000	3,600,000	
700	5,500	3,850,000	
800	5,000	4,000,000	

OTHER IMPROVEMENTS (4)

Type of Improvement	Capital Cost ($ per Location)
Portable Pump Connections, PRV Bypasses, Creek Crossing Locations	$150,000
Reinforcement at Fault and Slide Crossings	$300,000

PIPELINES (5)

Diameter (inches)	Unit Capital Cost Within Existing Paved Right of Way ($ per foot)
6	120
8	160
10	190
12	240
16	310

Table 9-2 ***Unit Capital Costs for Water System Improvements*** ***(August 2008 $)*** [(1)]		
18	350	
20	390	
24	470	
WELLS [(6)]		
Capacity	***Total Capital Cost per Well***	
120 gpm well with basic disinfection for sites where blending with water in the system would be adequate to allow use.	$900,000	
120 gpm well for sites that would require more extensive wellhead treatment (estimated capital cost for treatment at $4.00 per gallon on average, with range of $3.00 to $5.00 per gallon depending on specific site conditions)	$1,600,000	

(1) Unit capital costs include construction costs times 1.82 total markup for contingencies (30% of construction cost) and project implementation (40% of total construction cost with contingencies). Unit costs are in August 2008 dollars, ENR CCI of 9300 for San Francisco.

(2) Reservoir construction costs assume above ground structures and include average site work, valve vault, telemetry, piping and appurtenances. Steel reservoirs have a lower initial capital cost than steel reservoirs, however, steel reservoirs incur higher life cycle maintenance costs due to the need for periodic re-coating and cathodic protection. Cost estimates are based on concrete reservoirs.

(3) Pump station construction costs are based on an aboveground structure with standby pump, backup power capability, and telemetry.

(4) Cost of portable pump connections, bypass valves, or bypass connections at creek crossings is for 2 hydrants with valves off the transmission pipeline at each connection point (one hydrant and normally closed valve on either side of the zone separation), as well as up to 100 LF piping (either permanent or flexible piping). Connections are assumed to occur within existing right-of-way. Costs of portable pumps and generators are not included. At fault and slide crossings, the cost is per location based on installation of isolation valves and 12-inch diameter connection and manifold assembly on either side of the defined hazard, and flex hose for emergency use.

(5) Pipeline unit construction costs include valves and appurtenances, pavement removal and replacement, traffic control, and an average allowance for correction of utility interferences.

(6) Well construction costs include well drilling, well equipping, standby power, and up to 1,000 LF discharge piping to connect into distribution system. It is assumed that wells would be constructed at existing sites (no land costs), such as Cal Water owned properties, sites dedicated as part of new development agreements, or public properties through agreements between Cal Water and local agencies for emergency supply sites.

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Appendix A
Proposed Development Projects

APPENDIX A
Proposed Development Projects in the Study Area

Planning Area	***Project Name/Address***	***Current Land Use***	***Proposed Use***	***Current Status***
Menlo Park	1460 El Camino Real	Commercial/Office - Office buildings	16 two-story townhouse units, 26,800 square-feet (sqft) of office space	Project approved. Developer renewing building permits. No construction yet.
Menlo Park	1275 El Camino Real (Park Theatre)	Commercial/Office - Theatre	Office and non-office commercial uses, restoring existing building	Project is halted.
Menlo Park	1300 El Camino Real Mixed-Use Project	Commercial/Office - Vacant	108,850 sqft of commercial space	Developer working to get entitlements.
Menlo Park	110 & 175 Linfield Drive	Multi-family residential	56 multi-family units	Project appoved. Under construction.
Menlo Park	75 Willow Road	Commercial/Office - Office buildings	32 residential units (multi-family)	Project approved. Under construction.
Menlo Park	Derry Lane Mixed-Use Project, 550-580 Oak Grove Av. & 540-570 Derry Lane)	Commercial/Office - retail, service, auto storage	108 residential units (multi-family), 24,925 sqft of commercial space	Developer working to get entitlements.

Appendix B
Sensitivity Analyses of Service and Demand Projections

APPENDIX B-1
SENSITIVITY ANALYSES OF PROJECTED SERVICES

USING 5-YEAR AVERAGE GROWTH RATES:

Year	Customer Type							Total Services
	Single Family Residential	Multi-Family		Commercial Services	Industrial Services	Government Services	Other Services	
		Services	Units					
2005	16,250	65	1,300	1,284	1	95	30	17,725
2010	16,578	66	1,419	1,292	1	97	30	18,064
2015	16,912	67	1,549	1,300	1	99	30	18,410
2020	17,254	68	1,691	1,308	1	101	30	18,762
2025	17,602	69	1,846	1,317	1	103	30	19,121
2030	17,957	70	2,015	1,325	1	105	30	19,488
Increase	1,707	5	715	41	0	10	0	1,763
Growth Rate 5-year	0.40%	0.20%	1.77%	0.13%	0.00%	0.00%	0.00%	

Note: Multiple family services: ratio of units per service at year 2030 increases to 29 units per service (increase from current 20 units per service).

USING 10-YEAR AVERAGE GROWTH RATES:

Year	Customer Type							Total Services
	Single Family Residential	Multi-Family		Commercial Services	Industrial Services	Government Services	Other Services	
		Services	Units					
2005	16,250	65	1,300	1,284	1	95	30	17,725
2010	16,563	65	1,358	1,288	1	95	30	18,042
2015	16,881	65	1,418	1,292	1	95	30	18,364
2020	17,206	65	1,481	1,296	1	95	30	18,693
2025	17,537	65	1,546	1,300	1	95	30	19,028
2030	17,874	65	1,615	1,304	1	95	30	19,370
Increase	1,624	0	315	20	0	0	0	1,645
Growth Rate 10-year	0.38%	0.00%	0.87%	0.06%	0.00%	0.00%	0.00%	

Note: Multiple family services: ratio of units per service at year 2030 increases to 25 units per service (increase from current 20 units per service).

USING 20-YEAR AVERAGE GROWTH RATES:

Year	Customer Type							Total Services
	Single Family Residential	Multi-Family		Commercial Services	Industrial Services	Government Services	Other Services	
		Services	Units					
2005	16,250	65	1,300	1,284	1	95	30	17,725
2010	16,580	65	1,338	1,285	1	95	30	18,056
2015	16,917	65	1,376	1,286	1	95	30	18,394
2020	17,261	65	1,416	1,287	1	95	30	18,739
2025	17,612	65	1,457	1,288	1	95	30	19,091
2030	17,970	65	1,499	1,289	1	95	30	19,450
Increase	1,720	0	199	5	0	0	0	1,725
Growth Rate 20-year	0.40%	0.00%	0.57%	0.02%	0.00%	0.00%	0.00%	

Note: Multiple family services: ratio of units per service at year 2030 increases to 23 units per service (increase from current 20 units per service).

APPENDIX B-1
SENSITIVITY ANALYSES OF PROJECTED SERVICES

USING HIGHEST AVERAGE GROWTH RATES :

Year	*Customer Type*							*Total Services*
	Single Family Residential	*Multi-Family Residential*		*Commercial Services*	*Industrial Services*	*Government Services*	*Other Services*	
		Services	*Units*					
2005	16,250	65	1,300	1,284	1	95	30	17,725
2010	16,580	72	1,419	1,292	1	97	30	18,072
2015	16,917	79	1,549	1,300	1	99	30	18,426
2020	17,261	86	1,691	1,308	1	101	30	18,787
2025	17,612	93	1,846	1,317	1	103	30	19,155
2030	17,970	100	2,015	1,325	1	105	30	19,531
Increase	1,720	35	715	41	0	10	0	1,806
Growth Rate	0.40%	1.40%	1.77%	0.13%	0.00%	0.00%	0.00%	

Highest for Each Category over Any Period

Note: Multiple family services: ratio of units per service remains constant at current 20 units per service through 2030.

APPENDIX B-2
SENSITIVITY ANALYSES OF DEMAND PROJECTIONS

SCENARIO A: **10-Year Average Growth Rate**
10-Year Average Unit Demands per Service

Year	Average Day Demands (gallons per day)								
	Customer Type						Subtotal Customer Demand	Unaccounted-for Water (3.5%)	Total Demand
	Single Family Residential	Multi-Family Residential	Commercial	Industrial	Government	Other			
2005	10,278,671	231,052	1,281,806	5,206	247,193	63,586	12,107,514	439,133	12,546,647
2010	10,476,415	231,052	1,285,837	5,206	247,193	63,586	12,309,289	446,451	12,755,740
2015	10,677,964	231,052	1,289,880	5,206	247,193	63,586	12,514,882	453,908	12,968,789
2020	10,883,390	231,052	1,293,936	5,206	247,193	63,586	12,724,364	461,505	13,185,870
2025	11,092,769	231,052	1,298,005	5,206	247,193	63,586	12,937,811	469,247	13,407,058
2030	11,306,175	231,052	1,302,087	5,206	247,193	63,586	13,155,299	477,135	13,632,435
Per Service 10-year	633	3555	998	5206	2602	2120		3.5%	
								0.035	

SCENARIO B: **10-Year Average Growth Rate**
5-Year Average Unit Demands per Service

Year	Average Day Demands (gallons per day)								
	Customer Type						Subtotal Customer Demand	Unaccounted-for Water (3.5%)	Total Demand
	Single Family Residential	Multi-Family Residential	Commercial	Industrial	Government	Other			
2005	10,701,943	225,882	1,257,457	6,003	250,673	41,596	12,483,553	452,771	12,936,325
2010	10,907,831	225,882	1,261,411	6,003	250,673	41,596	12,693,395	460,382	13,153,777
2015	11,117,679	225,882	1,265,377	6,003	250,673	41,596	12,907,210	468,137	13,375,347
2020	11,331,565	225,882	1,269,356	6,003	250,673	41,596	13,125,075	476,039	13,601,114
2025	11,549,565	225,882	1,273,348	6,003	250,673	41,596	13,347,067	484,091	13,831,157
2030	11,771,760	225,882	1,277,352	6,003	250,673	41,596	13,573,266	492,295	14,065,560
Per Service 5-year	659	3475	979	6003	2639	1387		3.5%	

SCENARIO C: **5-Year Average Growth Rate**
10-Year Average Unit Demands per Service

Year	Average Day Demands (gallons per day)								
	Customer Type						Subtotal Customer Demand	Unaccounted-for Water (3.5%)	Total Demand
	Single Family Residential	Multi-Family Residential	Commercial	Industrial	Government	Other			
2005	10,278,671	231,052	1,281,806	5,206	247,193	63,586	12,107,514	439,133	12,546,647
2010	10,486,077	234,606	1,289,869	5,206	252,397	63,586	12,331,742	447,265	12,779,007
2015	10,697,668	238,161	1,297,983	5,206	257,602	63,586	12,560,205	455,551	13,015,757
2020	10,913,529	241,716	1,306,147	5,206	262,806	63,586	12,792,989	463,994	13,256,984
2025	11,133,745	245,270	1,314,363	5,206	268,010	63,586	13,030,181	472,597	13,502,778
2030	11,358,405	248,825	1,322,631	5,206	273,214	63,586	13,271,867	481,363	13,753,230
Per Service 10-year	633	3555	998	5206	2602	2120		3.5%	

SCENARIO D: **5-Year Average Growth Rate**
5-Year Average Unit Demands per Service

Year	Average Day Demands (gallons per day)								
	Customer Type						Subtotal Customer Demand	Unaccounted-for Water (3.5%)	Total Demand
	Single Family Residential	Multi-Family Residential	Commercial	Industrial	Government	Other			
2005	10,701,943	225,882	1,257,457	6,003	250,673	41,596	12,483,553	452,771	12,936,325
2010	10,917,890	229,357	1,265,366	6,003	255,950	41,596	12,716,162	461,208	13,177,370
2015	11,138,194	232,832	1,273,326	6,003	261,227	41,596	12,953,179	469,804	13,422,983
2020	11,362,944	236,307	1,281,335	6,003	266,505	41,596	13,194,691	478,564	13,673,255
2025	11,592,229	239,782	1,289,395	6,003	271,782	41,596	13,440,788	487,490	13,928,278
2030	11,826,141	243,257	1,297,506	6,003	277,059	41,596	13,691,562	496,585	14,188,148
Per Service 5-year	659	3475	979	6003	2639	1387		3.5%	

APPENDIX B-2
SENSITIVITY ANALYSES OF DEMAND PROJECTIONS

SCENARIO E: **Highest Growth Rate**
Highest Average Unit Demands per Service

Year	**Average Day Demands (gallons per day)**								
	Customer Type						***Subtotal Customer Demand***	***Unaccounted-for Water (3.5%)***	***Total Demand***
	Single Family Residential	***Multi-Family Residential***	***Commercial***	***Industrial***	***Government***	***Other***			
2005	10,708,750	237,907	1,281,806	6,003	289,140	127,114	12,650,721	458,834	13,109,555
2010	10,926,393	263,528	1,289,869	6,003	295,227	127,114	12,908,134	468,171	13,376,305
2015	11,148,459	289,148	1,297,983	6,003	301,314	127,114	13,170,022	477,669	13,647,692
2020	11,375,039	314,769	1,306,147	6,003	307,402	127,114	13,436,474	487,333	13,923,808
2025	11,606,224	340,390	1,314,363	6,003	313,489	127,114	13,707,583	497,166	14,204,749
2030	11,842,107	366,010	1,322,631	6,003	319,576	127,114	13,983,442	507,171	14,490,613
Per Service	659	3660	998	6003	3044	4237		3.5%	

Appendix C
District Information on Main Replacement Projects and Critical Pipelines

Public Version

California Water Service Company
Bear Gulch District

Long Term Main Replacement Matrix

Updated December 2005

Footage	Size	Location		From -- to	Location	Cost/ft	Total Cost	Flow in the Woodside zone	Leaks	Reliability or slide problems	Improve Fire Flow	Pressure in the Intermediate Zo	Operational Issues	Improve circulation	Bud for dsgn. Easements, perm	Importance	Replaces	Notes
2500	16"	Mt Home Road	--	Vintage to Sandhill	Woodside	$ 175	$ 437,500	X							X		8" CI	
2835	16"	Portola Road	--	Old La Honda to Sandhill	Woodside	$ 175	$ 496,125	X	X						X		6" CI	
3527	16"	Portola Road	--	South of Old La Honda to sta 8	Woodside	$ 175	$ 617,225	X	X						X		8" STL	recheck footage on this one in field
2364	12"	Woodside Road	--	Forest View to 8" AC	Woodside	$ 150	$ 354,600	X						X	X		NA	Allows additional feed to station 8
2600	12"	Woodside Road	--	Near Bridle to Oak Hills	Woodside	$ 150	$ 390,000	X							X		6" STL	
5400	24"	Woodside Road	--	Moore to Whiskey Hill	Woodside	$ 200	$ 1,080,000	X		X							12" CI	
2600	16"	Woodside Road	--	Mt Home to Fox Hollow	Woodside	$ 150	$ 390,000	X	X						X		12" CI	
2400	8"	Olive Hill	--	Albion to Canada & to Lanning	Woodside	$ 125	$ 300,000		X				X				6" STL & 4" CI	Backup to station 15
2500	8"	Lanning	--	Canada to Jane (Ravine)	Woodside	$ 125	$ 312,500		X								6" STL	
400	6"	Lanning Court	--		Woodside	$ 110	$ 44,000		X								6" STL	
300	6"	Ridge Court	--		Woodside	$ 110	$ 33,000		X								2" CI	
600	8"	Partition Drive	--	Replace above ground main	Woodside	$ 125	$ 75,000		X	X			X				6" STL	Blocks DW of station 24 -- Verify footage
1200	8"	Hillside	--	Glenwood to 6" @ 243	Woodside	$ 125	$ 150,000		X	X	X			X			2" STL & 1.5" STL	
1000	6"	Tripp Court	--	Summit springs to zone line	Woodside	$ 110	$ 110,000		X								2" STL	
400	6"	Tripp Court	--	Zone line to Trip Road	Woodside	$ 110	$ 44,000		X								2" STL	Consider feeding with regulator from high pressure
2000	8"	Family Farm	--	Portola Road to 8" AC	Woodside	$ 125	$ 250,000	X	X		X			X			4" CI	connects the Family Farm mains & will allow more feed to sta 8
1300	8"	Winding Way	--	Mt Home to near Manzanita	Woodside	$ 125	$ 162,500	X	X				X		X		8" CI & 8" STL	Also allows feed if Mt Home Road is down
400	6"	Manzanita	--	Across creek	Woodside	$ 200	$ 80,000		X						X		3" STL	
2400	12"	Manzanita	--	Winding to Whiskey Hill	Woodside	$ 150	$ 360,000	X	X				X	X			6" STL & 6" CI	Also allows feed if Mt Home Road is down
400	6"	Shine Road	--	Woodside to meters	Woodside	$ 110	$ 44,000		X		X						4" CI	
3800	8"	Summit Springs	--	Sta 25 to zone line (incl Patrol)	Woodside	$ 125	$ 475,000		X	X							various	Check for Cotton soils report
600	8"	Woodside Road	--	Bonson to Alameda	Woodside	$ 150	$ 90,000		X		X						6" CI	
5300	12"	Walsh Road	--	Sergeant to Alameda	Atherton	$ 200	$ 1,060,000		X			X			X		10" CI & 8" CI	Explosive leaks
		Alpine Road	--	Station 20 to La Cuesta	SM county		$ -	X		X	X				X		NA	In conjunction with pump at 20 for effic. improve. Need footage
1000	12"	280 Freeway crossing	--	Jane to Ridgeway	Woodside	$ 400	$ 400,000			X			X		X		NA	Additional pipeline here will allow abandonment of sta 15.
2	FH	Patrol Road	--	PBC at zone line on Patrol Rd	Woodside	$ 5,000	$ 10,000			X			X				NA	Emergency use if slide in Patrol Easement
400	2"	Willowbrook	--	Easement off Portola	Portola	$ 75	$ 30,000		X								2" CI	
200	2"	Grove easement	--		Portola	$ 75	$ 15,000		X								2" CI	
1100	8"	Nathorst	--		Portola	$ 125	$ 137,500		X		X						6" STL	
400	6"	Tan Oak	--	Corta Madera to FH	Portola	$ 110	$ 44,000		X								4" STL	
300	2"	Westridge easement	--		Portola	$ 150	$ 45,000		X	X			X				2" CI	Meters in easement, consider installing PRV from Alpine Road
600	8"	Ladera Easement	--	Ladera tank to Westridge	Portola	$ 175	$ 105,000		X	X							8" STL	
800	8"	Westridge	--	Ladera tank easm't to Degas	Portola	$ 125	$ 100,000		X								8" STL	
600	6"	Cresta Vista	--	Cervantes to end	Portola	$ 110	$ 66,000		X								2" CI	
450	8"	Willowbrook	--	Alpine to end of main	Portola	$ 125	$ 56,250			X	X		X	X			NA	Consider PRV with reverse check here
700	2"	Alpine Road	--	Near Sneakner Court	SM county	$ 75	$ 52,500		X				X				2" STL	Place main in Alpine Road for better meter locations
550	8"	Alpine Road	--	Wildwood to Bishop	SM county	$ 125	$ 68,750		X		X						6" STL	Main is not correctly shown on Distr map. Need to check.
600	8"	Altschul	--	Harkins to Sharon	SM county	$ 125	$ 75,000		X		X	X					4" CI	
450	6"	Perry	--	Leland to Vine	Menlo	$ 110	$ 49,500		X		X						2" CI	
450	6"	Palo Alto	--	Leland to Vine	Menlo	$ 110	$ 49,500		X		X						4" CI	
1400	8"	Oak Knoll	--	White Oak to Lemon	Menlo	$ 125	$ 175,000		X		X						6" STL	
200	2"	White Oak Court	--		Menlo	$ 75	$ 15,000		X								2" CI	
100	2"	Pembroke Court	--		Menlo	$ 75	$ 7,500		X								2" CI	
200	2"	Randall Court	--		Menlo	$ 75	$ 15,000		X								2" CI	
450	6"	Louise Court	--		Menlo	$ 110	$ 49,500		X		X						3" STL	
250	2"	William Court	--		Menlo	$ 75	$ 18,750		X								2" CI	
500	6"	May Brown Court	--		Menlo	$ 110	$ 55,000		X		X						3" STL	
400	6"	Lucky	--	Sharon to Liberty Park	Menlo	$ 110	$ 44,000		X		X						2" CI	
450	6"	Liberty Park	--	Lucky to Cloud	Menlo	$ 110	$ 49,500		X		X						2" CI	
800	8"	Florence	--	University to Fremont	Menlo	$ 125	$ 100,000		X		X						2" CI & 3" CI	
300	6"	Garden Lane	--	Off San Mateo	Menlo	$ 110	$ 33,000				X			X			NA	Eliminates substandard services
100	2"	Hillview Court	--	Off Hillview Drive	Menlo	$ 75	$ 7,500		X								2" CI	
500	8"	Werth	--	Arbor to Windsor	Menlo	$ 125	$ 62,500		X		X						6" STL	
300	6"	Blake	--	Middle to College	Menlo	$ 110	$ 33,000		X		X						3" CI	
2000	12"	University	--	Santa Cruz to Middle	Menlo	$ 150	$ 300,000		X		X						8" CI	Expensive & explosive leaks
650	8"	Mills	--	Alameda to Altshul	SM county	$ 125	$ 81,250		X		X						4" CI	
220	6"	Clayton	--	Alameda to Altshul	SM county	$ 110	$ 24,200		X		X						2" CI	
300	6"	Lee Court	--	Off Valparaiso	Menlo	$ 110	$ 33,000		X		X						2" CI	

Public Version

Footage	Size	Location		From -- to	Location	Cost/ft	Total Cost	Flow in the Woodside zone	Leaks	Reliability or slide problems	Improve Fire Flow	Pressure in the Intermediate Zo	Operational Issues	Improve circulation	Bud for dsgn. Easements, perm	Importance	Replaces	Notes
500	6"	Curtis Way	--	Santa Cruz to end of Court	Menlo	$ 110	$ 55,000		X		X						4" CI & 2" CI	Fire occurred at end of Curtis. FD requested a fire hydrant
3400	8"	Creek Drive	--	Arbor to ECR to Harvard	Menlo	$ 125	$ 425,000		X		X						4" CI	
1000	8"	Alma	--	Sherwood to SF connection	Menlo	$ 125	$ 125,000		X		X						8" STL	
400	8"	Laurel	--	Sherwood to Waverly	Menlo	$ 125	$ 50,000		X		X						6" STL	
200	6"	Waverly	--	Midblock section	Menlo	$ 110	$ 22,000		X								6" STL	
600	8"	Homewood Place	--	Linfield to end	Menlo	$ 125	$ 75,000		X		X						8" STL	Large water using customer at end (USGS)
2800	12"	Middlefield	--	Ravenswood to Linfield	Menlo	$ 150	$ 420,000		X		X						8" STL & 6" CI	
350	6"	Cherry	--	Laurel to Pine	Menlo	$ 110	$ 38,500		X		X			X			3" CI	
350	6"	Marcusson	--	Ravenswood to 6" AC	Menlo	$ 110	$ 38,500		X		X						6" STL	
1000	8"	Coleman	--	Menlo to Berkeley	SM county	$ 125	$ 125,000		X		X						6" STL	
750	8"	Toyon	--	Oak Grove to blowoff	Atherton	$ 175	$ 131,250				X			X			NA	
1000	8"	Edge Road	--	Ringwood to Lowery	Atherton	$ 175	$ 175,000		X		X						6" STL	
450	6"	Greenwood Court	--	Off Greenwood Drive	Menlo	$ 110	$ 49,500		X		X						4" STL	
1080	12"	Valparaiso	--	El Camino to Crane	Atherton						X			X			6" CI	Coordinate with Town street reconstruction project
5000	12"	Valpariaso	--	Emilie North Lemon	Menlo						X			X			6" CI	Coordinate with Town street reconstruction project
2200	8"	Valpariaso	--	Alameda to Orange	Menlo						X			X			6" CI	Coordinate with Town street reconstruction project
600	8"	Valpariaso	--	Delfino to North Lemon	SM county						X			X			6" CI	Coordinate with County street reconstruction project
800	12"	Bay Road	--	Hedge to Greenview	Atherton	$ 200	$ 160,000		X		X						10" STL & 6" STL	
200	6"	Lupin Court	--	Off Rosewood Drive	Atherton	$ 165	$ 33,000		X		X						2" CI	
400	6"	Wisteria	--	Off Rosewood Drive	Atherton	$ 165	$ 66,000		X		X						2" CI	
1200	6"	Maple Leaf Way	--	Off Debell	Atherton	$ 165	$ 198,000		X		X						2" CI	
250	6"	Elm Place	--	Off Linden	Atherton	$ 165	$ 41,250		X		X						2" CI	
600	8"	Acacia	--	Catalpa to Flood Circle	Atherton	$ 175	$ 105,000		X		X						2" CI	
2500	8"	Flood Circle	--	Loop	Atherton	$ 175	$ 437,500		X		X						4" CI	
700	8"	Juniper	--	Catalpa to Flood Circle	Atherton	$ 175	$ 122,500		X		X						4" CI	
800	8"	Magnolia	--	James to Flood Circle	Atherton	$ 175	$ 140,000		X		X						4" CI	
1800	8"	Hawthorne	--	Linden to James	Atherton	$ 175	$ 315,000		X		X						4" CI & 6" CI	
2050	8"	Heather	--	Linden to James	Atherton	$ 175	$ 358,750		X		X						4" CI & 6" CI	
2200	8"	Laurel	--	Encinal to Felton	Atherton	$ 175	$ 385,000		X		X						4" CI	
800	8"	Felton	--	Encinal to Laurel	Atherton	$ 175	$ 140,000		X		X						4" CI	
200	6"	Felton Court	--	Off Felton	Atherton	$ 175	$ 35,000		X		X						2" CI	
2400	6"	Arden Ave	--	Laurel to Felton	Atherton	$ 165	$ 396,000		X		X						4" CI	
2400	6"	Lennox Ave	--	Laurel to Felton	Atherton	$ 165	$ 396,000		X		X						4" CI	
800	8"	Moulton Drive	--	Off Glenwood	Atherton	$ 175	$ 140,000		X		X						4" CI & 2" CI	
400	6"	Fenwood Court	--	Off Glenwood	Atherton	$ 165	$ 66,000		X		X						4" STL	
200	6"	Bassett Court	--	Off Laurel	Atherton	$ 165	$ 33,000		X		X						2" CI	
400	6"	Mills Court	--	Off Glenwood	Menlo	$ 110	$ 44,000		X		X						4" CI	
250	6"	James Court	--	Off James	Atherton	$ 165	$ 41,250		X		X						2" CI	
850	8"	Maple	--	ECR to Railroad	Atherton	$ 175	$ 148,750		X		X						2" CI	
4500	12"	Tuscaloosa	--	ECR to Alameda	Atherton	$ 200	$ 900,000		X		X			X			6" CI	Low fire flows and long stretch of main.
3800	12"	Almendral	--	ECR to Selby Lane	Atherton	$ 200	$ 760,000		X		X			X			6" CI	Low fire flows and long stretch of main.
600	6"	Ashfield	--	ECR to 6" DI	Atherton	$ 165	$ 99,000		X		X						2" CI & 3" CI	
800	8"	Redwood Way	--	ECR to end	Atherton	$ 175	$ 140,000		X		X						4" CI & 2" CI	
300	6"	Barmetta	--	Redwood to end	Atherton	$ 165	$ 49,500		X		X						4" CI & 2" CI	
300	6"	Normandy	--	Redwood to end	Atherton	$ 165	$ 49,500		X		X						4" CI & 2" CI	
700	6"	Spencer	--	Isabella to end	Atherton	$ 165	$ 115,500		X		X						3" STL	
700	12"	Isabella	--	ECR to Whinchester	Atherton	$ 200	$ 140,000		X		X			X			4" CI	
800	6"	Inglewood	--	Atherton to end	Atherton	$ 165	$ 132,000		X		X						6" STL	
700	6"	Douglis	--	Victoria to end	Atherton	$ 165	$ 115,500		X		X						6" CI & 2" CI	
450	6"	Michael	--	Valpariso to end	Atherton	$ 165	$ 74,250		X		X						2" CI	
375	6"	Howard	--	Mcbain to end	Atherton	$ 165	$ 61,875		X		X						2" CI	
600	8"	Camino Al Lago	--	Elena to 6" AC	Atherton	$ 175	$ 105,000		X		X						4" CI	
400	12"	Middle	--	Hermosa to Cotton	Menlo	$ 150	$ 60,000		X		X						8" STL	
525	8"	Franks	--	Valpariso to Robles	Atherton	$ 165	$ 86,625		X		X						2" CI	
9600	12"	Stockbridge	--	ECR to Alameda	Atherton	$ 200	$ 1,920,000		X		X			X			6" CI & 2" CI	
350	6"	Parker	--	Midblock to end	Atherton	$ 165	$ 57,750				X						2" CI	
300	12"	Selby Lane	--	Grisham and across ECR	Atherton	$ 200	$ 60,000		X		X			X			4" CI	Main is in conflict with a county project and should be upgraded.
450	6"	Carolina	--	Stockbridge to end	Atherton	$ 165	$ 74,250		X		X						2" CI	

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Footage	Size	Location		From -- to	Location	Cost/ft	Total Cost	Flow in the Woodside zone	Leaks	Reliability or slide problems	Improve Fire Flow	Pressure in the Intermediate Zo	Operational Issues	Improve circulation	Bud for dsgn. Easements, perm	Importance	Replaces	Notes
300	6"	Selby Ct	--	Selby Lane to end	Atherton	$ 165	$ 49,500		X		X						4" STL	Near Country Lane
200	6"	Elizabeth Way	--	Shearer to end	Atherton	$ 165	$ 33,000		X		X						2' CI	
900	8"	Patricia	--	Stockbridge to Austin	Atherton	$ 175	$ 157,500		X		X						3" CI	
1250	12"	Serrano	--	Stockbridge to Selby	Atherton	$ 200	$ 250,000		X		X			X			4" CI	
9600	16"	Atherton	--	ECR to Alameda	Atherton	$ 250	$ 2,400,000		X		X						20" RS, 16" STL, 1	Possible slipeline project, would be nice to have a model.
	8"	San Carlos	--	Woodside to Himmel	SM county													
			--				$ -											
100102		**Total**					$ 23,185,650											
18.959	miles																	

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California Water Service Company
Bear Gulch District

Listing of Identified Critical Pipelines Crossing Faults, Creeks, and Known Slide Areas

Draft

Updated December 2004

Fault Crossing Pipelines

No.	Location	Main Type	Main Size	Main Purpose	Importance	Comments
1	Raymundo Drive off Runneymede	AC	6"	Transmission to Canada Tank	medium	
2	Woodside Road @ Mt Home Road	DI	12"	Transmission to Woodside Res & Sta 8	high	
3	Partition Road	AC	8"	Transmission to Summit Springs tank	medium	
4	Woodside Road @ Why Worry Lane	AC	12"	Transmission to Woodside Res	high	
5	Roberta Easement	AC	8"	Distribution main in 590 zone	medium	
6A	Portola Road	AC	12"	Transmission to Station 8	medium	
6B	Portola Road	CI	6"	Transmission to Station 8	medium	
7	Windham	CI	6"	Distribution main for one street	low	
8	Portola Road near Family Farm	AC	12"	Transmission to Sta 13 & Arrowhead	high	
9	Portola Tank Line	AC	12"	Transmission to Portola Tank	high	
10	Portola Road	AC	8"	Distribution main in 590 zone	low	If loop is completed, becomes trans. main
11	Raw Water pipeline near Indian Lane	STL	16"	Raw water transmission to BG Res	high	Important if we lose SF supply
12A	Kings Mt Road near trip	AC	8"	Distribution main in 590 zone	medium	
12B	Kings Mt Road near trip	CI	4"	Distribution main in 590 zone	medium	

Public Version

Slide Crossing Pipelines

No.	Location	Main Type	Main Size	Main Purpose	Importance	Comments
1A	Woodside Road near 280	AC	18"	Transmission to 590 zone	high	Cotton Report available
1B	Woodside Road near 280	CI	12"	Transmission to 590 zone	high	Cotton Report available
2	Wayside & Russel	YEL	8"	Transmission to Wayside Res	medium	Swing joints
3A	Santa Maria near Combsville	AC	8"	Transmission to Combsville Res	medium	
3B	Santa Maria near Combsville	STL	6"	Transmission to Combsville Res	medium	
4	Partition and Summit Springs	GALV	8"	Transmission to Summit Springs	medium	Victualic Couplings
5	Hayfields near top	AC	8"	Distribution to Hayfields & Old La Honda	medium	Cross country, some EBBA, some CL&C
6	Oakhill near station 16	AC	4"	Distribution main in 835 zone	low	Fire hose connections
7	Between Road & Summit Springs	YEL	6"	Distribution main in 1090 zone	medium	Only feed to area
8A	Marva Oaks	AC	8"	Transmission to Canada Tank	medium	
8B	Marva Oaks	AC	6"	Distribution main in 880 zone	low	Can supply low pressure from tank line

Public Version

Creek Crossing Pipelines

No.	Location	Main Type	Main Size	Main Purpose	Importance	Creek	Comments
1A	Olive Hill near Canada	CI	4"	Transmission from regulator to 640'	medium	Dry Creek	
1B	Olive Hill near Canada	AC	8"	Distribution main in 590 zone	medium	Dry Creek	
2	Woodside Rd near Mt Home	CI	12"	Transmission to Woodside Res & Sta 8	high	Dry Creek	
3	Raw water line near sta 3	STL	16"	Raw water pipeline	medium	Dry Creek	
4	Manzanita to Whiskey Hill	STL	6"	Distribution main in 590 zone	low	Dry Creek	
5A	Kings Mt and Tripp	AC	8"	Distribution main in 590 zone	medium	West Union Creek	
5B	Kings Mt and Tripp	CI	4"	Distribution main in 590 zone	medium	West Union Creek	
6	Woodside Road near Mt Home	AC	12"	Transmission to Woodside Res & Sta 8	high	West Union Creek	
7	Fox Hollow	AC	8"	Distribution main in 590 zone	low	Bear Creek	
8	Mt Home Road Bridge	STL	12"	Transmission to station 8	high	Bear Creek	
9	Raw water line near sta 3	STL	16"	Raw water pipeline	medium	Bear Creek	
10	Between Roan & Summit	YEL	6"	Distribution main in 1090 zone	medium	West Union Creek	Only feed to
11	Summit Springs above Partition	AC	8"	Transmission to station 25	medium	unnamed creek	
12	Tripp Court	STL	2"	Distribution main in 835 zone	low	unnamed creek	
13	Woodside Road near Indian Lane	AC	6"	Distribution main in 590 zone	low	Bear Gulch Creek	
14	Portola Road near Mt Home	DI	12"	Distribution main in 590 zone	low	unnamed creek	May become
15A	Portola Road near SandHill	AC	16"	Transmission to sta 8	high	unnamed creek	
15B	Portola Road near SandHill	AC	10"	Transmission to sta 8	high	unnamed creek	
16	Portola Road At Wayside	AC	12"	Transmission to sta 13 and Arrowhead	high	unnamed creek	
17	Family Farm (South)	CI	6"	Distribution main in 590 zone	low	Sausal Creek	
18	Family Farm (North)	CL&C	8"	Distribution main in 590 zone	low	Sausal Creek	
19	Portola Road near Farm Lane	AC	8"	Transmission to sta 13 and Arrowhead	high	Sausal Creek	
20	Westridge Drive at Possum Lane	CL&C	12"	Transmission to sta 13 and Arrowhead	high	Corte Madera Creek	
21	Groove at end	AC	6"	Distribution main in 675 zone	low	Corte Madera Creek	
22	Portola Road near Brookside	CL&C	12"	Transmission to Alpine Hills & sta 26	high	Corte Madera Creek	
23	Willowbrook	CL&C	8"	Distribution main in 715 zone	low	Corte Madera Creek	
24	Arastradero Road	CL&C	8"	Distribution main in 715 zone	medium	Los Trancos Creek	
25	Alpine Road west of 280	CCP	24"	Transmission to station 20	high	San Francisquito Crk	
26	Reservoir Road near Walsh	CI	10"	Transmission to low zone	medium	Atherton Channel	
27	Bellbrook near Walsh	AC	6"	Distribution main in 400 zone	low	Atherton Channel	
28	Walsh Road Court	CL&C	8"	Distribution main in 400 zone	low	Atherton Channel	
29	Broad Acres	CI	6"	Distribution main in 400 zone	low	Atherton Channel	

Public Version

No.	Location	Main Type	Main Size	Main Purpose	Importance	Creek	Comments
30A	Alameda at Walsh	STL	16"	Transmission to low zone	medium	Atherton Channel	
30B	Alameda at Walsh	AC	8"	Transmission for 400 zone	medium	Atherton Channel	
31	Camino a Lago near Barney	AC	8"	Distribution main in 220 zone	low	Atherton Channel	
32	Cowell Lane	AC	8"	Distribution main in 220 zone	low	Atherton Channel	
33	Camino a Lago near Monte Vista	CI	12"	Transmission in 220 zone	medium	Atherton Channel	
34	Barry Lane	AC	6"	Distribution main in 220 zone	low	Atherton Channel	
35A	Elaina Ave	CI	12"	Distribution main in 220 zone	medium	Atherton Channel	
35B	Elaina Ave	CI	4"	Distribution main in 220 zone	low	Atherton Channel	
36A	Isabella	AC	8"	Distribution main in 220 zone	low	Atherton Channel	
36B	Isabella	CI	4"	Distribution main in 220 zone	low	Atherton Channel	
37	El Camino	CI	12"	Transmission main in 220 zone	medium	Atherton Channel	
38	Middlefield Road near Watkins	CI	10"	Transmission main in 220 zone	medium	Atherton Channel	
39	Bay near Marsh	CI	10"	Transmission main in 220 zone	medium	Atherton Channel	
40	Bohannon	AC	10"	Transmission main in 220 zone	medium	Atherton Channel	
41	Old Alpine Road	CL&C	8"	Distribution main in 715 zone	medium	Los Trancos Creek	

Public Version

Appendix D
SFPUC Surface Water Supply Reliability Analysis

Appendix D
SFPUC Surface Water Supply Reliability Bear Gulch Water Supply and Facilities Master Plan

This appendix discusses the reliability of the San Francisco Public Utilities Commission (SFPUC) supply. This information was revised and updated from the work performed for the Mid Peninsula District's Water Supply and Facilities Master Plan. The reliability assessment includes: an analysis of the ability to serve SFPUC regional system customers following natural disasters, such as seismic events, that cause supply disruptions; and potential supply cutbacks during drought periods, such as occurred during 1976 and 1977 and 1987 through 1992. The update includes a discussion of potential SFPUC projects that would mitigate potential supply reductions.

Information is based on SFPUC documents that address seismic and supply reliability issues. Several documents review reliability as it pertains to the existing system. In February 2005, SFPUC published a draft program description for the Water System Improvements Program (WSIP), the $4.3 billion capital improvement program currently underway to reinforce the SFPUC system. This draft program was subsequently updated and a revised draft issued in October 2005. The program description establishes level of service goals for seismic and delivery reliability to meet 2030 demands, and identifies the WSIP projects to meet these goals.

In addition, information was obtained from the Bay Area Water Supply & Conservation Agency (BAWSCA), which represents members who purchase SFPUC supplies, regarding their perspective on SFPUC supply reliability.

The following topics are discussed in this appendix:

- Summary of Key Findings
- Overview of SFPUC Supply System
- SFPUC Supply Vulnerability to Hazards
- SFPUC Supply Vulnerability to Droughts

All tables and figures are included at the end of this appendix.

Summary of Key Findings

Key findings are summarized below:

- In the SFPUC Emergency Response and Recovery Manual (2003), a number of potential emergency scenarios were identified and evaluated for the existing system. Several earthquake scenarios investigated in detail the impacts of a major earthquake on the San Andreas, Hayward or Calaveras Faults. The SFPUC findings indicate that it will take two days to initiate water service after a major earthquake, and 90 days to restore all facilities. Until all facilities are restored, the existing SFPUC supply system will be able to deliver 50% of the current average summer day demand, which is equivalent to 50% of the Year 2030 average day demand of 300 million gallons per day (mgd).

- SFPUC's current WSIP includes a number of projects to improve system reliability in the event of a major earthquake, or other disaster. WSIP goals include restoring minimum service (215 mgd) within 24 hours of an earthquake, and restore average daily demand (300 mgd) within 30 days. The WSIP includes a number of projects to seismically reinforce the system, to achieve these goals. The current schedule calls for completion of all the projects that would benefit the Cal Water system over the next 7 years (by the end of 2014).

- SFPUC's projected 2030 demand for normal hydrologic years is 300 mgd. SFPUC's current planning goals include drought cutbacks of up to 20%, based on 2030 level of demands. For planning purposes, SFPUC used an 8.5-year "design drought," similar to extended drought 1987 through 1992, followed by a critically dry conditions similar to 1976-1977. SFPUC's cutbacks would increase throughout the drought period, beginning with 3.3% reductions during the first 3 years, then 13.3% reductions in the next 3 years, and finally 20% reductions in the last 2.5 years. For the 8.5-year design drought, this equates to deliveries ranging from 240 mgd to 290 mgd, with an average delivery of 265 mgd during the drought, or average cutback of 12% during the drought. Improvements will be needed to the SFPUC supply system to meet these goals.

- SFPUC's firm yield of its existing supply system, the amount it can reliably supply in dry years, is 226 mgd. This yield is 75% of projected 2030 demand of 300 mgd, requiring an average 25% cutback in demands during dry years, when insufficient supply is available to meet demand. Since deliveries are typically higher in the early years of a drought, before long-term drought conditions are recognized, an average drought cutback of 25% would likely mean cutbacks of less than 25% in early drought years, and cutbacks of greater than 25% in later drought years.

- Because SFPUC has an existing firm yield that is less than projected dry-year deliveries, SFPUC is investigating potential supply projects to increase drought reliability. These include restoring the SFPUC's Calaveras Reservoir to 98,000 acre-

feet (AF) capacity, desalination projects, groundwater conjunctive use projects, and recycled water projects. Projects are currently in the preliminary planning phase.

Overview of SFPUC Supply System

SFPUC supplies its regional system customers from the Hetch Hetchy system, the Sunol Valley Water Treatment Plant (SVWTP) and the Harry Tracy Water Treatment Plant (HTWTP). Figure 1 provides an overview of the SFPUC regional system facilities that are described in this section.

The Hetch Hetchy and SVWTP serve the Lower Gradient Pressure Zone of the regional system. The Hetch Hetchy and SVWTP supplies are blended and chloraminated in the Sunol Valley and served to regional system customers via the Bay Division Pipelines serving the South Bay, and the Pulgas and Crystal Springs Bypass Tunnel, and the Sunset and Crystal Springs Pipeline that convey water to Peninsula and San Francisco customers. The nominal operating gradient to Peninsula customers is elevation 302 feet, based on the overflow weir on Pulgas Tunnel that discharges water to the raw water Crystal Springs Reservoir. The gradient at Cal Water turnouts, which are near the Pulgas Valve Lot, would be at a similar gradient because the valve lot is close to the reservoir.

The HTWTP supplies the Upper Gradient Pressure Zone of the regional system. HTWTP treats water from the Crystal Springs and San Andreas reservoirs and serves water to the San Andreas 2 and 3 pipelines that serve customers in the northern Peninsula and San Francisco. The nominal gradient for the pressure zone is 465 feet, based on the overflow elevation of the treated water reservoir at the HTWTP.

Cal Water Bear Gulch service area has seven turnouts served from the Lower Gradient Pressure Zone through the Bay Division Pipelines, at or near the Pulgas Valve Lot.

Turnout	Location
BG-01	
BG-02	
BG-03	
BG-04	
BG-05	
BG-06	
BG-07	

During supply disruptions in the Lower Gradient Pressure Zone, SFPUC can increase the HTWTP production rate and use the Capuchino Regulating Station in San Bruno to supply the Lower Gradient Pressure Zone from the Upper Gradient Pressure Zone. During HTWTP disruptions, SFPUC can use the Baden Pump Station in South San Francisco to supply the Upper Gradient Pressure Zone from the Lower Gradient Pressure Zone.

SFPUC Supply Vulnerability to Hazards

The SFPUC has evaluated the existing system to identify supply vulnerability to hazards. Based on this assessment, SFPUC identified several improvements that have been incorporated into its WSIP to reduce supply vulnerability. This section discusses both the review of the existing system and the proposed improvement projects.

Existing System Vulnerability Assessment

The SFPUC Emergency Response and Recovery Manual (Pirnie-Williams, 2003) identifies the types of hazards that could cause supply disruptions to the regional water system. Hazards that could result in supply disruptions include: earthquakes; dam failures; fires; contamination of water supplies; hazardous spills or leaks; severe storms or floods; landslides; aqueduct, pipeline, reservoir, tank and/or building failure; civil unrest, disturbance or terrorist action; national security emergency; widespread power outage; process/treatment plant failure; and, facility failures.

Each event is discussed qualitatively in the report. The report also includes a quantitative analysis of several earthquake scenarios, including which facilities would likely fail during specific events, how long it would take to restore service, and what level of demand could be met while facilities are being restored. The other scenarios are only discussed qualitatively.

Table 1 includes a summary of the potential earthquake scenarios that could affect service to Cal Water. The table includes the following information, developed from the SFPUC Report:

- Failure scenario;
- Anticipated facilities out of service for scenario;
- Qualitative assessment of likelihood of event;
- Anticipated outage duration; and
- Anticipated level of service during outage.

For earthquake scenarios, where the SFPUC has provided quantitative analysis, the SFPUC report used the following assumptions in determining recovery time estimates:

- Major pipeline breaks can be repaired within 20 days;
- All pipeline leaks can be repaired within 34 days;
- Water treatment plants can be repaired within 3 weeks;
- Tunnels can be repaired within 3 months; and
- A combined force of 100 SFPUC staff and contractors is available for repair work.

The top portion of Table 1 (Scenarios 1 through 8) summarizes earthquake scenarios that could disrupt or limit service to Cal Water. Several scenarios would serve about 50% of the current average summer demand (150 to 160 mgd system demand which is 50% of the Year 2030 average day demand of 300 mgd) for a part or all of the outage. In all eight scenarios, breaks are predicted in the two or more of the Bay Division Pipelines that would isolate Cal Water turnouts on these pipelines. Section 8 investigates alternative options to serve these zones if the turnouts are off-line.

The bottom portion of Table 1 (Scenarios 9 and 10) summarizes other natural hazards that would potentially impact service to Cal Water identified in the SFPUC Emergency Response and Recovery Manual but not evaluated in detail. Information in this portion of the table was developed by CDM, based on its knowledge of the SFPUC system and qualitative information in the Emergency Response & Recovery Manual.

Of these non-earthquake scenarios, it is CDM's opinion that none would significantly impact service to Cal Water's Bear Gulch service area, since it served from the Lower Gradient Zone.

Water Supply Improvement Program Projects to Reduce Vulnerability

For seismic reliability, SFPUC has established the following service goals, based on meeting certain threshold Year 2030 demands for the system:

- Deliver minimum system demand (215 mgd) within 24 hours after a major earthquake;
- Restore facilities to meet average daily demand (300 mgd) within 30 days after a major earthquake;

The 300 mgd level of demand is equivalent to average daily demand for 2030 demand conditions and is equivalent to average summer demand at current demand levels.

Table 2 summarizes the planned WSIP projects to meet the level of service goals. Figure 2 shows the locations of planned projects. The current WSIP schedule calls for completion of all the projects that would benefit the Cal Water system by the end of 2014.

All of the projects listed in Table 2 will improve the seismic reliability of the regional system and thereby benefit Cal Water to some degree. Of the projects listed in the table, the Irvington Tunnel No. 2/Alameda Siphons provides the most seismic reliability benefit for the Cal Water Bear Gulch system. Failure of the Irvington Tunnel would sever the regional system from the Hetch Hetchy and Sunol Valley WTP supplies, which would mean that SFPUC supply would be available only from Harry Tracy WTP. This project would provide redundant, seismically reinforced facilities

that would enable continued delivery of Hetch Hetchy and/or Sunol Valley WTP supplies during an emergency.

BAWSCA sees significant challenges to SFPUC's ability to implement the WSIP, including institutional barriers, delays and escalating costs. BAWSCA is continuing to track WSIP progress and work with SFPUC to facilitate program implementation.

SFPUC Supply Vulnerability to Drought

For water supply, SFPUC anticipates being able to meet an average daily system demand of 300 mgd in normal and wet hydrologic years, which is the existing average summer day demand. It is also the Year 2030 average day demand, which was developed based on purchase projections provided by BAWSCA members who purchase SFPUC supplies.

During drought, SFPUC has established a service goal of providing up to 20% cutback during a design drought of 8.5 years. The target delivery reduction would be time-phased. During the first three years, the average reduction is anticipated at 3.3%. During the second three years, the average reduction is anticipated at 13.3%. During the last 2.5 years, the average reduction is anticipated at 20%. For the 8.5-year design drought at 2030 demand levels, this equates to deliveries ranging from 240 mgd to 290 mgd, with an average delivery of 265 mgd during the drought, or an average cutback of 12% during the drought.

The existing firm yield of the SFPUC system is estimated to be 226 mgd with existing supplies.[1] The firm yield represents the amount that could be delivered during drought years. During normal and wet hydrologic years, adequate water would be available to meet a system demand of 300 mgd, which is the existing average summer day demand and the Year 2030 average day demand. During dry years, the existing supply is not adequate to meet this system demand.

With the current yield, SFPUC could meet 75% of Year 2030 demand, based on the firm yield. Since deliveries are typically higher in the early years of a drought, before long-term drought conditions are recognized, an average drought cutback of 25% would likely mean cutbacks of less than 25% in early drought years, and cutbacks of greater than 25% in later drought years. SFPUC planning documents do not state the assumptions for the existing yield (existing supply amount); however, CDM's estimate is noted below for Year 2030 based on proportional cutback similar to SFPUC's target service goals.

[1] The firm yield estimate includes Calaveras Reservoir at 98,000 AF. The reservoir is currently restricted by California Department of Water Resources, Division of Safety of Dams to approximately 38,000 AF.

Design Drought Years	***Year 2030 Reductions With Future Additional Supply to Increase Firm Yield to 254 mgd (Target Service Levels)***	***Year 2030 Reductions With Existing Supply at Firm Yield of 226 mgd (reductions estimated by CDM at twice the target service level)***
First 3 years	3.3%	7%
Second 3 years	13.3%	27%
Last 2.5 years	20%	40%
Average over entire 8.5 years	12%	25% (average is about twice the target service level)

To meet SFPUC drought goals of a 20% maximum reduction during any year of the drought, an additional 39 mgd of supply would be needed to meet the Year 2030 average day demand. SFPUC has identified the following potential supplies that could make up the shortfall:

- Groundwater. Groundwater projects include three coupled projects: 1) restore Lake Merced water levels; 2) develop new local groundwater wells with 4 mgd total capacity within the City and County of San Francisco that can serve as emergency and regular supply in the Sunset District and along the Great Highway; and 3) the regional groundwater conjunctive use program in northern San Mateo County to provide supplemental dry year supply (10 new wells are estimated to provide 7 mgd of supply). The Water System Improvements Program description of the regional conjunctive use program anticipates that SFPUC surface water would be used in lieu of pumping groundwater in normal and wet years. Water would then be stored in the groundwater basin to pump during dry years or an extended drought.

- Recycled Water. SFPUC is completing a Recycled Water Master Plan. Two specific projects included in the Water System Improvements Program include: 1) recycled water on the west side of San Francisco (Westside Baseline) treated with centralized advanced treatment to deliver water to irrigation users, primarily parks; and, 2) highly advanced treatment of recycled water for Harding Park irrigation and Lake Merced recharge. SFPUC is also partnering with the North Coast County Water District on a recycled water project to irrigate areas of Pacifica and Sharp Park Golf Course, and with Daly City on recycled water for golf courses in the Lake Merced area.

- Desalination. SFPUC is participating in a joint venture study being conducted by four Bay Area utilities to investigate whether a joint venture desalination facility is feasible. The regional desalination facility would treat ocean or Bay water using reverse osmosis treatment technology. The purpose of the desalination facility would be to increase the reliability of the agencies' water supplies by providing a new source that is not dependent on any of their existing sources.

The WSIP includes funding for the groundwater projects and recycled water projects. In some cases, funding covers planning, but does not cover construction. In all instances, planning is at a relatively early stage and yield estimates are not provided in current planning documents. Therefore, implementation and future supply amounts from these projects is uncertain. The WSIP's desalination project is on hold pending funding issues.

It is not anticipated that SFPUC surface water supply from its local watershed reservoirs will increase in the future. Currently, there are restrictions on the operation of Calaveras Reservoir, which is a key component of the local surface water supply. Due to safety concerns, the Division of Safety of Dams has restricted the operating volume of Calaveras Reservoir to about a third of its maximum capacity. The SFPUC's WSIP includes a project for reconstruction of Calaveras Reservoir to restore the reservoir to its original capacity. Expansion of the reservoir beyond its original capacity would require participation of regional partners and additional funding beyond that designated in the WSIP. Therefore, the project is expected only to restore existing local yield to the system, not provide additional yield, unless regional partners are identified.

The current direction from the SFPUC is that it is committed to meeting projected 2030 purchases in normal and wet hydrologic years, and to meeting drought supply reliability goals. BAWSCA has expressed concern about escalation of project costs especially since only preliminary technical work has been completed to date, and that there is still considerable uncertainty about whether issues may be identified in the CEQA process that could affect overall implementation schedules and feasibility of programs.

BAWSCA sees its role with its member agencies as helping them to increase their overall supply reliability, given many agencies dependence on surface water supply from the SFPUC. BAWSCA has the statutory authority to plan for and acquire supplemental water supplies and to encourage conservation and use of recycled water supplies on a regional basis.

BAWSCA's direction as set by the Board includes 10 strategic challenges that focus on formulating policy and programs to ensure that the SFPUC regional water system is fixed. To date, BAWSCA's efforts have focused on monitoring the implementation of the SFPUC regional supply improvements, making sure the suburban customers are treated fairly in allocation of SFPUC WSIP costs, encouraging conservation and water recycling efforts, and being a catalyst for developing a regional plan for a sudden long-term SFPUC water outage.

With respect to conservation, BAWSCA currently has a subscription-based program available to member agencies, where member agencies can pay for BAWSCA to administer specific conservation programs for them. BAWSCA currently has five conservation programs that they are administering. These five programs are the:

Residential Washing Machine Rebate Program, Conservation Landscape Audit Program, "Our Water" 4th grade school education program, Landscape Education Class Series, and High-Efficiency Toilet Direct Install Program for Commercial and Multi-family housing accounts. Cal Water has participated in the washing machine program, the school program, and high-efficiency toilet program, along with BAWSCA's public information and plumbing retrofit projects.

On the reclamation side, BAWSCA encouraging the use of recycled water through its participation in the Bay Area Regional Water Recycling Program. BAWSCA is providing support for the North Coast County Water District (City of Pacifica) Recycling Project, the Redwood City Recycling Project, the South Bay Water Recycling program, the City of Santa Clara recycled water program, and the Palo Alto/Mountain View Recycling Project. To date, BAWSCA support has been on the regional level. This has involved pushing these projects forward for grant funding consideration through regional programs BAWSCA is participating in, such as the Bay Area Regional Water Recycling Program, the Integrated Regional Water Master Plan, and other CALFED programs.

Individual BAWSCA board members have expressed interest in considering taking the lead on procurement of other non-SFPUC supplies for member agencies. However, to date, the BAWSCA board has taken no formal action or provided policy direction regarding possibly taking on this role.

Table 1
SFPUC Existing System Supply Vulnerability - Natural Hazards

Hazard Scenario	***Facilities Out of Service that Affect Deliveries to Cal Water***	***Likelihood of Event***	***Duration of Outage***	***Level of Service During Outage, Impact to Cal Water*** *(Existing Average Summer Demand = Year 2030 Average Day Demand)*
Earthquake Scenarios				
1. San Andreas Fault M7.9, without Pulgas Tunnel damage	Crystal Springs-San Andreas PL Pulgas PS Crystal Springs PS BDPL No. 1, 2, 4 - one break each Sunset Supply Line south of HTWTP one break San Andreas PL3 @ HTWTP - one break	Significant threat	2 days to initiate water service. 90 days to restore all facilities	All customers receive existing average summer demand (299 mgd) during outage. Cal Water served from HTWTP.
2. San Andreas Fault M7.9, with collapse of Pulgas and Crystal Springs Bypass Tunnels	Pulgas Tunnel Crystal Springs Bypass Tunnel Pulgas PS Crystal Springs PS BDPL No. 1, 2, 4 - one break each Crystal Springs No. 2 - one break in South San Francisco San Andreas PL No. 2 - one break between Baden PS (South San Francisco) and San Pedro Valve Lot (Daly City)	Significant threat	2 days to initiate water service. 90 days to restore all facilities	Cal Water service connections at Orange Ave. and Elm Court are out of service; supply could be possibly be augmented from Cal Water system. San Andreas Pipeline 2 out of service in area of Cal Water turnouts, but San Andreas Pipeline 3 in service. All customers receive existing average summer day demand (299 mgd) during outage, except turnouts isolated by breaks.
3. San Andreas Fault M7.9, without Pulgas Tunnel damage, with HTWTP out of service	HTWTP Pulgas PS Crystal Springs PS BDPL No. 1, 2, 4 - one break each Sunset Supply Line south of HTWTP one break San Andreas PL3 @ HTWTP - one break	Significant threat	2 days to initiate water service 15 days to meet existing average summer demand (300 mgd) 34 days to restore all facilities	54% of existing average summer demand (160 mgd) during first 15 days if only potable water is served to the system. Cal Water would receive treated Hetch Hetchy supply. 94-99% of existing average summer demand (280 to 297 mgd) if raw water is served to the system from Lake Merced and/or San Andreas Reservoir. Cal Water would receive raw water.
4. Hayward Fault M.7.1, with SVWTP out of service	SVWTP San Antonio PP BDPL No. 1, 4 - two breaks each BDPL No. 2, 3 - one break each Sunset Supply Line south of HTWTP one break San Andreas PL3 @ HTWTP - one break	Significant threat	2 days to initiate water service. 16 days to provide 217 MGD 34 days to provide existing average summer demand (300 MGD) 90 days to restore all facilities	52-54% of existing average summer demand (156 to 160 mgd) if only potable water is served to the system. Cal Water would be served from HTWTP. 59% of existing average summer demand (177 mgd) if raw water is served from Lake Merced. Cal Water would be served from HTWTP.

Public Version

Table 1
SFPUC Existing System Supply Vulnerability - Natural Hazards

Hazard Scenario	***Facilities Out of Service that Affect Deliveries to Cal Water***	***Likelihood of Event***	***Duration of Outage***	***Level of Service During Outage, Impact to Cal Water*** *(Existing Average Summer Demand = Year 2030 Average Day Demand)*
5. Hayward Fault M.7.1, with SVWTP and Crystal Springs No. 2 out of service	SVWTP San Antonio PP BDPL No. 1, 4 - two breaks each BDPL No. 2, 3 - one break each Crystal Springs No. 2 - one break San Andreas PL No. 2 - one break between Baden PS (South San Francisco) and San Pedro Valve Lot (Daly City)	Significant	2 days to initiate water service. 16 days to provide 216 MGD 34 days to provide existing average summer demand (300 MGD) 90 days to restore all facilities	52-54% of existing average summer demand (154 to 160 mgd) during first 15 days if only potable water is served to the system. Cal Water would be served from HTWTP. 59% of existing average summer demand (177 mgd) if raw water is served from Lake Merced. Cal Water would be served from HTWTP. Cal Water service connections at Orange Ave. and Elm Court are out of service; supply could possibly be augmented by Cal Water system. San Andreas Pipeline 2 out of service in area of Cal Water turnouts, but San Andreas Pipeline 3 in service.
6. Hayward Fault, with collapse of Irvington Tunnel, with SVWTP out of service	SVWTP San Antonio PP Irvington Tunnel BDPL No. 1, 4 - two breaks each BDPL No. 2, 3 - one break each Sunset Supply Line - one break San Andreas PL No. 3 - one break at HTWTP	Least likely of all scenarios	Provide 153 to 177 MGD for duration of outage 90 days to restore all facilities	51-54% of existing average summer demand (153 to 160 mgd) for duration of outage if only potable water is served to the system. Cal Water would be served from HTWTP. 59% of existing average summer demand (177 mgd) for duration of outage if raw water is served from Lake Merced. Cal Water would be served from HTWTP.
7. Calaveras Fault M6.8, with SVWTP out of service	SVWTP Alameda Siphons San Antonio PP BDPL No. 1, 2, 4 - one break each Sunset Supply Line - one break	Significant threat	2 days to initiate water service 16 days to provide 240 MGD 90 days to restore all facilities	54% of existing average summer demand if only potable water is served to the system. Cal Water would be served from HTWTP. 59% of existing average summer demand if raw water is served from Lake Merced. Cal Water would be served from HTWTP.
8. Calaveras Fault M6.8, with SVWTP and Crystal Springs No. 2 out of service	SVWTP San Antonio PP BDPL No. 1, 2, 4 - one break each Crystal Springs No. 2 north of HTWTP - one break	Significant threat	2 days to initiate water service 90 days to restore all facilities	95% of existing average summer demand (285 mgd). Cal Water would be served from HTWTP. Cal Water service connections at Orange Ave. and Elm Court could be out of service depending on location of Crystal Springs No. 2 pipe break; supply could possibly be augmented by Cal Water system.

Public Version

Table 1
SFPUC Existing System Supply Vulnerability - Natural Hazards

Hazard Scenario	***Facilities Out of Service that Affect Deliveries to Cal Water***	***Likelihood of Event***	***Duration of Outage***	***Level of Service During Outage, Impact to Cal Water*** *(Existing Average Summer Demand = Year 2030 Average Day Demand)*
Scenarios Not Evaluated in Detail in SFPUC Report. Information developed by CDM.				
9. Rainfall Induced Reservoir Turbidity Events in Hetch Hetchy System	Hetch Hetchy Aqueduct.	Limited. (1)	None.	Events occur during winter months when SFPUC has sufficient capacity to switch to local sources of supply. 100% level of service anticipated.
10. Rainfall Induced Reservoir Turbidity Events in Peninsula Reservoirs	Hetch Hetchy Aqueduct.	--	None.	Events occur during winter months when SFPUC has sufficient capacity to use Hetch Hetchy/SVWTP supplies, along with Baden PS to supply High Zone.
11. Landslide Damaging Crystal Springs Bypass Tunnel	Crystal Springs Bypass Tunnel	Limited (2)	90 days, if same criterion used as for repair following seismic events.	Events occur during winter months when SFPUC has sufficient capacity at HTWTP to meet Peninsula demands. 100% level of service anticipated.
12. Crystal Springs Watershed Contamination	Harry Tracy WTP	Unknown	Unknown.	Potentially up to average summer demand (approx 40 mgd for Peninsula/western SF) through Baden PS.

(1) SFPUC experienced high turbidities in 1995, 1997 and 1997 due to heavy rainfall in the Hetch Hetchy watershed. Completion of the Priest Bypass in late 2003 is expected to significantly reduce the number of watershed events that affect SFPUC's ability to serve Hetch Hetchy supply.

(2) Occurred in 1998.

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Table 2
SFPUC Capital Improvement Programs that Mitigate Natural Hazards

Project	Project Description	Estimated Project Completion	Potential Mitigation for:										
			1. San Andreas EQ	2. San Andreas EQ, Pulgas/ CS Bypass Tunnel Out of Service	3. San Andreas EQ, HTWTP Out of Service	4. Hayward EQ, SVWTP Out of Service	5. Hayward EQ, SVWTP and CS 2 PL Out of Service	6. Hayward EQ, SVWTP and Irvington Tunnel Out of Service	7. Calaveras EQ, SVWTP Out of Service	8. Calaveras EQ, SVWTP and CS 2 PL Out of Service	9. Turbidity Event, Hetch Hetchy or Peninsula Reservoirs	10. Landslide Damaging Crystal Springs Bypass Tunnel	11. Crystal Springs Watershed Contamination
1. Calaveras Dam Replacement	Reconstruct dam to restore capacity of 98,000 AF	Q1 2012			✓						✓		✓
2. Irvington Tunnel # 2/Alameda Siphons	Provide redundant facilities for Irvington Tunnel and Alameda siphons.	Q3 2013						✓					
3. Bay Division Pipelines Seismic Reinforcement at Hayward Fault	Seismically reinforce the Bay Division 3 & 4 Pipelines.	Q4 2012				✓	✓	✓					
4. Bay Division Pipeline 4 Condition Assessment PCCP Sections	Detailed condition assessment of two reaches of the pipeline, 8.56 and 7.96 miles long	Q1 2008	✓	✓	✓	✓	✓	✓	✓	✓			
5. Bay Division Pipeline Reliability Upgrade	Provide new Pipeline 5 to replace Pipelines 1 & 2	Q1 2014	✓	✓	✓	✓	✓	✓	✓	✓			✓
6. BDPL No. 3 and 4 Crossovers	Additional valve stations to facilitate maintenance or repairs	Q2 2013				✓	✓	✓					

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Figure 1
Regional Water System Overview

CDM

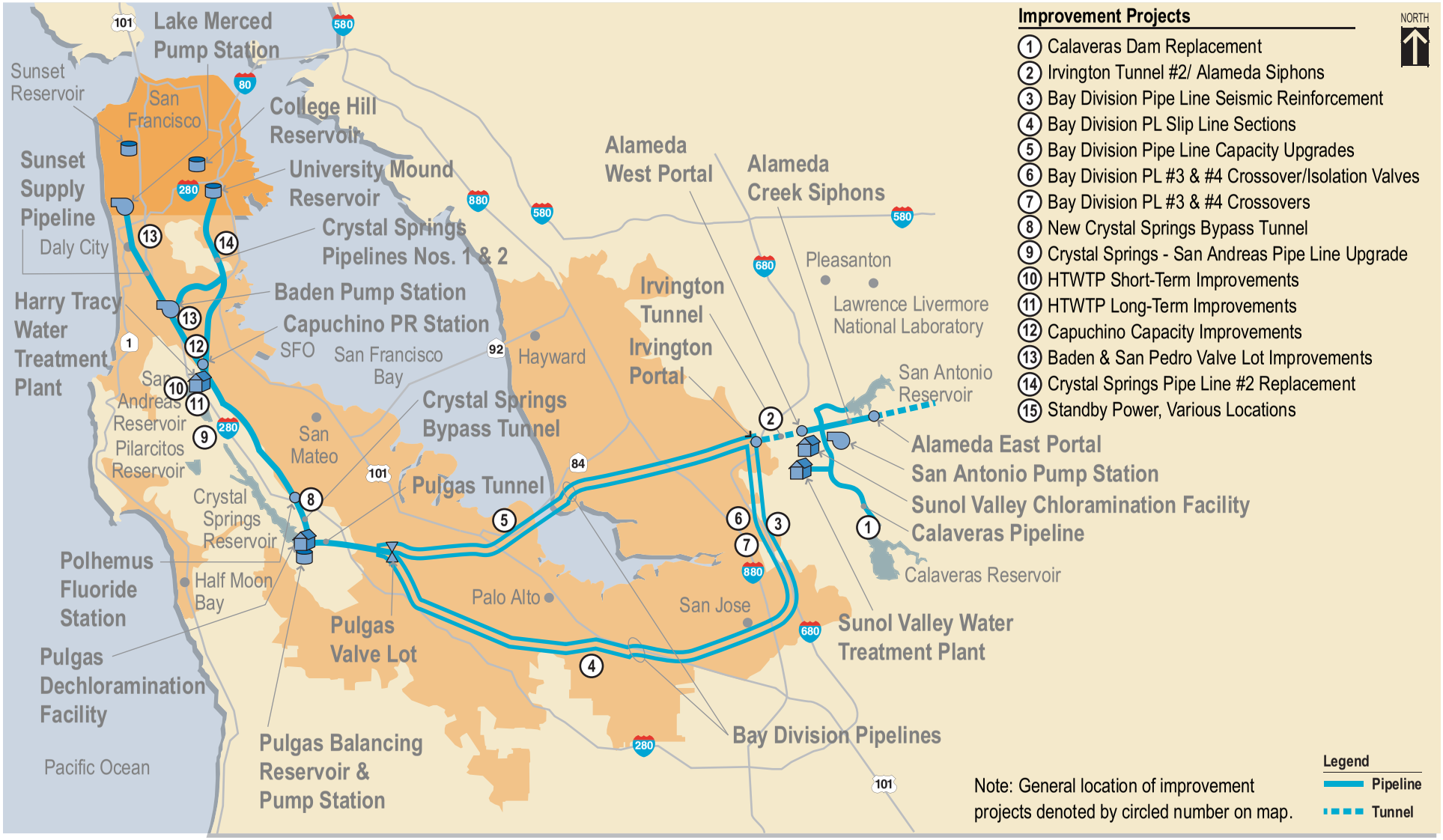

Figure 2
SFPUC Water Supply Improvement Projects to Reduce Vulnerability

CDM

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Appendix E
Water Quality Standards

Appendix E
Water Quality Standards

Table 1 ***Primary Maximum Contaminant Levels*** ***(All values are in milligrams per liter (mg/l), unless otherwise noted)***	
Contaminant	***Primary MCL***
22 CCR §64431, Table 64431-A – Inorganic Chemicals	
Aluminum*	1
Antimony	0.006
Arsenic	10 ug/l Federal; 50 ug/l State
Asbestos (MFL = million fibers per liter, for fibers exceeding 10 microns in length)	7 MFL
Barium	1
Beryllium	0.004
Cadmium	0.005
Chromium, Total	0.05
Cyanide	0.15
Fluoride	2.0
Mercury	0.002
Nickel	0.1
Nitrate (as NO_3)	45
Nitrate + Nitrite (sum as nitrogen)	10
Nitrite (as nitrogen)	1
Selenium	0.05
Thallium	0.002
22 CCR §64441 and §64443 – Radioactivity	
Gross alpha particle activity (including radium-226 but excluding radon and uranium)	15 picocuries per liter (pCi/L)
Gross beta particle activity	4 mrem/yr
Combined Radium-226 and Radium-228	5 pCi/L
Strontium-90	8 pCi/L
Tritium	20,000 pCi/L
Uranium	20 pCi/L
22 CCR §64439 – Total Trihalomethanes	
Sum of bromodichloromethane, dibromochloromethane, bromoform, and chloroform	0.1 (0.08 per USEPA) (Trihalomethane MCLs in this table will be superseded by the new USEPA regulations that go into effect in July 2008 and July 2011.)
22 CCR §64444 – Organic Chemicals	
(a) Volatile Organic Chemicals (VOCs)	
Benzene	0.001
Carbon tetrachloride	0.0005
1,2-Dichlorobenzene (o-Dichlorobenzene)	0.6
1,4-Dichlorobenzene (p-DCB)	0.005
1,1-Dichloroethane (1,1-DCA)	0.005
1,2-Dichloroethane (1,2-DCA)	0.0005
1,1-Dichloroethylene (1,1-DCE)	0.006
cis-1,2-Dichloroethylene	0.006
trans-1,2-Dichloroethylene	0.01
Dichloromethane (Methylene chloride)	0.005
1,2-Dichloropropane (Propylene dichloride)	0.005
1,3-Dichloropropene	0.0005
Ethylbenzene (Phenylethane)	0.7
Monochlorobenzene (Chlorobenzene)	0.07

Table 1 ***Primary Maximum Contaminant Levels*** ***(All values are in milligrams per liter (mg/l), unless otherwise noted)***	
Contaminant	***Primary MCL***
MTBE*	0.013
Styrene (Vinylbenzene)	0.1
1,1,2,2-Tetrachloroethane	0.001
Tetrachloroethylene (PCE)	0.005
Toluene (Methylbenzene)	0.15
1,2,4-Trichlorobenzene (Unsym-Trichlorobenzene)	0.07
1,1,1-Trichloroethane (1,1,1,-TCA)	0.200
1,1,2-Trichloroethane (1,1,2-TCA)	0.005
Trichloroethylene (TCE)	0.005
Trichlorofluoromethane (Freon 11)	0.15
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.2
Vinyl chloride	0.0005
Xylenes (single isomer or sum of isomers)	1.750
(b) Non-Volatile Synthetic Organic Chemicals (SOCs)	
Alachlor (Alanex)	0.002
Atrazine (Aatrex)	0.003
Bentazon (Basagran)	0.018
Benzo(a)pyrene	0.0002
Carbofuran (Furadan)	0.018
Chlordane	0.0001
2,4-D	0.07
Dalapon	0.2
1,2-Dibromo-3-chloropropane (DBCP)	0.0002
Di(2-ethylhexyl)adipate	0.4
Di(2-ethylhexyl)phthalate (DEHP)	0.004
Dinoseb	0.007
Diquat	0.02
Endrin	0.002
Endothal	0.1
Ethylene dibromide (EDB)	0.00005
Glyphosate	0.7
Heptachlor	0.00001
Heptachlor epoxide	0.00001
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
Lindane (gamma-BHC)	0.0002
Methoxychlor	0.04
Molinate (Ordam)	0.02
Oxamyl	0.2
Pentachlorophenol	0.001
Picloram	0.5
Polychlorinated biphenyls (PCBs)	0.0005
Simazine (Princep)	0.004
2,4,5-TP (Silvex)	0.05
2,3,7,8-TCDD (Dioxin)	0.00000003
Thiobencarb (Bolero)*	0.07
Toxaphene	0.003

*Contaminant also has a secondary MCL

Table 2 ***Secondary Maximum Contaminant Levels (see 22 CCR §64449)*** ***(All values are in milligrams per liter (mg/L), unless otherwise noted)*** ***1° MCL = primary MCL***			
Consumer Acceptance Limits			
Chemical or Characteristic	***Secondary MCL***		
Aluminum (1° MCL = 1 mg/L)	0.2		
Color	15 units		
Copper	1.0		
Corrosivity	Non-corrosive		
Foaming agents (MBAS)	0.5		
Iron	0.3		
Manganese	0.05		
Methyl tertiary butyl ether (MTBE) (1°MCL = 0.013 mg/L)	0.005		
Odor-Threshold	3 units		
Silver	0.1		
Thiobencarb (Bolero) (1° MCL = 0.07 mg/L)	0.001		
Turbidity	5 units		
Zinc	5.0		
Constituent	***Secondary MCL Ranges***		
	Recommended	***Upper***	***Short Term***
Total Dissolved Solids, or	500	1,000	1,500
Specific Conductance, micromhos	900	1,600	2,200
Chloride	250	500	600
Sulfate	250	500	600

Table 3 ***Drinking Water Action Levels for Unregulated Chemicals Requiring Monitoring (not MCLs)***	
Contaminant	***Action Level (milligrams per liter)***
Boron	1
Copper (Lead & Copper Rule)	1.3
Chromium-6 (MCL pending)	0.001
Dichlorodifluoromethane	1
Lead (Lead & Copper Rule)	0.015
Perchlorate (MCL pending)	0.004
Tertiary butyl alcohol	0.012
1,2,3-Trichloropropane	0.000005
Vanadium	0.05

Appendix F
Groundwater Supply Analysis

Task 2-1 Groundwater Supply
Bear Gulch District
Water Supply & Facilities Master Plan

This report presents data reconnaissance, compilation, and analysis results for hydrogeologic and groundwater quality assessments in California Water Services Company's Bear Gulch District. The following items are discussed herein:

- Summary of key findings.
- Hydrogeology.
- Reported basin yield.
- Groundwater quality.
- Soil and shallow groundwater contamination.
- Promising test well sites.
- Recommended data collection activities.

SUMMARY OF KEY FINDINGS

- About 36-percent of the California Water Services Bear Gulch District overlies the San Francisquito Cone groundwater basin (District areas serving portions of Redwood City, Atherton, and Menlo Park).

- San Francisquito Cone aquifers are bounded to the southwest by the Santa Cruz Mountains and to the northeast by San Francisco Bay. No natural features define its northwestern or southeastern extents. Hence, the groundwater underlying Atherton and Menlo Park is hydraulically connected to groundwater underlying East Palo Alto and Palo Alto. The magnitude and extent of this connection is poorly understood.

- In general, the San Francisquito Cone groundwater system consists of an approximately 80-feet thick upper unconfined to semi-confined water-bearing zone, overlying semi-confined and confined water-bearing zones. Beneath most of the Bear Gulch District, an approximately 70 feet-thick bed of predominantly silt and clay separates the upper and lower zones.

- Beneath the Bear Gulch District, water-bearing sediment thickness generally increases to the east.

- The greatest density of existing water supply wells is located within the Town of Atherton. Most of these private wells irrigate residential properties, with the remaining wells utilized by institutions to irrigate landscaping and athletic fields and sometimes to provide potable water for seasonal student populations.

- In the shallow zone, groundwater-flow is northward toward San Francisco Bay and discharges to the sloughs and or is extracted by dewatering operations. In the inland deeper zones, groundwater-flow is away from the foothills and San Francisquito Creek and towards San Francisco Bay. Horizontal gradients flatten in the central Atherton area, which generally coincides with the greatest density of private wells and presumably groundwater pumpage.

- Reported specific capacity values for wells located within the Bear Gulch District range from 0.1 to 60 gpm/ft, and average 5-gpm/ft. In general, the spatial distribution of specific capacity is fairly uniform, with the highest values reported for central areas of the Bear Gulch District.

- Detailed study in the Town of Atherton measured an average discharge rate from 11 residential wells of about 30 gpm, and an average discharge rate from 6 institutional wells of about 120 gpm (Metzger and Fio, 1997). Institutional wells are generally deeper and larger diameter than the residential wells.

- Conservative estimates of contemporary inflows and outflows indicate an approximately 1,200 to 2,400 acre-feet per year excess of recharge over pumpage (approximately 1 to 2 million gallons per day). The Bear Gulch District represents 36-percent of the San Francisquito Cone's total surface area, suggesting that 0.36 to 0.72 MGD of this water may be potentially available for extraction by Cal Water. Groundwater development will initially remove water from storage, and ultimately will capture water that presently discharges to San Francisco Bay and the lowest portions of San Francisquito Creek, or represents subsurface inflows to portions of Redwood City, East Palo Alto, and Palo Alto.

- A regional-scale, steady-state groundwater-flow model was utilized to preliminarily assess annual average volumetric water balance changes resulting from a 0.36 and 0.72 MGD pumping increase. Model results indicate that about 60-percent (250 acre-feet) of the 0.36 MGD simulated annual pumping increase is derived from subsurface flow that ultimately discharges to San Francisco Bay. The remaining pumping increase (160 acre-feet per year) is derived from subsurface flow that otherwise moves beneath the bay toward eastern Alameda County. Doubling the simulated pumping rate from 0.36 MGD to 0.72 MGD captures almost all of the subsurface flow that otherwise discharges to the bay, and almost 50-percent of the flow beneath the bay toward eastern Alameda County. The additional groundwater use by Cal Water could conceivably impact groundwater conditions beneath portions of Redwood City, Menlo Park, East Palo Alto, and Palo Alto.

- Screening the new wells exclusively in the deeper confined zone aquifer reduced simulated impacts to shallow zone water level and flow, but the reduction is not one to one. For example, pumping the entire 0.36 MGD from model layer 3 reduced pumpage from the shallow zone (layer 1) by 180 acre-feet per year, but the quantity of discharge to the bay increased less than 20 acre-feet per year. These results suggest that shallow zone pumping impacts can be partially mitigated by pumping from greater depth. However, the benefit appears to be limited due to the leaky characteristics of the clay beds and the corresponding increase in vertical groundwater movement.

- Analytical well functions were employed to simulate annual and seasonal changes in groundwater elevation drawdown as a result of pumping equal water volumes during a period of 6 months and one year, respectively. When the well is operated annually (assuming a constant monthly pumping rate), the maximum and annual drawdown is the same and occurs at the end of the one-year pumping cycle; under annual operating conditions, groundwater levels in the vicinity of the new pumping wells are about 30 feet lower at the end of the annual pumping cycle. In contrast, when the wells are operated seasonally the maximum drawdown occurs at the end of the pumping cycle and the minimum drawdown occurs at the end of the year following the 6-month recovery. Operating wells seasonally produces greater simulated drawdown (more than 50 feet at the end of the 6-month pumping cycle), but water levels significantly recover after the 6-month period of operation.

- Several negative impacts can occur from over-pumping aquifers and causing excessive drawdown of the water table and deeper confined zone groundwater levels. In the Bear Gulch District, these impacts include potential saltwater intrusion and subsidence of the land surface. Additionally, shallow groundwater contamination by past industrial activities has occurred at sites located at the margins of San Francisco Bay, and lowering confined zone groundwater levels can increase the vertical and inland movement of contaminant plumes. The models employed in this study help identify the potential for these impacts, but the results they provide are preliminary due to inherent modeling limitations.

- The Town of Atherton's drainage criteria document identifies shallow groundwater as a construction problem in parts of Atherton, and the document's groundwater elevation map indicates the water table is within 20-feet of land surface beneath the northern portion of the Bear Gulch District. Plans to extract this shallow water for beneficial use must consider potential inland movement of bay water, the susceptibility of shallow zone groundwater to degradation by land surface activities and leaking sewer lines, and potential impacts to trees from water table drawdowns resulting from the pumping and consequential dewatering.

- Projects that replace irrigation with local groundwater will provide a direct increase in groundwater supply (for example, irrigating landscaping and turf areas with recycled water rather than groundwater). Similarly, potential percolation basins or injection wells may enhance groundwater recharge and increase groundwater supplies.

- Total Dissolved Solids (TDS) concentrations in well-water samples are greatest near the mountain front and San Francisco Bay, whereas relatively lower concentrations are reported for wells located within central portions of the Bear Gulch District and near San Francisquito Creek. Most shallow Bay Plain monitoring well water samples contain TDS concentrations that range from very brackish (>10,000 mg/L) to substantially greater than seawater (>35,000 mg/L). Inland pumping in excess of recharge can reverse present-day hydraulic gradients and induce the relatively shallow saline water to migrate further inland and degrade the deeper water supply aquifers.

- TDS concentrations are significantly correlated with boron, calcium, chloride, iron, magnesium, manganese, potassium, sodium, sulfate, and total hardness. The water produced by all but one well is classified as "Very hard".

- The best quality groundwater is expected in wells near San Francisquito Creek and within the central portions of the Bear Gulch District.

- Data limitations prevented a quantitative assessment of temporal trends in groundwater quality. Limited specific conductance data suggest an approximate average annual increase of 1 to 16 mg/L TDS per year. The data set is insufficient to determine the statistical significance of this trend.

- The TDS concentrations in all wells with water quality data (20) exceeded the secondary MCL for TDS (500 mg/L). For the wells reporting chloride and sulfate data (35), two exceeded the secondary MCL for chloride (250 mg/L) and one exceeded the secondary MCL for sulfate (250 mg/L). No wells exceeded the MCL's for fluoride. One of the 32 wells reporting nitrate concentrations exceeded the primary MCL for nitrite+nitrate (10 mg/L). Eight of the 14 wells reporting manganese concentrations exceeded the secondary MCL for manganese (0.05 mg/L).

- The SWRCB Geographic Environmental Information Management System (GEIMS) database identified 194 shallow soil and groundwater contamination sites located in the cities of Atherton, East Palo Alto, Menlo Park, Portola Valley, and Woodside. Of those 194 sites, 33 were identified as currently active and 14 are located within the Bear Gulch District. The CIWMB Solid Waste Information System (SWIS) database

identified 3 solid waste sites in the vicinity of the Bear Gulch District; two sites are closed and one is an active transfer station.

- Preliminary estimates suggest there may be an opportunity to supplement the Bear Gulch District water supply with 2 to 4 production wells. Six promising sites for future test wells are identified from open space areas and potential willing cooperators such as parks, schools, and fire stations.

- In the Bear Gulch District, overdraft can impact all users by increasing well pumping lifts, degrade groundwater quality by saltwater intrusion, and, land surface subsidence. A comprehensive data collection effort can better quantify basin yield and manage water resources.

- Key data for improving San Francisquito Cone safe yield estimates include observed groundwater level changes in wells and estimated pumpage. Additionally, it is important to account for all major water sources entering and leaving the basin to assess the magnitude of groundwater accretion or depletion.

INTRODUCTION

This report presents data reconnaissance, compilation, and analysis to describe hydrogeologic and groundwater quality conditions in California Water Services Company's Bear Gulch District. The following work tasks were completed.

Data retrieved:

- Searched, retrieved and reviewed available groundwater level and water quality data from California Department of Water Resources, U.S. Geological Survey NWIS, and Santa Clara Valley Water District data bases.
- Well location and construction information obtained from San Mateo County and U.S. Geological Survey data bases.
- Active soil and groundwater remediation sites from State Water Quality Control Board Geo-tracker database.

Historical documents reviewed:

- "Geohydrologic Framework, Historical Development of the Ground-Water System, and General Hydrologic and Water-Quality Conditions in 1990, South San Francisco Bay and Peninsula Area, California", U.S. Geological Survey, 1994.
- "Ground-Water Development and the Effects on Ground-Water Levels and Water Quality in the Town of Atherton, San Mateo County, California", 1997, U.S. Geological Survey.
- "Streamflow Gains and Losses along San Francisquito Creek and Characterization of Surface Water and Groundwater Quality, Southern San Mateo and Northern Santa Clara Counties, California, 1996-1997", 2002, U.S. Geological Survey.
- "A Comprehensive Groundwater Protection Evaluation for the South San Francisco Bay Basins", Regional Water Quality Control Board San Francisco Bay Region, May 2003.
- "Feasibility of Supplemental Groundwater Resources Development Menlo Park and East Palo Alto, California", Todd Engineers, 2005.

Hydrogeological maps and figures prepared:

- Surficial geology maps showing the inferred distribution of water-bearing and non-water bearing zones.
- Thickness of water-bearing deposits.
- Extisting water supply well locations.
- Groundwater-flow directions and historical water level trends.
- Reported distribution of specific capacity.
- Total Dissolved Solids concentration distribution in shallow and deep groundwater zones.
- Reported soil and groundwater contamination site locations.
- Promising sites for potential new water-supply test wells.

Our findings follow.

HYDROGEOLOGICAL CHARACTERIZATION AND ASSESSMENT

The California Water Services Bear Gulch District is located within southern San Mateo County (**Figure 1**). The District overlies the Santa Cruz Mountains in the southwest and alluvial apron and bayplain sediment deposits in the northeast. The most relevant surface drainage is San Francisquito Creek, which has formed an approximately 22 square mile alluvial fan referred to as the San Francisquito Cone.

The San Francisquito Cone forms a semi-confined aquifer underlain by consolidated rock. To the southwest, it is bounded by the exposed consolidated rock of the Santa Cruz Mountains and to the northeast by San Francisco Bay[1]. No natural features define its northwestern or southeastern extents. Hence, the groundwater underlying Atherton, Menlo Park and East Palo Alto is hydraulically connected to groundwater underlying Palo Alto. The magnitude and extent of this connection has not been quantified.

Geologic Framework

The primary water-bearing sediments are unconsolidated alluvial fan deposits formed by San Francisquito Creek and other minor tributaries that drain the mountains and foothills. HydroFocus grouped surficial geologic map units into non-water bearing and water bearing sediments (**Figure 2**). The geologic units older than late Pliocene are considered non-water bearing bedrock[2]; wells in bedrock withdraw water from fractures, and typically these wells have variable yields. In contrast, younger Pliocene, Pleistocene, and Holocene age semi-consolidated and unconsolidated gravel and sand deposits are considered water-bearing because they typically transmit significant quantities of water to wells. The expected probable yields of wells located in water-bearing sediments are

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[1] Unconsolidated marine sediments beneath South San Francisco Bay coalesce with continental sediments deposited by streams draining the Peninsula, East Bay and Santa Clara Valley. Historically, stratigraphic units were given different names, which impeded recognition of the inter-connectedness of units and water-supplies (Norfleet Consultants, "Groundwater Study and Water Supply History of the East Bay Plain, Alameda and Contra Costa Counties, California", June 1998). For example, California Department of Water Resources mapped the extent of the Niles Cone aquifer as extending from Alameda County into parts of Santa Clara and San Mateo counties. Pumping tests reported by the Department of Water Resources showed that groundwater extraction from the Menlo Park area of San Mateo County lowered water levels observed in wells located in Santa Clara and Alameda counties, confirming hydraulic continuity beneath the bay (California Department of Water Resources, "Evaluation of Ground Water Resources, South Bay, Appendix A: Geology", August 1967). The hydraulic connection between San Francisquito Cone and Niles Cone water-bearing zones is poorly understood.

[2] John L. Fio and David A. Leighton, "Geohydrologic Framework, Historical Development of the Ground-Water System, and General Hydrologic and Water-Quality Conditions in 1990, South San Francisco Bay and Peninsula Area, California", U.S. Geological Survey Open-File Report 94-357, 1995.

one to three orders of magnitude greater than wells located in the non-water bearing sediments[3]. On the basis of these boundaries, about 36-percent of the Bear Gulch District is underlain by water-bearing alluvial fan deposits. These water-bearing deposits are principally found in District areas serving portions of Redwood City, Atherton, and Menlo Park.

A geologic section constructed from borehole data shows the distribution of aquifers and confining beds forming the San Francisquito Cone (**Figure 3**). In general, the groundwater system consists of an approximately 80-feet thick upper unconfined to semi-confined water-bearing zone, overlying lower semi-confined and confined water-bearing zones. An approximately 70 feet-thick bed of silt and clay separates the upper and lower zones, and forms a laterally continuous confining bed[4]. Near the mountain front, the clay bed ends providing areas upslope of the clay a direct hydraulic connection to the deeper aquifer zones. A series of faults (the Pulgas, Atherton and San Francisquito Faults) may also influence the hydrology of this multi-aquifer system[5].

Aquifer Thickness and Existing Wells

The spatial distribution of water-bearing sediments and relative well production is qualitatively inferred from the total thickness of unconsolidated sediment deposits and the distribution of existing water supply wells (**Figure 4**)[6]. Beneath the Bear Gulch District, sediment thickness increases to the east. The greatest density of water supply wells is located within the Town of Atherton[7]. Most of these wells

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[3] Webster, D.A., 1972, "Map showing ranges in probable maximum well yield from water-bearing rocks in the San Francisco Bay region, California", U.S. Geological Survey Miscellaneous Field Studies Map MF-431.

[4] California Department of Water Resources, "Evaluation of groundwater resources, South San Francisco Bay, Appendix : A, Geology", Bulletin 118-1, 1967.

[5] Loren F. Metzger, U.S. Geological Survey Water-Resources Investigations Report 02-4078, "Streamflow Gains and Losses along San Francisquito Creek and Characterization of Surface Water and Groundwater Quality, Southern San Mateo and Northern Santa Clara Counties, California, 1996-1997", 2002.

[6] We calculated sediment thickness as the difference between land and bedrock surface elevations; land surface elevations were determined utilizing a 30-meter resolution Digital Elevation Model (DEM) obtained from the USGS National Elevation Data Set, and bedrock surface elevations were determined from "Maps Showing Elevation of Bedrock and Implications for Design of Engineered Structures to Withstand Earthquake Shaking in San Mateo County, California", U.S. Geological Survey Open-File Report 90-496, by Hensolt and Brabb (1990), and "Data base of well and areal data, south San Francisco Bay and Peninsula area, California", U.S. Geological Survey Water-Resources Investigations Report 94-4151, by Leighton, Fio and Metzger (1994).

[7] The Town of Atherton's Municipal Code 8.32 requires a permit for all agricultural wells, domestic wells and domestic irrigation wells; the permit does not pertain to the use or operation of the well as a water supply intended for human consumption as provided in San Mateo county Ordinance 03101. One requirement of the permit is that each well shall have a meter installed to record the

irrigate residential properties, with the remaining wells utilized by institutions to irrigate landscaping and athletic fields, and sometimes to provide potable water for seasonal student populations.

Existing wells range in depth from 16 to 560 feet below land surface. Most of the wells are considerably deeper than 100 feet below land surface (median well depth of 170-feet below land surface); indicating existing wells probably extract groundwater from both the shallow and deep zones. The relationships between recharge, pumping, water-level changes, and hydraulic communication between inland aquifers and San Francisco Bay have not been quantified.

Groundwater-Flow

Our data reconnaissance efforts obtained historical water levels from 79 San Francisquito Cone wells. Most water levels represent only a few months of data, but 20-year water level records are available for two wells located in Palo Alto and Menlo Park (**Figure 5**). The Palo Alto well showed a fairly steady water level recovery beginning in the early 1960's; the water level rise generally continues until the data record ceases around 1984. In Menlo Park, the water level record also shows steady recovery following two drought periods; the first drought occurred at the beginning of the data record in 1976-77, followed by a second drought period during the early 1990's.

Metzger and others (1997) reported average depth to water measurements beneath the Bear Gulch District (Atherton) that ranged from 16 to 68 feet below land surface. The wells can be screened across multiple water-bearing zones, and therefore these measurements did not necessarily represent the water table but more likely a composite of hydraulic conditions at the water table and in deeper water bearing zones. Generalized hydraulic head contours for the shallow (HydroFocus, 2003) and deeper (Metzger, 1997) water bearing zones are mapped in **Figure 6**. In the shallow zone, the contours indicate northward flow toward San Francisco Bay discharges to the sloughs and is extracted by dewatering operations. In the inland deeper zones, groundwater-flow is away from the foothills and San Francisquito Creek and towards San Francisco Bay. Horizontal gradients flatten in the central Atherton area, which generally coincides with the greatest density of private wells and presumably groundwater pumpage.

Reported Specific Capacities and Well Production Rates

Specific capacity (SC) is an indicator of well yield, usually expressed as gallons of water per minute per foot of drawdown (gpm/ft). The SC is related to aquifer properties and well- and test-specific characteristics such as well construction, well age, and the pumping time and pumping rate at the time of the test.

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volume of water used. A record of such water usage shall be submitted by the permittee to the town annually, unless otherwise requested by the town.

Reported SC values for wells located within the Bear Gulch District range from 0.1 to 60 gpm/ft, and average 5-gpm/ft. The spatial distribution of reported SC values is mapped in **Figure 7**. In general, the SC values are fairly uniform, with the highest SC values reported for central areas of the Bear Gulch District. Wells having relatively large SC values produce significant water quantities with less drawdown, whereas wells having relatively low SC values require greater drawdown to produce comparable yields. Hence, the greatest potential well yields are expected within the areas having the highest reported SC values.

Detailed study within the Town of Atherton measured an average discharge rate from 11 residential wells of about 30 gpm, and average measured discharge rate from 6 institutional wells of about 120 gpm (Metzger and Fio, 1997). Institutional wells are generally deeper and larger than residential wells.

Historical Water Use and Reported Basin Yield

For at least a century, San Francisquito Cone groundwater has provided water to overlying areas of San Mateo and Santa Clara counties. In **Table 1**, we summarize historical recharge and pumping estimates for the San Francisquito Cone. In the 1930's, groundwater extraction was estimated at 7,220 acre-feet per year. Although no estimate of recharge was provided, declining groundwater levels and increasing well water salinity indicated pumpage exceeded recharge[8]. In 1962, annual pumpage was still excessive (7,500 acre-feet per year), but most of the pumping had shifted to northern Santa Clara County (the primary groundwater users were the City of Palo Alto and Stanford University). Since about 1965, most of the demand for water has been met by imported surface water. As a result, long-term recharge has exceeded pumping and water levels have shown a general recovery.

[8] Loren F. Metzger and John L. Fio, "Ground-Water Development and the Effects on Ground-Water Levels and Water Quality in the Town of Atherton, San Mateo County, California", U.S. Geological Survey Water-Resources Investigations Report 97-4033.

Table 1. Historical San Francisquito Cone Groundwater Use.			
Water Year	Water Use (acre-feet/year)		
	Recharge	Pumpage	Net
1931[a]	---	7,220	---
1962[b]	3,000	7,500	-4,500
1990-94[c] average	3,640	2,440	1,200
2005[d] low estimate	3,610	1,200	2,410
2005[d] high estimate	6,680	1,200	5,480

a: Killingsworth, C. and B.C. Hyde, "A Report on the Underground Water Supply of Stanford University and Vicinity", Stanford University, February 1932. The report did not discuss the amount of groundwater recharge or net storage change in the basin, but it did state the basin showed evidence of overdraft conditions (declining water levels and increasing groundwater salinity).
b: Sokol, Daniel, "The Hydrogeology of the San Francisquito Creek Basin, San Mateo and Santa Clara Counties, California", Palo Alto, Calif., Stanford University, Ph. D. dissertation, 1964.
c: Metzger, Loren F., U.S. Geological Survey, un-published data, 1996.
d: Todd Engineers, "Final Feasibility of Supplemental Groundwater Resources Development, Menlo Park and East Palo Alto, California", August 2005.

The annual quantity of water that can be extracted from a basin is typically estimated utilizing a combination of observed annual groundwater elevation changes and estimated water inflows (recharge) and outflows (natural discharge and pumpage). The annual difference between San Francisquito Cone inflows and outflows has varied over time. For example, prior to 1962 there was an annual deficit of about 4,500 acre-feet per year, indicating that more water was extracted from the Cone than was replenished (**Table 1**). This water deficit resulted in declining water levels, deteriorating water quality, and land subsidence in some areas. In contrast, conservative estimates of contemporary inflows and outflows indicate an approximately 1,200 to 2,400 acre-feet per year excess of recharge over pumpage (approximately 1 to 2 million gallons per day).

Recharge in excess of pumpage can (1) discharge to natural surface water features (for example, San Francisco Bay and the lowest portions of San Francisquito Creek); (2) contribute to rising groundwater levels and increased groundwater storage within the San Francisquito Cone[9]; or, (3) move into

[9] Some areas in Atherton now experience shallow groundwater conditions, and one site required construction dewatering at 45-70 gallons per minute (Cal Water, personnel communication). We reviewed Town of Atherton documents provided by Cal Water ("Atherton Final Drainage Criteria" and map showing "Groundwater Elevation Contours, Town of Atherton"). The drainage criteria document identifies shallow groundwater as a construction problem in parts of Atherton, but does not provide quantitative information on the effected areas or the volume of problem water. We utilized Atherton's "Groundwater Elevation Contour" map to estimate depth to groundwater; depth to groundwater is land surface elevation less groundwater elevation. The resulting map (**Figure 8**) indicated that the water table beneath the northern portion of the Bear Gulch District is within 20-feet of land surface. Plans to pump from this shallow water-bearing zone must consider potential water quality and environmental issues. The shallow groundwater area is the nearest to San Francisco Bay, and shallow groundwater pumping can induce the inland movement of bay

subsurface areas adjacent to the San Francisquito Cone. Recharge in excess of pumpage represents a potential supplemental water supply to the Bear Gulch District[10].

Water management activities that reduce current groundwater use within the Bear Gulch District can increase supplemental water supplies. For example, replacing groundwater currently used to irrigate landscaping and turf areas with recycled water can provide a direct increase in the groundwater supply. Percolation basins, injection wells or in-lieu recharge programs can enhance groundwater recharge and also increase supplies. These examples do not represent an exhaustive list of potential water supply enhancement projects, and additional investigation and analysis is required to confirm project feasibility.

WATER QUALITY

Our data search and retrieval obtained water quality data for samples from a total of 57 wells perforated in either the shallow or deep zones; the well locations are shown in **Figure 9**. The well names and sample analytical results are reported in **Table 2**.

Spatial Distribution

We prepared a map showing the spatial distribution of Total Dissolved Solids (TDS) concentrations in groundwater using shallow zone contours from a previous Bay Plain investigation[11] and reported TDS concentrations in samples from inland deeper zone wells (**Figure 10**). In general, TDS concentrations are greatest near the mountain front and near San Francisco Bay, whereas relatively lower concentrations are reported for wells located within the central portions of the District and near San Francisquito Creek. Most shallow Bay Plain monitoring well water samples contain TDS concentrations that range from very brackish (>10,000 mg/L) to substantially greater than seawater (>35,000 mg/L). Inland

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water and degrade existing groundwater quality. The shallow water-bearing zone is the most susceptible to degradation by land surface activities and leaking sewer lines. Metzer and Fio (1997) reported that a relatively shallow well (screened interval from 35 to 60 feet below land surface) located within the shallow groundwater area had a nitrogen concentration of 12 mg/L, which exceeded the primary maximum contaminant level of 10 mg/L. Finally, pumping from the shallowest zone and lowering of the water table may affect the subsurface water supply utilized by Oaks and other highly valued trees growing in the area.

[10] Because the data reported in **Table 1** is for the entire San Francisquito Cone, and the Bear Gulch District represents only about 36-percent of the total Cone area, the existing potential groundwater supply to the District is most likely significantly less than 1 to 2 million gallons per day.

[11] HydroFocus, Inc., "Groundwater-Flow System Description and Simulated Constituent Transport, Raychem/Tyco Electronics Site, 300-314 Constitution Drive, Menlo Park, CA", submitted to California EPA Department of Toxic Substances Control (November 21, 2003).

pumping in excess of recharge can reverse present-day hydraulic gradients and cause the relatively shallow saline water to migrate further inland and potentially degrade the deeper water supply aquifers.

Linear regression indicates that TDS concentrations are significantly[12] correlated (alpha=0.05) with the following constituents: boron (r^2 = 0.86), calcium (r^2 = 0.69) chloride (r^2 = 0.99), iron (r^2 = 0.92), magnesium (r^2 = 0.99), manganese (r^2 = 0.93), potassium (r^2 = 0.97), sodium (r^2 = 0.99), sulfate (r^2 = 0.99), and total hardness (r^2 = 0.95). Therefore, the spatial distribution of these constituents can generally be inferred from the TDS isoconcentration lines shown in **Figure 10**.

Water hardness is attributable to multiple constituents, and hardness levels generally parallel observed spatial TDS trends. Median water hardness, in terms of equivalent calcium carbonate, ranges from 127 to 2,100 and all but one well is classified as producing "Very hard" water (Hem, 1985).

Metzger and others (1997) reported relationships between water chemistry and water residence time in the aquifer. Groundwater samples from wells located near San Francisquito Creek were typically similar to surface water, whereas deeper samples collected near the mountain front and San Francisco Bay were influenced by dissolution of minerals associated with marine sediments (i.e., both undifferentiated clay deposits associated with the bay and marine rocks associated with the consolidated bedrock assemblages that underlay the deepest aquifers). Hence, the best quality groundwater is expected in wells near San Francisquito Creek and within the central portions of the Bear Gulch District. Increasing constituent concentrations and water hardness are expected in wells located to the north near San Francisco Bay, and wells located to the south near the mountain front and underlying bedrock.

Temporal Trends

Data limitations prevented a quantitative assessment of temporal trends in groundwater quality. In **Table 2**, one shallow well and four deep wells were sampled twice over intervals ranging from 3.5 to 16 years, however the constituents analyzed were rarely the same. Specific conductance was reported for both sampling events; specific conductance is related to the total ionic concentration, and in most natural waters the TDS (in mg/L) ranges from 55- to 75-percent of the specific conductance in µmho/cm (Hem, 1985). The reported specific conductance values in **Table 2** increase by 4- to almost 50-percent, suggesting an approximate average annual increase of 1 to 16 mg/L TDS per year. The data set reported in **Table 2** is insufficient to determine the statistical significance of this trend.

[12] An analysis of variance (ANOVA) was performed on the data to determine if the correlations are statistically significant.

Water Quality Standards

Table 3 summarizes the well-water quality data relative to EPA maximum contaminant levels (MCL) for key inorganic water quality constituents. The table shows primary and secondary MCLs established by EPA and the maximum value reported in **Table 2**. Primary standards are based on health considerations; secondary standards are based on taste, odor, color, corrosiveness, foaming, and staining properties.

Table 3. Federal EPA Maximum Contaminant Levels (MCLs) and Constituent Concentration Levels.

Constituent	EPA Standard (MCL's)	MCL Concentration Limit (mg/L)	Maximum Concentration in Existing Wells (mg/L)
Inorganics			
Hardness	None	---	657
TDS	Secondary	500	1,170
Cl	Secondary	250	347
SO_4	Secondary	250	270
F	Primary Secondary	4.0 2.0	0.30
NO_3	Primary	10	12
Fe	Secondary	0.3	0.08
Mn	Secondary	0.05	0.50

Note: NO_3 concentrations are reported combined with NO_2. Reported NO_2 concentrations are low; therefore the combined NO_2+ NO_3 concentrations are likely representative of NO_3 concentrations.

The TDS concentrations in all 20 wells having data exceeded the secondary MCL for TDS (500 mg/L). For the wells reporting chloride and sulfate concentrations (35), two exceeded the secondary MCL for chloride (250 mg/L) and one exceeded the secondary MCL for sulfate (250 mg/L). No wells exceeded the MCL's for fluoride.

One of the 32 wells that reported nitrate concentrations exceeded the primary MCL for nitrite+nitrate (10 mg/L). Excessive nitrate concentrations are a concern in drinking water as it may cause methemoglobinemia in small children. Elevated nitrate concentrations in groundwater can be indicative of leaking sewer lines or excessive fertilizer application.

Eight of the 14 wells that reported manganese concentrations exceeded the secondary MCL for manganese (0.05 mg/L). Manganese occurs naturally in groundwater, and is an essential element for both plants and animals, but is an undesirable constituent in water supplies owing to its tendency to deposit black oxide stains.

Soil and Shallow Groundwater Quality Contamination

We utilized information archived in the State Water Resources Control Board (SWRCB), and California Integrated Waste Management (CIWMB) databases to locate and map soil and groundwater contamination sites in and around the Bear Gulch District. The data sources employed included the SWRCB Geographic Environmental Information Management System (GEIMS) database, and CIWMB Solid Waste Information System (SWIS). This data reconnaissance effort is not considered comprehensive, and additional sites of concern may exist, but the results are considered illustrative of the general frequency and distribution of soil and groundwater contamination sites within the Bear Gulch District.

Active sites of concern are mapped on **Figure 11**; most active sites are located outside the Bear Gulch District. New wells should be located away from areas having the highest density of sites of concern, and a detailed review of regulatory files is needed to characterize contamination sites as part of any effort to site a new well. Below is a summary of the sites of concern mapped on **Figure 11**.

- The SWRCB GEIMS database identified the addresses of 194 sites located in the cities of Atherton, East Palo Alto, Menlo Park, Portola Valley, and Woodside. Of those 194 sites, 33 were identified as currently active sites and 14 of the active sites are within the Bear Gulch District. The SWRCB's GeoTracker website was used to obtain the mapping coordinates and constituents of concern for 21 of the 33 active sites. The remaining 12 active sites were located using ArcMap's address locating capabilities (geocoding).

  The reported constituents of concern for the 14 active sites located in the Bear Gulch District are listed below in **Table 4**.

Table 4. Constituents of Concern in Active San Mateo County Department of Health Services Local Oversight Program Sites.

Constituent of Concern	*Number of Sites*
Diesel	1
Gasoline/Fuel	8
Mineral Spirits	1
Solvents	3
Not Identified	1
Sum	14

- The CIWMB SWIS database identified 3 solid waste sites in the vicinity of the Bear Gulch District, but no sites within the District (**Figure 11**). Two sites. The two sites shown north of Highway 101 are the Marsh Road Landfills; both are listed as closed. The site south of 101 is an active transfer station.

USE OF GROUNDWATER BASIN

Potential Additional Yield to Bear Gulch Service Area

Potential additional yield from the entire San Francisquito Cone may be about 1 to 2 million gallons per day (MGD). The Bear Gulch District represents 36-percent of the San Francisquito Cone's total surface area, suggesting that 0.36 to 0.72 MGD of this water may be potentially available for extraction by Cal Water. Assuming an average water-supply well production rate of 120 gpm, a potential opportunity may exist for the Bear Gulch District to supplement local supplies with water extracted from 2 to 4 production wells.

Possible Sites for Water Supply Wells

Promising sites for future test wells are shown in **Figure 12**. The well sites are considered representative; our search was not comprehensive, and additional suitable sites may exist within the Bear Gulch District Service Area. Additionally, we did not confirm site accessibility by way of land purchases or easements.

The six sites in **Figure 12** represent open space areas delineated from aerial photographs and potential willing cooperators such as parks, schools, fire stations[13], and others. Our specific screening criteria to identify these sites follow.

- Underlain by more than 300-feet of unconsolidated water-bearing sediments (**Figure 4**).
- Reported TDS concentrations in groundwater less than about 1,000 mg/L (**Figure 10**). Sites located closest to San Francisquito Creek will most likely produce the highest quality water (i.e., produce water having the lowest TDS concentrations).
- More than 500 feet from mapped shallow soil and groundwater contamination sites (**Figure 11**).
- More than 1,000 feet from existing institutional wells.

[13] The Menlo Park Fire Department has expressed interest in a cooperative arrangement with Cal Water whereby Cal Water can construct and operate water supply wells on their property in exchange for their use during emergencies. Station 4 located at 3322 Alameda is one proposed station location, but available data suggest the groundwater supply is limited beneath this site. Station 4 is located near the boundary between water bearing and non-water bearing zones, the depth to bedrock appears to be less than 100 feet (**Figure 4**) and depth to water probably more than 50 feet (**Figure 8**). The relatively low density of existing wells in the general area of Station 4 also suggests that groundwater supplies in this portion of the basin are limited. In contrast, Station 3 appears to be a favorable location for a future test well and is one of the six sites that passed our preliminary site selection screening criteria (**Figure 12)**.

One alternative Cal Water would like to consider is locating wells to convey groundwater back to the water treatment plant for blending with the local surface water supply. One of the two existing water mains beneath Atherton Avenue could conceivably be utilized to transmit groundwater up gradient to Bear Gulch Reservoir for storage and subsequent treatment. In order to discharge the groundwater into Cal Water's reservoir, all regulatory requirements would have to be met. Three of the six sites in **Figure 12** are located fairly close to Atherton Avenue (St. Anthony Church, Atherton Town Hall, and Fire Station 3); aerial photographs suggest that most of the remaining property along Atherton Avenue is private residential.

Estimated Impacts from Increased Extraction

Groundwater extraction by Cal Water to utilize some or all of the 0.36 to 0.72 MGD of estimated annual potential yield will alter the basin's volumetric water balance and lower groundwater levels. The additional groundwater use could conceivably impact groundwater conditions beneath portions of Redwood City, Menlo Park, East Palo Alto, and Palo Alto. We employed a regional-scale, steady-state groundwater-flow model to preliminarily assess annual average volumetric water balance changes resulting from a 0.36 and 0.72 MGD pumping increase. To assess seasonal water level drawdown, we employed analytical well functions that simulate two-dimensional transient groundwater elevation changes resulting from variable pumping rates and pumping periods.

Volumetric Water Balance

A regional groundwater-flow model was utilized to preliminarily assess changes to the volumetric water balance resulting from pumping increases within the Bear Gulch District. The model was originally employed as part of an environmental site assessment of the Bay Plain area of Menlo Park[14], located down gradient of the Bear Gulch District (**Figure 13**). The model uses a single layer to represent the upper semi-confined water bearing zone, and two layers to represent the deeper confined water bearing zone. The model boundaries are defined as follows.

- *Northern Boundary*: Underlies Redwood Creek and corresponds to the horizontal groundwater-flow path that originates near the foothills and moves eastward to discharge into San Francisco Bay. Groundwater does not cross this flow line boundary.

- *Eastern Boundary*: Located east of the San Francisquito Cone and on the opposite side of San Francisco Bay, which corresponds to the bay shore area in western Alameda County. Groundwater can move across this

[14] HydroFocus, "Groundwater Flow System Description and Simulated Constituent Transport, Raychem/Tyco Electronics Site 300-314 Constitution Drive, Menlo Park, California", submitted to California EPA Department of Toxic Substances Control, 2003.

boundary in response to recharge and pumping conditions west and east of San Francisco Bay.

- *Southern Boundary*: Located in Santa Clara County and corresponds to the flow line that originates near the foothills and moves eastward toward a regional pumping depression beneath Palo Alto. Groundwater does not cross this flow line boundary.

- *Western Boundary*: Contact between consolidated rock and permeable basin fill of the San Francisquito Cone. Groundwater movement from consolidated rock into the basin fill is assumed negligible.

The groundwater-flow model simulates water inflows and outflows representative of estimated average annual 1990-94 conditions (**Table 1**). For the purposes of this assessment, we employed the model to explore possible volumetric water balance changes resulting from a 0.36 and 0.72 MGD annual pumping increase (400 to about 800 acre-feet/year). The simulated pumping increase was uniformly distributed between three locations near Atherton Avenue, and each simulated well is pumped at an annual average rate of about 0.12 and 0.24 MGD, respectively (about 130 to almost 270 acre-feet per year).

The simulated volumetric water balance for existing development levels (assumed equal to average 1990-94 conditions), 0.36 MGD pumping increase (Scenario 1), and 0.72 MGD pumping increase (Scenario 2) is summarized in **Table 5**. Model results for Scenario 1 indicate that about 60-percent (250 acre-feet) of the 0.36 MGD simulated annual pumping increase is derived from subsurface flow that ultimately discharges to San Francisco Bay. The remaining pumping increase (160 acre-feet per year) is derived from subsurface flow that otherwise moves beneath the bay toward eastern Alameda County. Doubling the simulated pumping rate from 0.36 MGD to 0.72 MGD (400 to about 800 acre-feet per year) captures almost all of the subsurface flow that otherwise discharges to the bay, and almost 50-percent of the flow beneath the bay toward eastern Alameda County.

Table 5. Comparison of Volumetric Water Balances for Simulated Existing Conditions and Two Possible Pumping Increases in the Bear Gulch District.

	Annual pumping increase[a] (AF/yr)		
	Existing	Scenario 1 0.36 MGD (400 AF/yr)	Scenario 2 0.72 MGD (800 AF/yr)
IN			
Recharge	3,360	3,360	3,360
OUT			
Wells	2,100	2,500	2,900
Seepage to Bay	390	140	10
Subsurface Outflow[b]	870	710	440
SUM[c]	0	10	10

a) Depth distribution of pumping between model layers 1 through 3 was 45-, 20-, and 35-percent, respectively, and based on hydraulic conductivity and layer thickness.
b) Flow beneath the bay toward eastern Alameda County.
c) Non-zero values are the result of round-off errors.

Several additional model runs were conducted to test the sensitivity of the simulated volumetric water balance to pumping depth. Screening the new wells exclusively in the deeper confined zone aquifer reduced water level and flow impacts in the shallow water bearing zone, but the reduction is not one to one. For example, pumping the entire 0.36 MGD from model layer 3 reduced pumpage from the shallow zone (layer 1) by 180 acre-feet per year, but the quantity of discharge to the bay increased less than 20 acre-feet per year. These results suggest that shallow zone pumping impacts can be partially mitigated by pumping from greater depth. However, the benefit appears to be limited due to the leaky characteristics of the clay beds and the corresponding increase in vertical groundwater movement.

Annual and Seasonal Drawdown

Based on Cal Water's operations, it could be preferable to utilize local groundwater during the period May through December rather than distribute the monthly extraction period uniformly over the entire year. We therefore compared annual and seasonal groundwater level changes by doubling the annual monthly pumping rate for 6-months of the year and then shutting down the wells for the remaining 6-months.

To compare annual and seasonal drawdown patterns, we employed analytical well functions developed by Strack[15] and the computer software WinFlow[16] to

[15] Otto D.L. Strack, 1988, "Groundwater Mechanics", Prentice Hall Englewood Cliffs.

[16] Environmental Simulations, Inc., 2003, "Aquifer[Win32] – WinFlow – WinTran Version 3".

simulate two-dimensional, transient groundwater elevation changes as a result of pumping equal water volumes during a period of 6 months and one year, respectively. The software utilizes the principle of superposition to evaluate the cumulative interference from multiple wells and simulate temporal and spatial groundwater level drawdown in response to seasonal and annual pumping patterns. Our analysis utilized the following assumed well construction and aquifer conditions required by the WinFlow software:

Depth to top of screened interval: 100 feet below land surface.

Depth to bottom of screened interval: 450 feet below land surface.

Transmissivity: Reported transmissivity estimates for the San Francisquito Cone range from 23 to 15,800 ft^2/day, and average 3,300 ft^2/day (Sokol, 1964). We utilized a value of 1,900 ft^2/day corresponding to the depth-averaged transmissivity specified in the calibrated regional groundwater flow model.

Storativity*:* 0.001. Reported storativity estimates for the San Francisquito Cone range from about 0.0002 to 0.10, with a representative value of 0.001 (Sokol, 1964).

Well Pumping Rate: Three wells pumping 0.12 MGD each for a twelve month period (annual operation), or three wells pumping 0.24 MGD each for a six month period (seasonal operation).

Recharge*:* The analytical functions assume the aquifer is confined, and therefore vertical recharge from seasonal rainfall and other sources are ignored.

We utilized the WinFlow software to simulate maximum and annual drawdown in the well field and at existing nearby water supply wells. When the well is operated annually (assuming a constant monthly pumping rate), the maximum and annual drawdown is the same and occurs at the end of the one-year pumping cycle; under annual operating conditions, the maximum simulated drawdown in the vicinity of the pumping wells was about 30 feet. This means that at the end of the annual pumping cycle, groundwater levels in the vicinity of the new pumping wells would be 30 feet lower than if the new wells weren't pumped[17]. In contrast, when the well is operated seasonally the maximum drawdown occurs at the end of the pumping cycle, and the minimum drawdown occurs at the end of the year following the 6-month recovery. Operating wells seasonally produces greater simulated drawdown (more than 50 feet at the end

[17] Metzger and Fio (1997) reported seasonal water level variations during 1993-1995 in private wells ranging from a few feet to more than 25 feet. The magnitude of water level variation increases inland, with the greatest range in seasonal water levels reported near the foothills.

of the 6-month pumping cycle); after the 6-month recovery period, the residual drawdown is only about 5 feet. Hence at the end of a typical irrigation season, groundwater levels in the vicinity of the new pumping wells would be 50 feet lower than existing conditions if the new wells weren't pumped.

Potential Impacts and Model Limitations

Several negative impacts can occur from over-pumping aquifers and causing excessive drawdown of the water table and deeper confined zone groundwater levels. In the Bear Gulch District, these impacts include potential saltwater intrusion and subsidence of the land surface[18]. Additionally, shallow groundwater contamination by past industrial activities has occurred at sites located at the margins of San Francisco Bay, and lowering confined zone groundwater levels can increase the vertical and inland movement of contaminant plumes. The models employed in this study help identify the potential for these impacts, but the results they provide are preliminary due to inherent modeling limitations.

If pumping levels exceed basin yield, salty bay water can move inland and degrade the quality of inland groundwater. The regional groundwater-flow model results showed that operating water supply wells can lower groundwater levels in both the shallow and deep water bearing zones, even if the wells are perforated exclusively in the deep zone. However, the model assumes steady-state conditions and simulated results represent average annual water levels and flow rates based on 1990-1994 conditions. A transient model calibrated to seasonal water level changes can simulate the short- and longer-term timing of shallow zone water level declines in response to pumping from the deep zone, and incorporating more recent water inflow and outflow data can improve the reliability of the estimated potential yield available to Cal Water.

The timing of water level declines was simulated with analytical equations that ignore downward moving groundwater which recharge the deep water bearing zone. Although the general relationships between annual and seasonal operation strategies would probably not change significantly if one considered vertical flow, the recharge can be significant and the results presented in this study likely over-estimate the water level decline. A monitoring program implemented as part of a project to install and use local groundwater can provide ongoing, real-time information to enable managers to adapt their pumping rates and maintain flexibility in their water use decisions.

[18] Lowering of groundwater levels increases the effective stress borne by the sediment grains of the aquifer, and can induce the release of water by the compaction of compressible fine-grained sediment beds resulting in subsidence of the land surface. Previous studies showed more than 6 feet of subsidence occurred during the period 1934-67 in parts of northern Santa Clara County, and less than one foot occurred during the same period in southern San Mateo County. Monitoring of water levels and land-surface altitude in the Bear Gulch District is recommended for assessing the occurrence and extent of future subsidence owing to groundwater use by Cal Water.

Data Collection to Improve Yield Estimates

The San Francisquito cone can be visualized conceptually as an underground reservoir, and groundwater use affects the supply available to all users. A groundwater consumption rate equal to the basin replenishment rate (safe yield) theoretically can be continued indefinitely without causing a long-term decline in groundwater levels and storage; pumpage in excess of safe yield can lead to overdraft, which lowers groundwater levels and depletes the underground water supply. In the Bear Gulch District, overdraft can impact all users by increasing the well pumping lifts; degrade groundwater quality by the inland movement of salty San Francisco Bay water; and, cause land surface subsidence. A comprehensive data collection effort can better quantify basin yield and manage groundwater resources.

Most methods for estimating safe yield are based on the analysis of several years of hydrologic and groundwater usage data. In the San Francisquito Cone area, key data components include groundwater level changes in wells and pumpage. Additionally, it is important to account for all major water sources entering and leaving the basin to assess the magnitude of groundwater accretion or depletion.

Monitoring wells

Groundwater storage changes are represented by water level changes in wells, whereby seasonal or longer-term water level decreases can indicate depletion and increases can indicate accretion. One effective monitoring approach utilizes dedicated water level recording devices (pressure transducers) in select existing and potential future test wells.

Several criteria can be applied toward selecting wells for a water level monitoring network. It is important for selected wells to have known construction information (i.e., well screen length and depth, borehole depth, and filter pack and sanitary seal depths), and recorded site geology (i.e., high quality well driller reports and geophysical logs). In addition, well location, accessibility, and activity issues also need consideration.

- Well locations should form a network across the Bear Gulch District, track groundwater conditions near possible new production well sites, and quantify groundwater changes near key recharge and discharge features like San Francisquito Creek.

- Selected wells must be accessible for periodic site visits, and the wellhead must provide access for installing the water-level recording instrumentation.

- Water level monitoring wells should be inactive during the monitoring period so that measured water levels are not influenced by pumping within the well.

We reviewed available well data bases and successfully identified 14 San Francisquito Cone wells having sufficient well construction information, but none were located within the Bear Gulch District. The most promising existing wells for future monitoring are located near the District's northern boundary at the U.S. Geological Survey and St. Patrick's Seminary (**Figure 14**). We could not ascertain their current activity status or the availability of site geologic information. Our search for candidate monitoring wells is not comprehensive, and additional work is needed to identify existing wells before implementing a monitoring program.

Water budget calculations

The long-term, average replenishment rate refers both to the quantity of recharge added to the basin and the rate percolating recharge moves through the subsurface and is ultimately discharged or captured by water supply wells. To quantify safe yield, data is needed on water inflows (water deliveries, rainfall, and subsurface water movement into the basin), outflows (consumptive use of imported water and self-supplied groundwater, subsurface outflow into adjacent basins, and groundwater discharge to surface water features). The difference between volumetric inflows and outflows is the change in water volume stored beneath the subsurface (groundwater storage change).

A water budget is an accounting of recorded and estimated water inflows and outflows. **Table 6** lists the primary hydrologic information required for the San Francisquito Cone and the possible data sources. Some information is straightforward to obtain, such as water purchases and deliveries; whereas other information like pumpage is obtained less directly and must be estimated from the number of wells and assumed activity levels.

Table 6. Water Budget Components and Groundwater Storage Changes.	
Budget Component	Potential Data Source
INFLOW	
SFPUC Purchases	Cal Water and other local purveyor records.
Bear Gulch Deliveries	Cal Water and other local purveyor records.
Estimated Private Self-Supply	Pumping estimates based on number of wells, use, operation time, etc.
Daily Rainfall	UC IPM Weather Station (Redwood City) and long-term average annual isohyetal maps.
Leaky Pipes	Leak Detection Surveys
Subsurface Inflow	Estimated groundwater level gradients and transmissivity near San Francisquito Cone boundaries.
Leakage from San Francisquito Creek (upper basin)	Stream gauge data; reported seepage run results, creek stage and water levels in adjacent wells.
OUTFLOW	
Consumptive Use	Potential Evapotranspiration (PET) calculated from mean daily temperature recorded at the UC IPM Weather Station (Redwood City) and Blaney-Criddle Formula; representative plant use coefficients.
Sewer Discharge	West Bay Sanitary District and Fair Oaks Sewer District records.
Runoff	Estimated from distribution of soils and impervious and pervious areas.
Subsurface Outflow	Estimated groundwater level gradients and transmissivity near San Francisquito Cone boundaries.
Seepage into San Francisquito Creek (lower basin)	Stream gauge data; seepage run results, creek stage and water levels in adjacent wells.
STORAGE CHANGE	Sum of INFLOW - OUTFLOW
Well Water Level Change	Calculated from observed groundwater level changes and estimated aquifer storage coefficients. Provides the basis for alternative independent storage change estimates.

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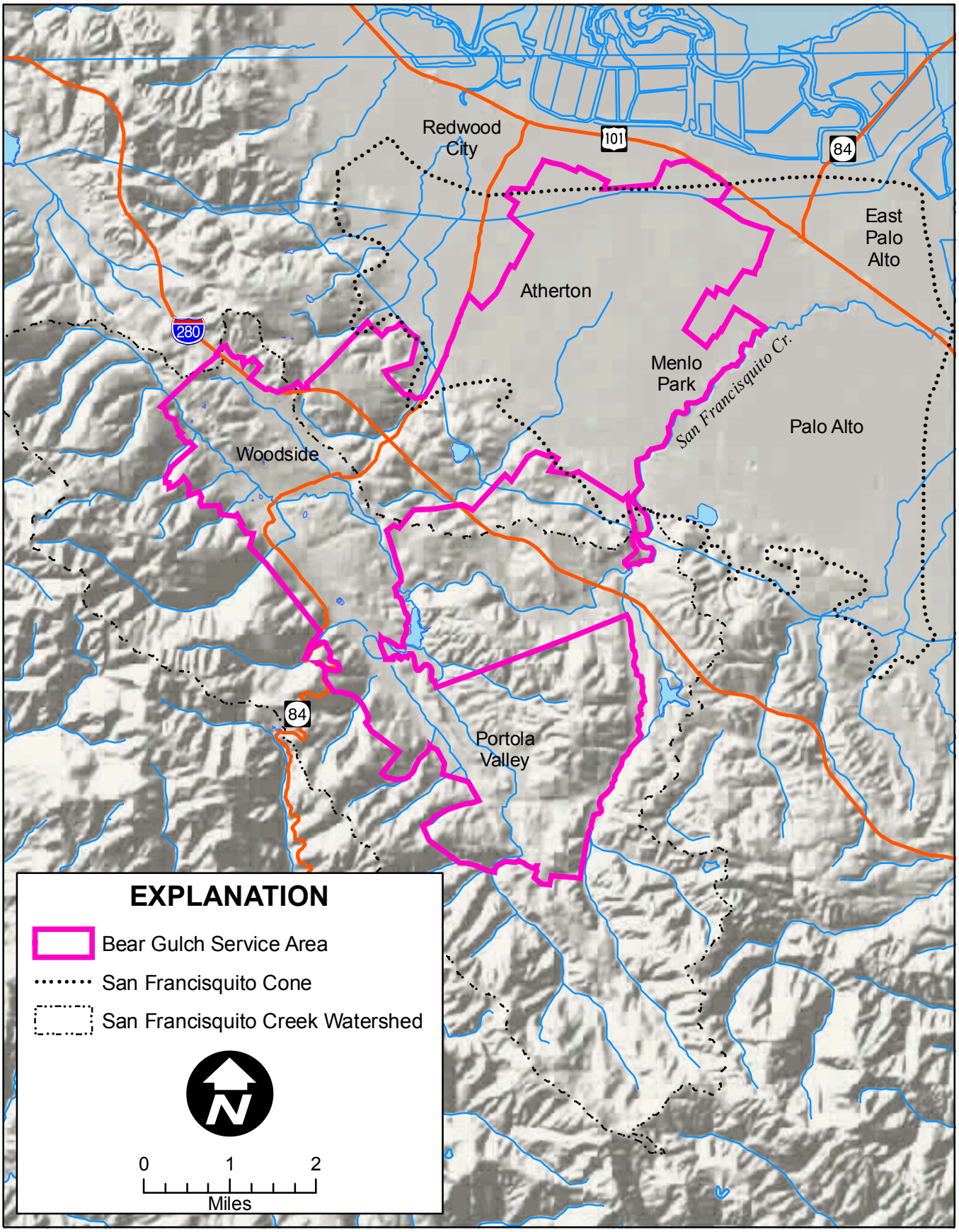

HYDROFOCUS INC. Solutions for Land and Water Resources	Bear Gulch Service Area and Relevant Features.	Figure 1
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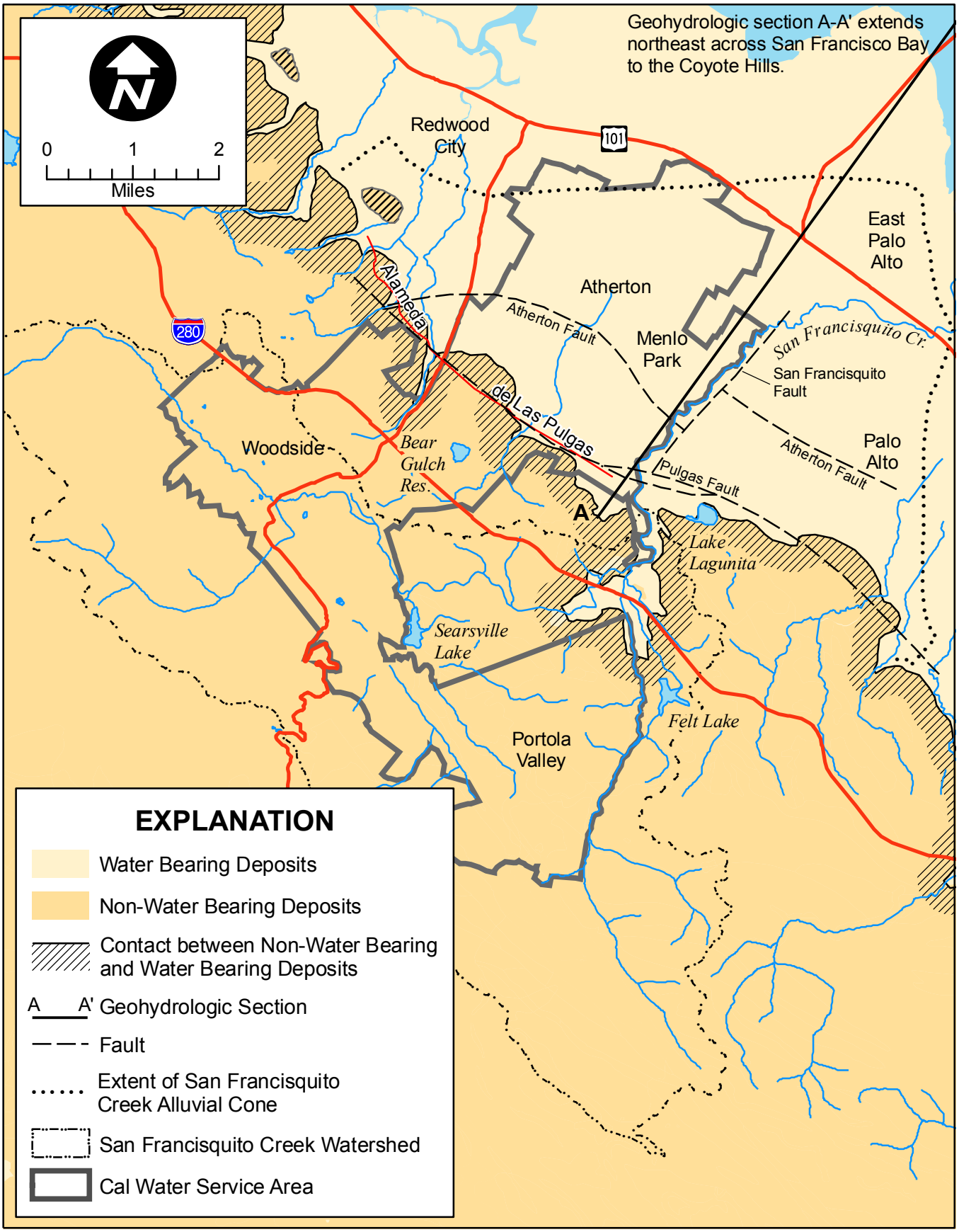

HYDROFOCUS INC. Solutions for Land and Water Resources	Distribution of Water Bearing and Non-Water Bearing Areas, San Francisquito Cone.	Figure 2
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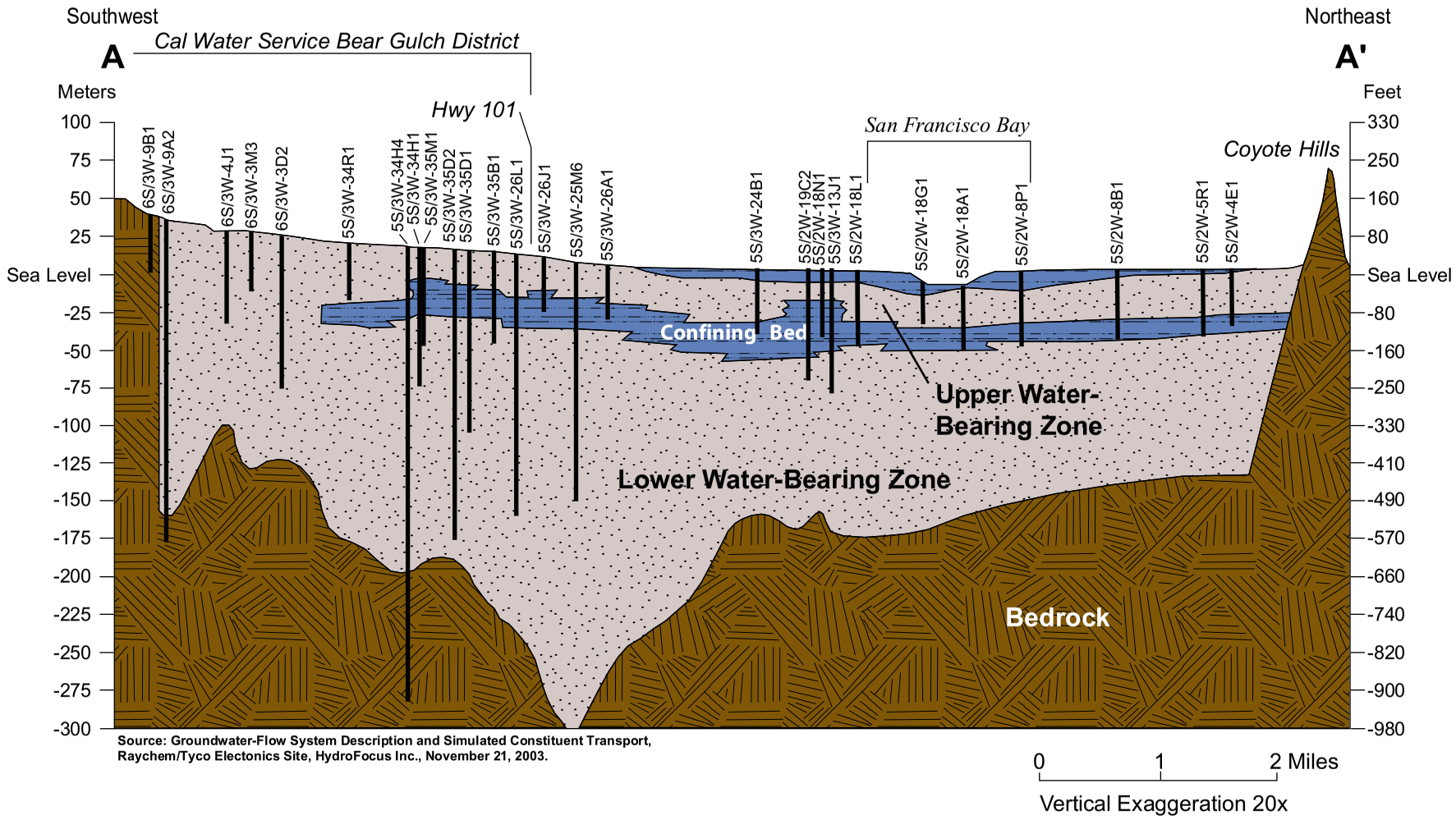

Source: Groundwater-Flow System Description and Simulated Constituent Transport, Raychem/Tyco Electonics Site, HydroFocus Inc., November 21, 2003.

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Geohydrologic Section.

Figure 3

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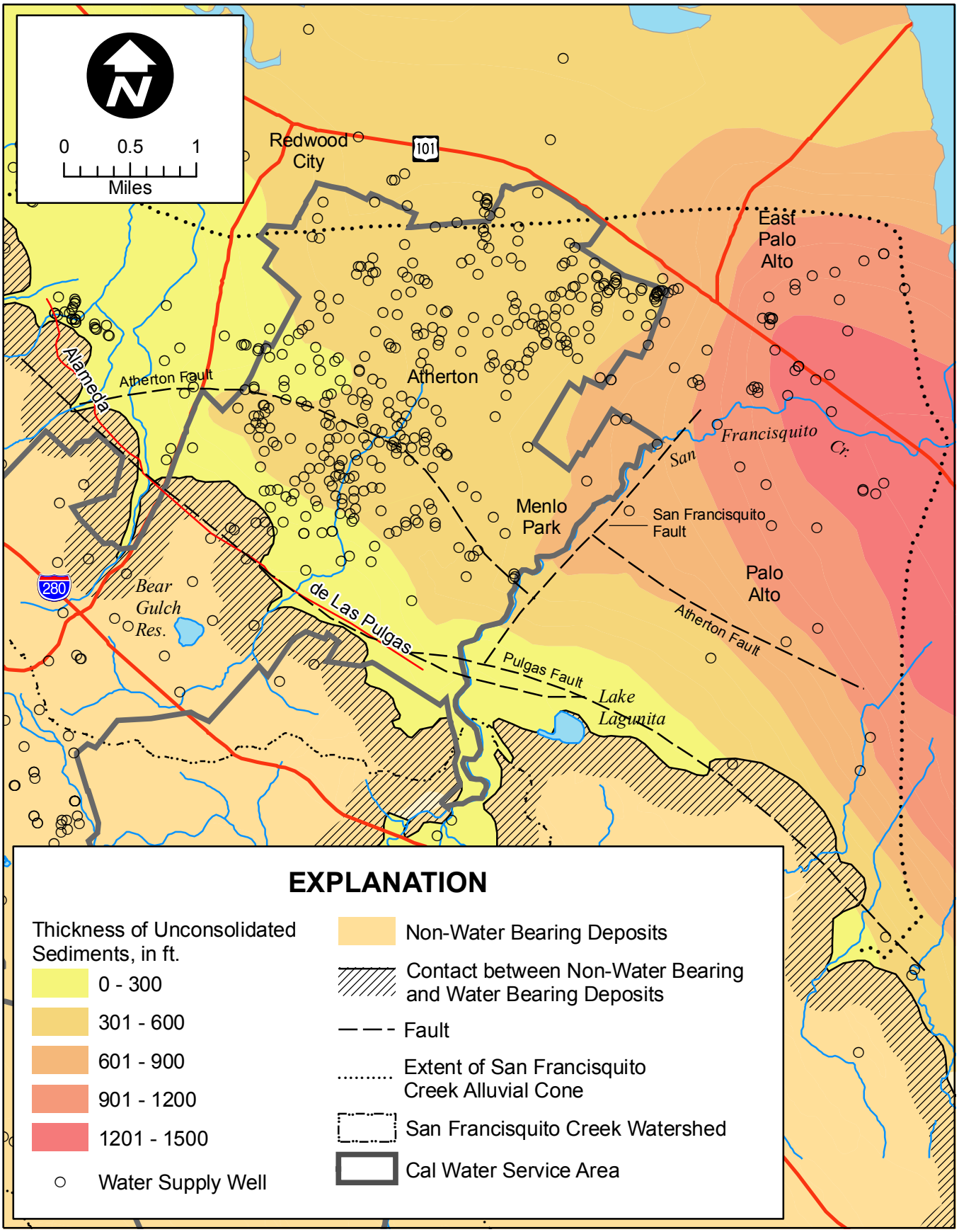

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Thickness of Water Bearing Zone and Distribution of Water Supply Wells, San Francisquito Cone.

Figure 4

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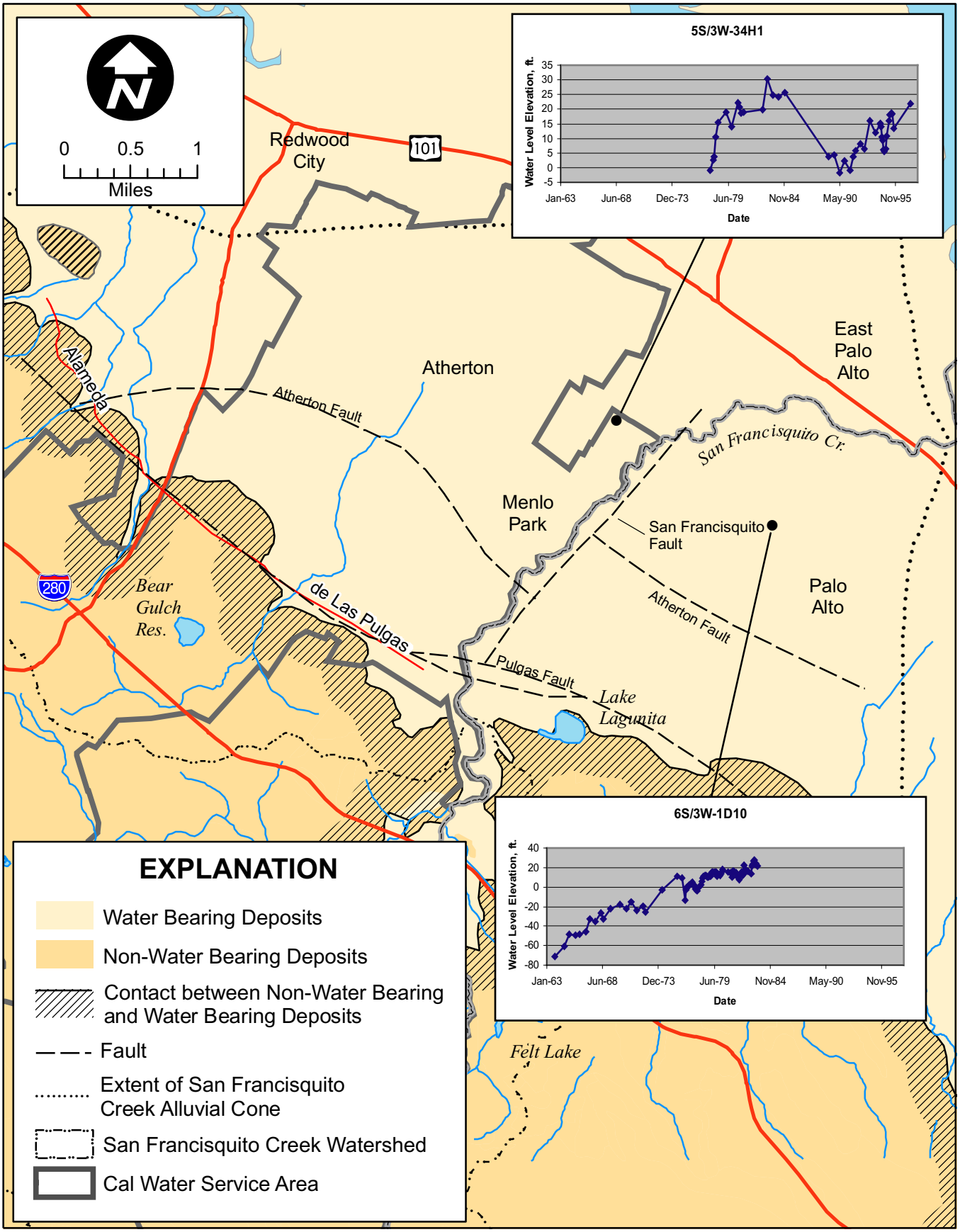

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Historical Water Level Trends, San Francisquito Cone.

Figure 5

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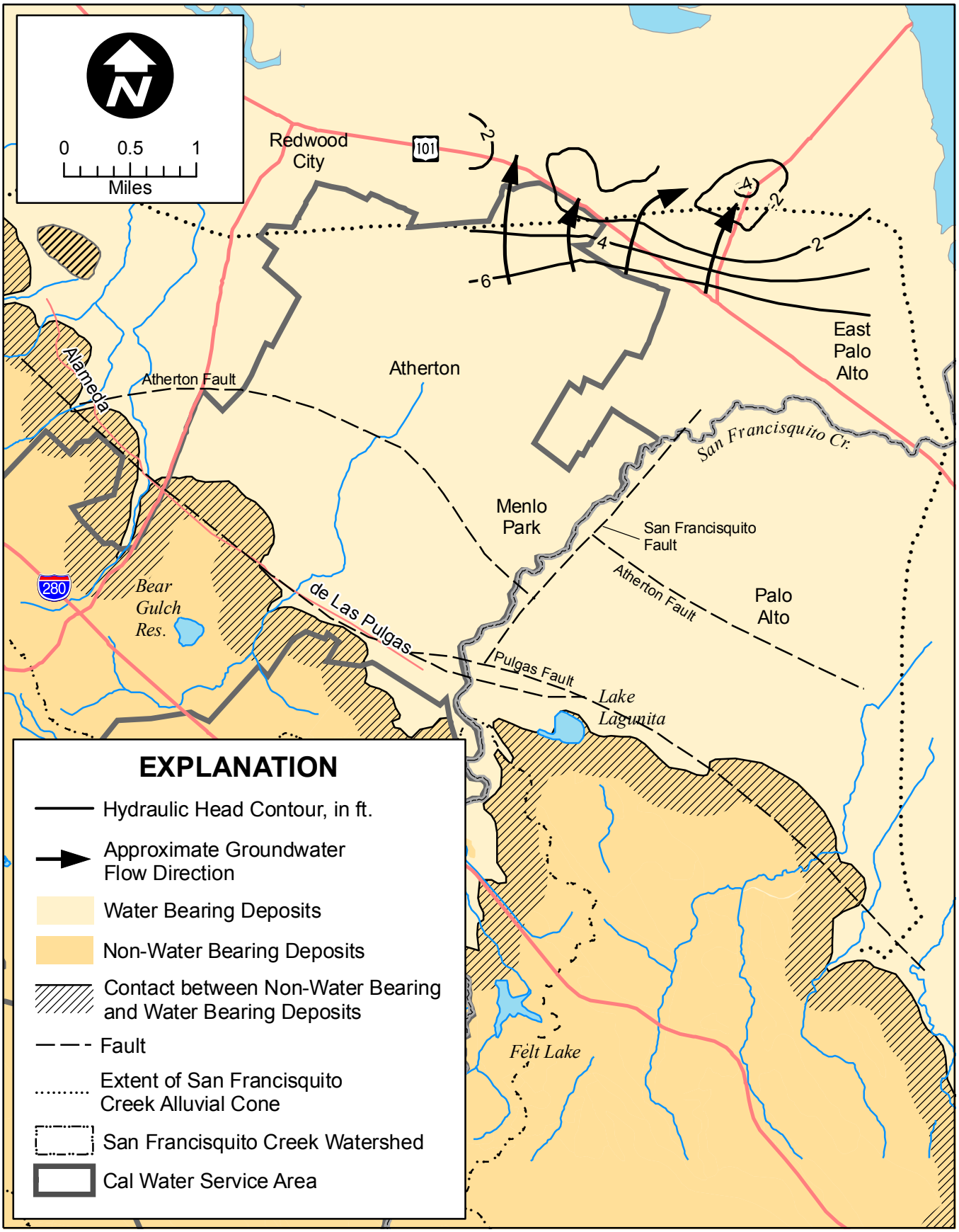

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General Hydraulic Head Distribution, Shallow Zone, 1991-2001.

Figure 6(a)

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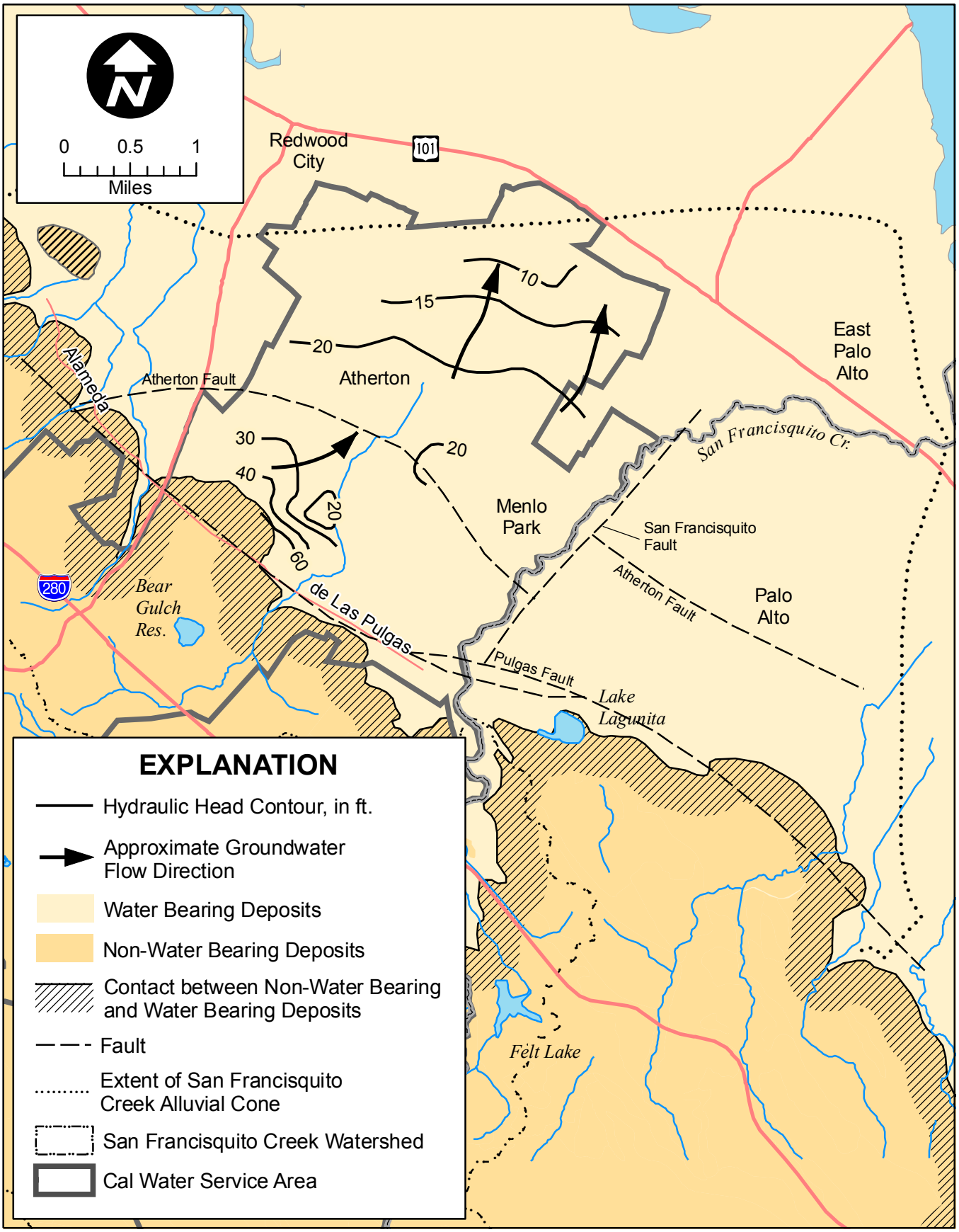

HYDROFOCUS INC. Solutions for Land and Water Resources	General Hydraulic Head Distribution, Deep Zone, March 1995.	Figure 6(b)
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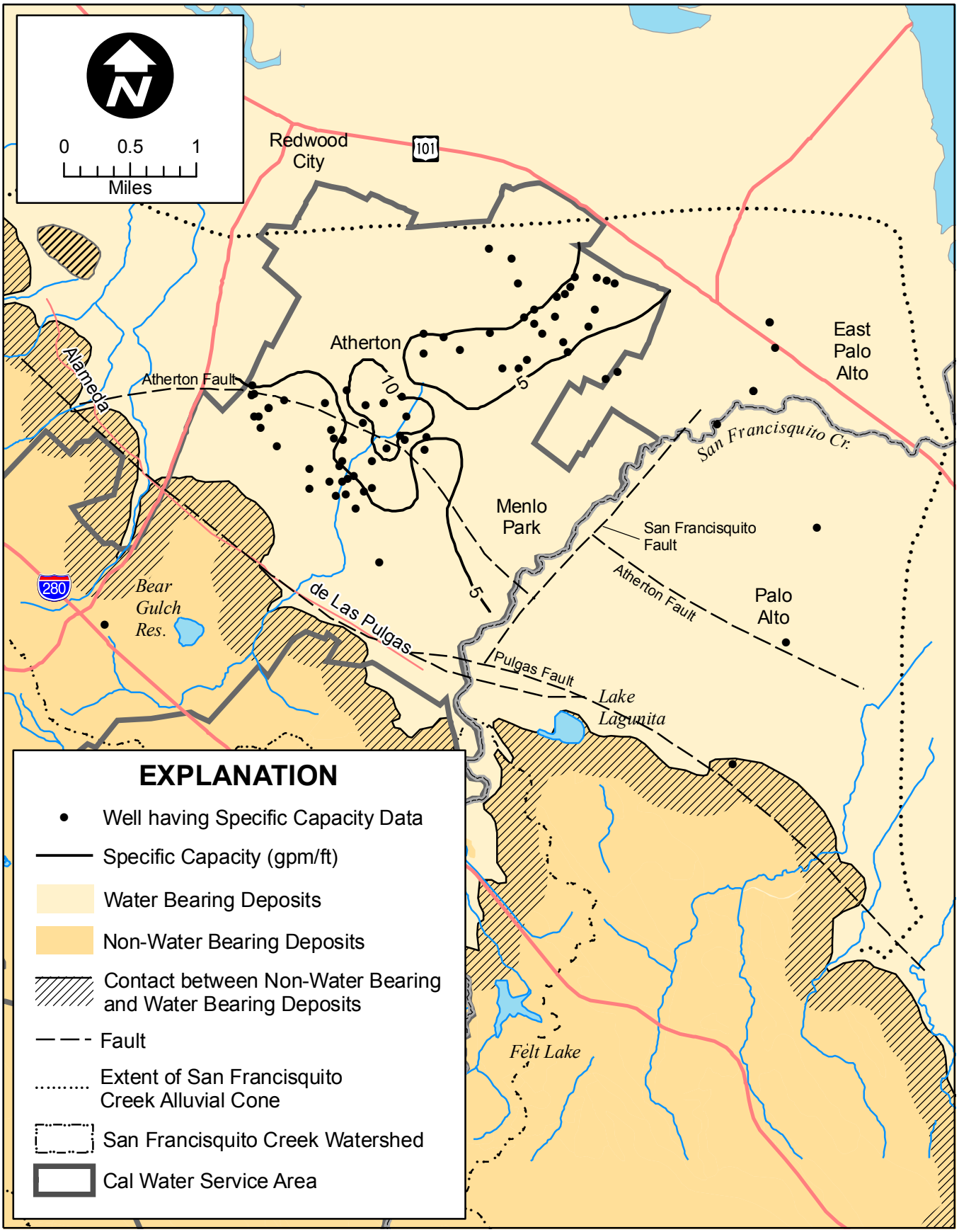

HYDROFOCUS INC. Solutions for Land and Water Resources	Distribution of Specific Capacity Reported for Wells Located on the San Francisquito Cone.	Figure 7
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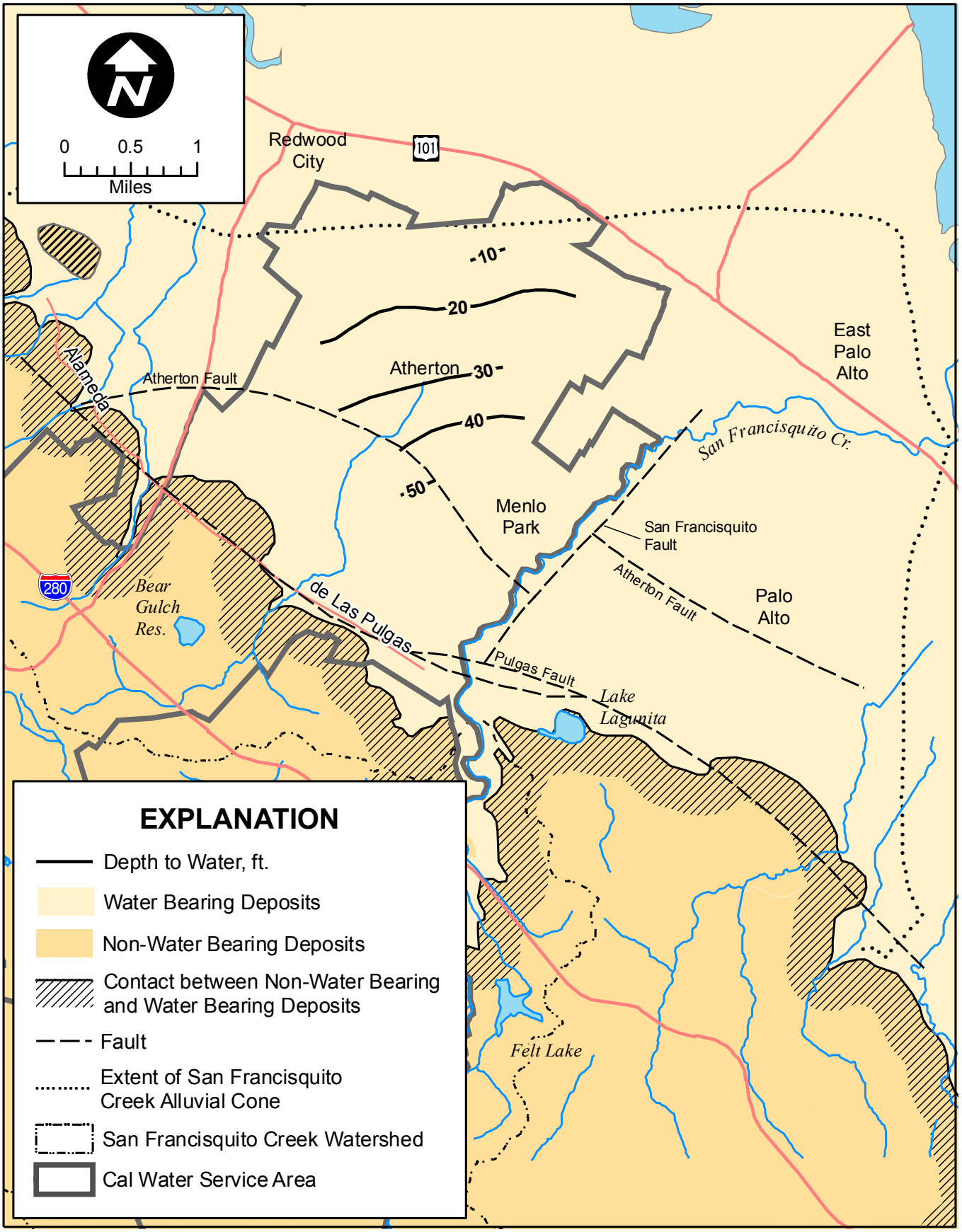

HYDROFOCUS INC. Solutions for Land and Water Resources	Approximate Depth to Water, San Francisquito Cone.	Figure 8
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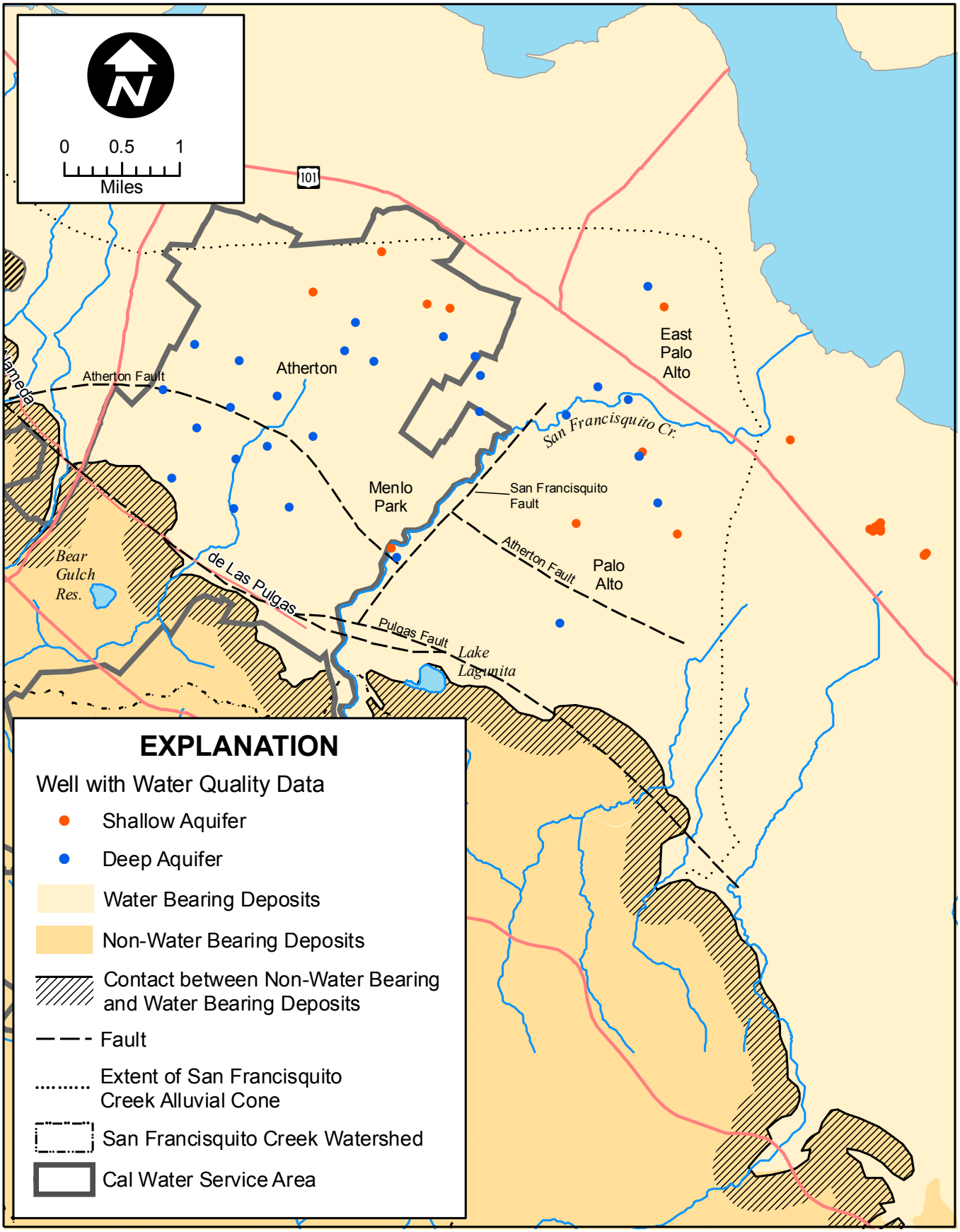

HYDROFOCUS INC. Solutions for Land and Water Resources	Wells with Water Quality Data, San Francisquito Cone.	Figure 9
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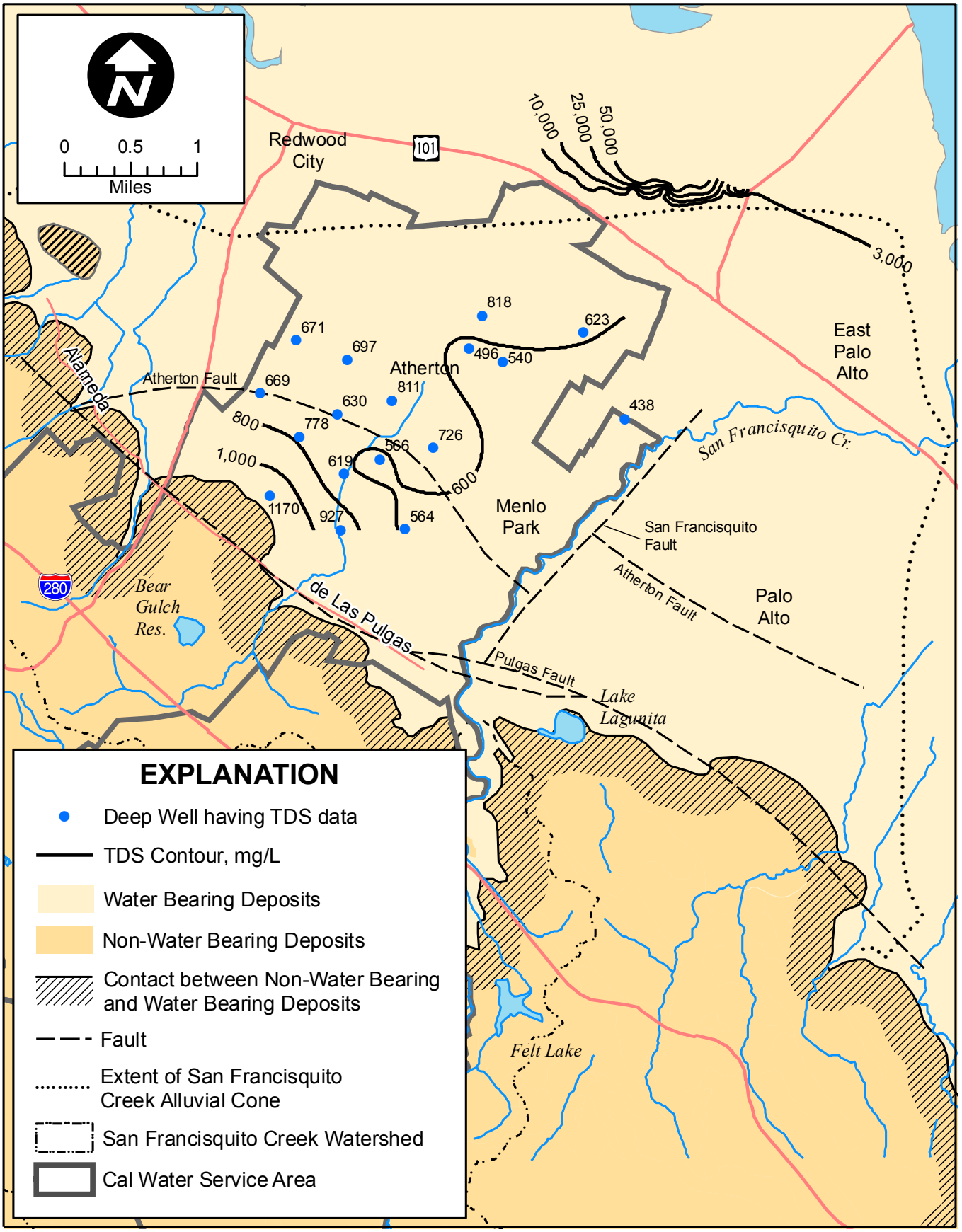

HYDROFOCUS INC. Solutions for Land and Water Resources	Total Dissolved Solids Concentrations in Groundwater, San Francisquito Cone and Bay Plain Areas.	Figure 10
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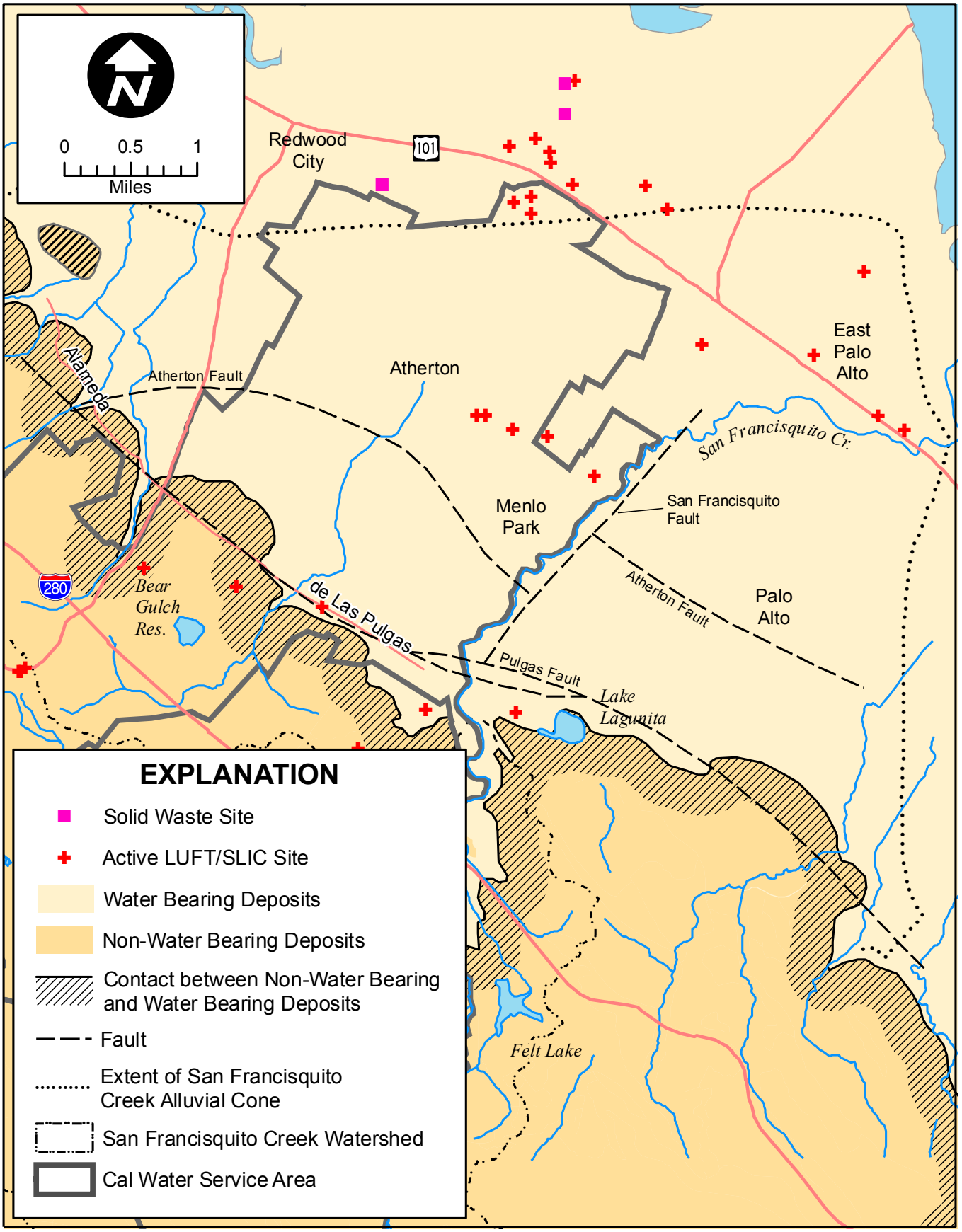

HYDROFOCUS INC. Solutions for Land and Water Resources	Soil and Shallow Groundwater Contamination Sites, San Francisquito Cone.	Figure 11
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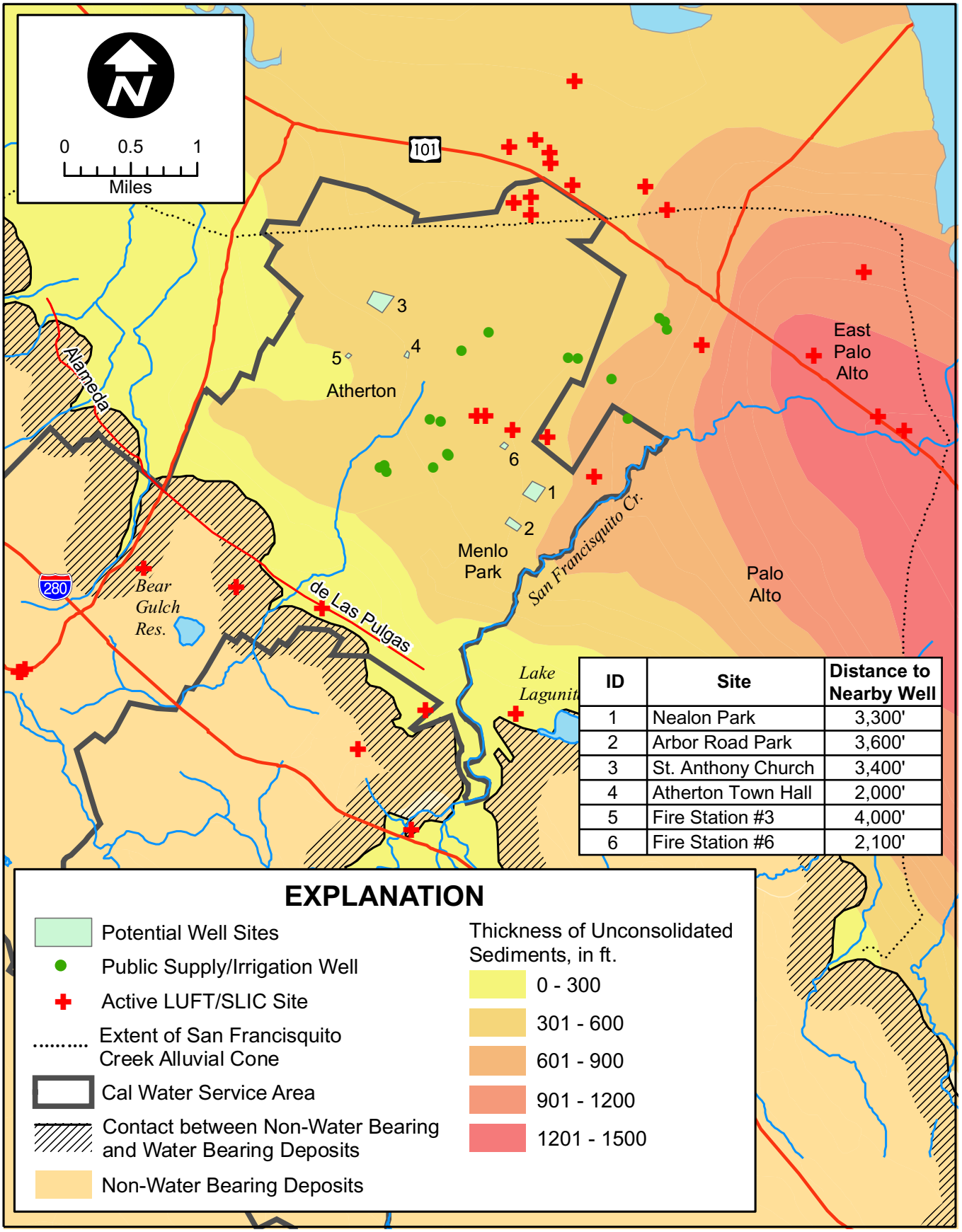

ID	Site	Distance to Nearby Well
1	Nealon Park	3,300'
2	Arbor Road Park	3,600'
3	St. Anthony Church	3,400'
4	Atherton Town Hall	2,000'
5	Fire Station #3	4,000'
6	Fire Station #6	2,100'

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Promising Sites for Potential New Water Supply Wells, Bear Gulch Service Area, San Francisquito Cone.

Figure 12

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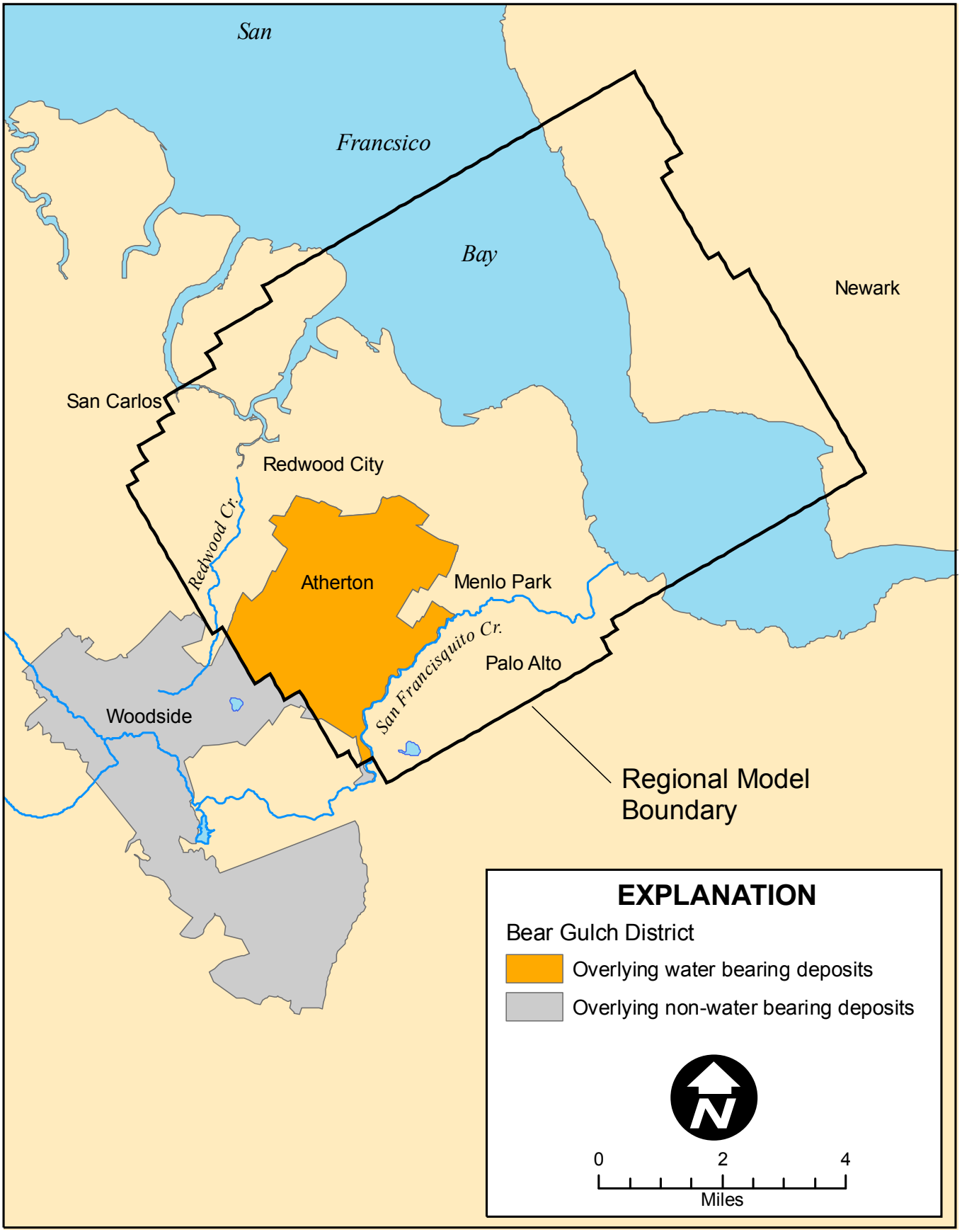

HYDROFOCUS INC. Solutions for Land and Water Resources	Location of Bear Gulch District and Regional Model.	Figure 13
PROJECT: 5027	DATE: 2/15/08	

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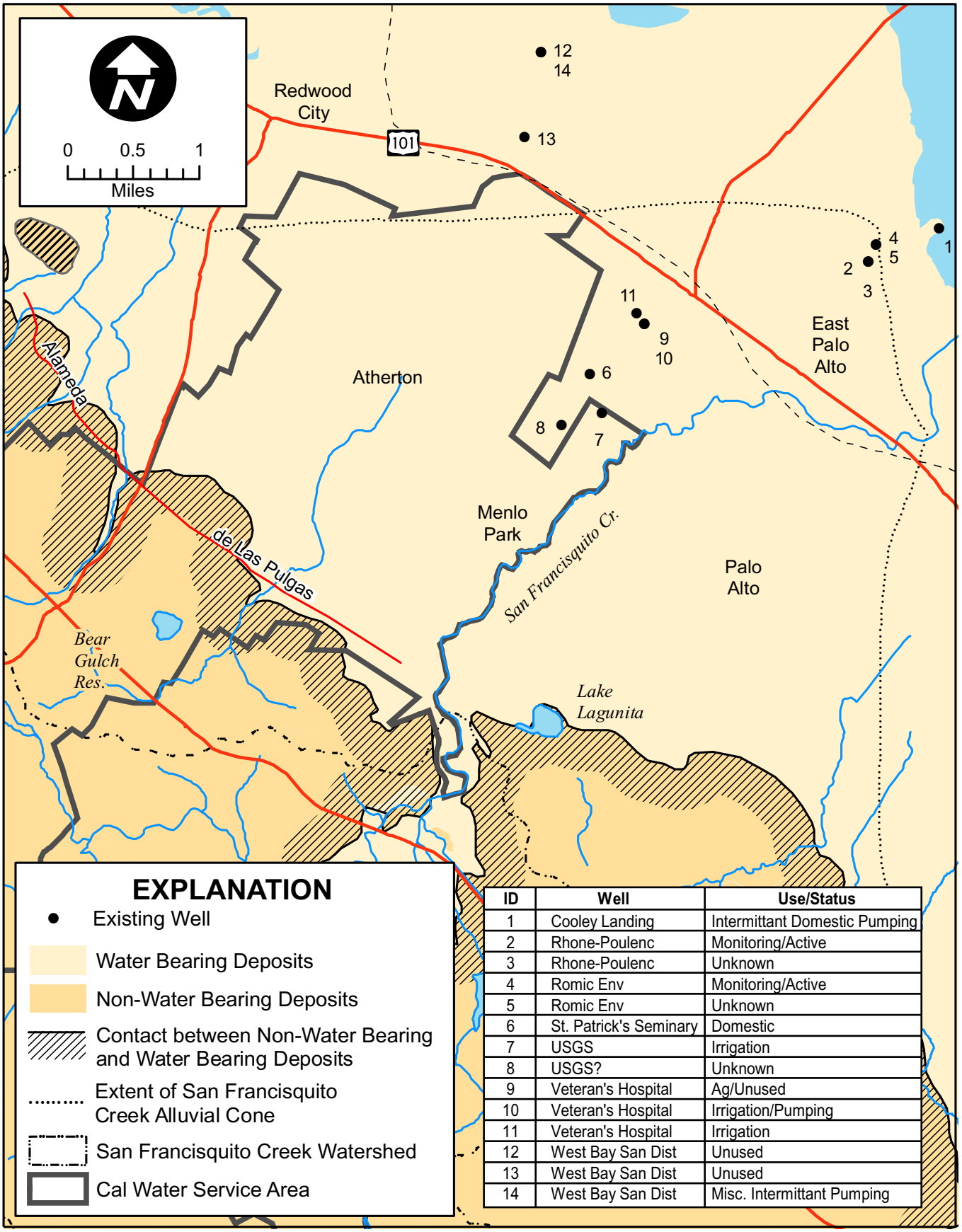

ID	Well	Use/Status
1	Cooley Landing	Intermittant Domestic Pumping
2	Rhone-Poulenc	Monitoring/Active
3	Rhone-Poulenc	Unknown
4	Romic Env	Monitoring/Active
5	Romic Env	Unknown
6	St. Patrick's Seminary	Domestic
7	USGS	Irrigation
8	USGS?	Unknown
9	Veteran's Hospital	Ag/Unused
10	Veteran's Hospital	Irrigation/Pumping
11	Veteran's Hospital	Irrigation
12	West Bay San Dist	Unused
13	West Bay San Dist	Unused
14	West Bay San Dist	Misc. Intermittant Pumping

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Potential Existing Wells for Groundwater Level Monitoring, Bear Gulch District, San Francisquito Cone.

Figure 14

PROJECT: 5027

DATE: 2/15/08

Appendix G
Recycled Water System Details

Public Version

Detailed Breakdown for Conceptual Recycled Water Pipeline System
Bear Gulch District

Site ID	Site Name	Annual Average Demand (AFY)	Annual Average Demand (mgd)	Max Month Average Day (mgd)	Max Month Peak Hour (mgd)	Pipelines					Cumulative Capital Costs and Annual Revenue Requirements for Low Zone Recycled Water Pipeline System (cumulative as system is expanded)					
						Segment	Size (in)	Length (ft)	Transmission Main Capital Cost (1)	Distribution Pipe Capital Cost (1)	Segment	Cumulative Total Capital Costs for Pipelines	Cumulative Annual Revenue Requirement for Pipelines (2)	Cumulative Average Day Demand (mgd)	Cumulative Initial Recycled Supply (AF per Year)	Cumulative Annualized Revenue Requirement per AF for Pipelines
	SEGMENT A SUBTOTAL	0.0	0.000	0.000	0.000	A	18	7,880	$2,837,000	$0	A	$2,837,000	$425,550	0.00	0	$0
	SEGMENT B SUBTOTAL	391.9	0.350	0.840	2.242	B	16	10,564	$3,380,000	$0	A+B	$6,217,000	$932,550	0.35	392	$2,380
13	Selby School	6.3	0.006	0.013	0.036											
17	Los Lomitas School	9.8	0.009	0.021	0.056											
18	Woodside High School	38.6	0.034	0.083	0.221											
20	Menlo Country Club	326.1	0.291	0.699	1.866											
22	Highway 280 Median	11.2	0.010	0.024	0.064											
	SEGMENT C SUBTOTAL	27.7	0.025	0.059	0.158	C	16	5,035	$1,611,000	$0	A+B+C+C1	$8,105,000	$1,215,750	0.37	420	$2,898
	SEGMENT C1 SUBTOTAL	27.7	0.025	0.059	0.158	C1	6	2,305	$0	$277,000						
1	Public	7.8	0.007	0.017	0.045											
2	Public	19.9	0.018	0.043	0.114											
	SEGMENT D SUBTOTAL	427.9	0.382	0.917	2.448	D	16	9,555	$3,058,000	$0	A+B+C+C1+D+D1	$11,684,000	$1,752,600	0.76	847	$2,068
3	Atherton Town Hall	7.2	0.006	0.015	0.041											
5	Public	0.3	0.000	0.001	0.002											
6	Holbrook Palmer Park	51.4	0.046	0.110	0.294											
7	Circus Club	65.1	0.058	0.139	0.372											
8	Nealon Park	21.2	0.019	0.045	0.121											
9	Jack W. Lyle Park	10.1	0.009	0.022	0.058											
10	Encinal School	11.9	0.011	0.025	0.068											
14	Menlo College	93.2	0.083	0.200	0.533											
15	St. Joseph & Sacred Heart School	71.9	0.064	0.154	0.411											
16	Hillview School	11.5	0.010	0.025	0.066											
19	Oak Knoll School	10.7	0.010	0.023	0.061											
21	El Camino Real Median	11.2	0.010	0.024	0.064											
	SEGMENT D1 SUBTOTAL	62.4	0.056	0.134	0.357	D1	8	3,256	$0	$521,000						
4	Public	7.8	0.007	0.017	0.045											
11	Menlo-Atherton High School	46.2	0.041	0.099	0.264											
12	Laurel School	8.4	0.008	0.018	0.048											

Notes:

(1) Unit capital costs include pipeline construction costs (as shown in Section 9 of report) times a total compounded markup of 2.0 that includes a 10% allowance for items not determined, plus a 30% construction contingency and a 40% project implementation allowance.

(2) Annual revenue requirements were estimated as 15% of the total capital cost, which is Cal Water's rule of thumb for order of magnitude estimates. The 15% factor includes the authorized rate of return, the cost to borrow half the amount, and the tax liability. This represents the initial revenue requirement for project implementation. The actual revenue requirement will decrease over time due to depreciation.

Appendix H
Hydraulic Model

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1 Maximum Demand Day Verification Charts
2 High Demand Day Verification Charts

Appendix H
Bear Gulch System Hydraulic Model

Purpose

This Appendix presents the findings for the Bear Gulch District Model Development Project prepared by the CDM Team for the California Water Service Company (Cal Water). The purpose was to develop and calibrate a computerized hydraulic model of the Bear Gulch District distribution system. This model was then used for preparation of the Water Supply & Facilities Master Plan.

Overall Approach for Model Development

The computerized hydraulic model of the Bear Gulch District system was developed from the ArcGIS geodatabase provided by Cal Water, using H20MAP software version 7.0 by MWHSoft. H20MAP is a stand-alone GIS –based program that combines spatial analysis tools and mapping functions with a versatile hydraulic model. H2OMAP also supports geocoding and multiple mapping layers which can be imported from other GIS-compatible software such as CAD, Word file, standard formats of "Shapefiles", Arcinfo coverages and others.

Cal Water provided CDM with the Bear Gulch District water distribution map showing existing facility locations and pressure zone boundaries, and a profile schematic diagram of the existing system. In addition, Cal Water provided CDM with GIS files containing virtually all pipes and valves in the Bear Gulch District system, and associated data such as pipe diameters, pipe material, pipe length, and the pressure zone where the pipe is located.

Cal Water also provided CDM with an ArcGIS database file of the former Los Trancos system containing pipe and elevation information, which was merged into the Bear Gulch model.

The model of the Bear Gulch District system contains pipes of all sizes in the system, as contained in Cal Water's GIS database. Modeling the entire system keeps the model in a one-to-one match with the GIS database, and is needed for geocoding addresses and allocating customer usage data to the appropriate model nodes.

The model is configured for 24-hour extended period simulations (EPS). An EPS model provides a more detailed look at system operations, such as reservoir filling cycles, than a steady-state model that provides a snapshot for one particular demand condition, such as the average hourly demand on the maximum day.

If desired, Cal Water could skeletonize the model in the future to create a model of only the major pipelines, e.g., only pipelines 8-inch and greater in diameter. A skeletonized model is sometimes used for modeling overall system hydraulics and conveyance of water across the system through various pressure zones. Skeletonizing

***

the model reduces the number of facilities and the time required for model execution, and can make it easier to review the results of model simulations to focus only on the key facilities. If the model is skeletonized in the future, modeled facilities should be carefully selected so that deadends at higher elevation in the zone are not eliminated when the system is evaluated for fire flow. Table 1 summarizes key facilities that supply water into and out of each zone.

Modeled Facilities

Figure 1 shows the modeled water system facilities with the pipes color coded by diameter and the pressure zone boundaries.

Table 1 summarizes the modeled pressure zones and key facilities in the Bear Gulch system. Below is a discussion of the various types of modeled facilities and model data.

Table 1
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	Sources of Supply	Deliveries out of Zone	Storage
Menlo Park/Atherton			
220		--	--
265		--	--
319-A (Alpine Rd)		Station 20 PRV-319-220-4 (Lemon Ave and Oak)	--
319-B (Santa Cruz Rd)		--	--
319-C (Woodside Rd)		PRV-319-220-1 (Woodside Rd and Bonsen Ct)	--

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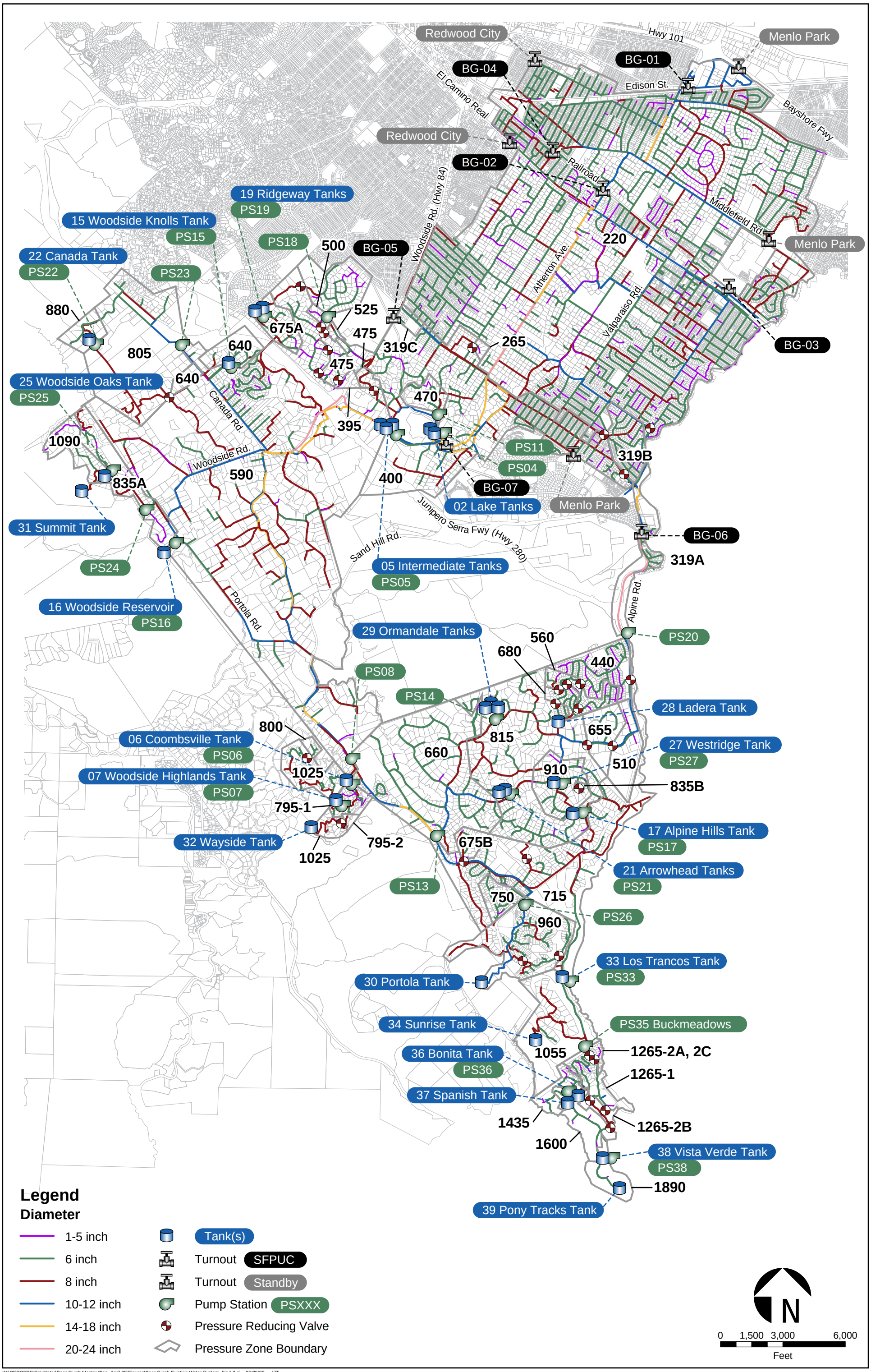

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CDM

Figure 1
Bear Gulch Existing Water System

Table 1
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	***Sources of Supply***	***Deliveries out of Zone***	***Storage***
400			Intermediate
470			hydro (5000 gal)
Woodside			
395			--
475			--
500			--
525			--
590			Coombsville
			Ridgeway
			Woodside Knolls
			Woodside Res
640			hydro (3000 gal)
675-A			hydro (3000 gal)
805			Canada
835-A			Woodside Oaks
880			hydro (2000 gal)
1090			Summit

Table 1
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	***Sources of Supply***	***Deliveries out of Zone***	***Storage***
Portola Valley			
440			--
510			--
560			--
655			--
660			Arrowhead Ormondale
675-B			--
680			Ladera
715			Alpine Hills Los Trancos
750			--
795-1			Woodside Highlands
795-2			--
800			--
815			Westridge
835-B			--
850			--
910			hydro @ 17(5000) hydro @ 27 (2500)
960			Portola
1025			Wayside

Table 1
Cal Water Bear Gulch District System Zones and Key Facilities

Zone	Sources of Supply	Deliveries out of Zone	Storage
Los Trancos			
1055			Sunrise
1265-1			Bonita
1265-2A			--
1265-2B			--
1435			--
1600			Vista Verde
1890			Pony Tracks

Pipes

Pipe locations and diameters were extracted directly from Cal Water's GIS files. The model automatically calculated pipe length from the GIS files based on the digitized length of the pipes between nodes.

CDM estimated pipe roughness factors based on pipe material, diameter, and assumed ages, using reasonable values established by past modeling experience and from other industry sources. The GIS files contained pipe material information for most pipes. Less than 1% of the pipes did not have associated material information. For those pipes that did not have material information, the material was assumed to be either: 1) similar to other adjacent pipes, e.g., PVC would be assumed in an area of other PVC pipes; or 2) similar to the most common material type for that diameter pipe, e.g., most 2-inch pipes are cast iron.

The GIS file has age information in the "Install Date" field for 562 out of 10,623 (or about 5%) of the pipelines. For pipelines without age information, general estimates of pipe age were assumed based on: 1) pipe diameters, e.g., very small pipes are typically older; 2) pipe material, e.g., cast iron pipes are typically older than PVC pipes; and 3) discussions with Cal Water District staff regarding their knowledge of the general ages of pipes in the system.

In Section 4, Model Calibration, there is a discussion of pipe roughness factors.

Node Elevations

Digital Elevation Models (DEMs) were used to calculate the model junction elevations. These DEMs consist of a raster grid of regularly spaced elevation values that have been primarily derived from the USGS topographic maps. For this study, 7.5 minute maps with 10 meter resolution were used.

ArcGIS 3D-Analyst extension tool was used to process the model junctions with the DEMs raster file to obtain the junction elevations.

This topographic information is appropriate for a master planning level of analysis. In the locations of very steep topography such as at zone boundaries or tops of hills, this level of topographic mapping may not accurately reflect the actual service elevations in small localized areas that may have had site-specific grading done for building pads or where customer demands have been aggregated at the closest model nodes in streets based on the billing address. The customers may actually be served from smaller laterals off the distribution pipeline that may be at significantly lower ground elevations due to the steep hilly terrain.

In localized areas with steep topography, there are typically only a few buildings at these nodes. If the model is used in the future for more detailed localized analyses of such areas, obtaining more detailed topographic information may be warranted to refine the model ground elevations.

Connectivity

Since GIS files are not typically set up with pipe-node connectivity in mind, CDM performed checking to establish correct model connectivity, i.e., that the pipes are connected correctly to each other. H_2OMAP and similar software packages allow modelers to view connectivity on-screen and ensure that it matches the digitized images of pipes and nodes that represent the water system in the model.

Pump Stations

The Bear Gulch system, including the former Los Trancos system, has 26 pump stations, which supply 20 of the 41 pressure zones in the system. The other zones are supplied by either PRV stations or by SFPUC turnouts.

Cal Water provided pump design data which included a graph (design curve) of Total Dynamic Head (TDH) versus flow at operating rpm for each pump. The pump design curves were input into the model as either three point curves, or as multiple point curves if more points were needed to accurately depict the curve. The pumps are controlled to simulate system operations based on either reservoir level control or time control. Table 2 summarizes key model information for the pumps.

Table 2
Pump Stations - Bear Gulch System

Pump Station Number	Pump ID	Source Zone	Service Zone	Design Flow (gpm)	Design Head (ft)
02	PMP-002-B	Bear Gulch WTP clearwell (Lake tanks)	220	1200	45
	PMP-002-C		220	1200	45
	PMP-002-D		220	1200	45
04	PMP-004-C	220	400	1900	220
	PMP-004-I	220	400	2000	233
	PMP-004-F	220	400	2200	225
	PMP-004-G	220	400	1500	115
	PMP-004-H	220	400	2600	126
05	PMP-005-J	400	590	1920	280
	PMP-005-K	400	590	1950	270
	PMP-005-L	400	590	1950	270
	PMP-005-M	400	590	1950	270
	PMP-005-N	400	590	1950	270
06	PMP-006-A	590	795-1	155	239
	PMP-006-B	590	795-1	250	260
07	PMP-007-B	795-1	1025	250	260
	PMP-007-C	795-1	1025	650	150
08	PMP-008-B	590	660	400	140
	PMP-008-C	590	660	700	160
	PMP-008-D	590	660	1200	190
	PMP-008-E	590	660	600	100
11 (Hydro-pneumatic)	PMP-011-A	400	470	200	65
	PMP-011-B	400	470	150	80
	PMP-011-C	400	470	400	94
13	PMP-013-B	660	715	800	75
	PMP-013-C	660	715	800	94
14	PMP-014-A	660	815	300	225
15 (Hydro-pneumatic)	PMP-015-A	590	640	250	175
16	PMP-016-A	Woodside Res	590	1000	50
17	PMP-017-A	715	815	200	110
	PMP-017-B	715	910	320	200
	PMP-017-C	715	910	320	200
18	PMP-018-A	400	590	400	305
19 (Hydro-pneumatic)	PMP-019-A	590	675A	450	95
	PMP-019-B	590	675A	500	94
20	PMP-020-A	319A	815	500	480
	PMP-020-B	319A	815	500	480
21	PMP-021-A	660	815	700	220
22 (Hydro-pneumatic)	PMP-022-A	805	880	100	90
	PMP-022-B	805	880	100	90
23	PMP-023-A	590	805	300	250
	PMP-023-B	590	805	300	360
24	PMP-024-A	590	835A	200	240
	PMP-024-B	590	835A	200	240
25	PMP-025-A	835	1090	200	240
	PMP-025-B	835	1090	200	240
26	PMP-026-A	715	960	250	375
	PMP-026-B	715	960	250	375
27 (Hydro-pneumatic)	PMP-027-A	815	910	350	100
33	PMP-033-A	715	1055	180	465
	PMP-033-B	715	1055	165	465
35	PMP-035-A	1055	1265-1	136	224
	PMP-035-B	1055	1265-1	137	224
36	PMP-036-A	1265-1	1600	135	347
	PMP-036-B	1265-1	1600	140	347
38	PMP-038-A	1600	1890	75	268
	PMP-038-B	1600	1890	75	249

Reservoirs

Bear Gulch system has 30 distribution system reservoirs with a total storage capacity of 9.9 MG. This does not include the Bear Gulch Reservoir or Lower Bear Gulch Creek Reservoir, which are raw water reservoirs, and are not modeled. Table 3 summarizes the key model information for distribution system reservoirs. Reservoirs were modeled to allow simulation of water level changes over time during extended period simulations, i.e., reservoir level fluctuations over the day. Bottom elevations for tanks and reservoirs were taken from the system profile schematic, while overflow elevations and diameters were taken from a spreadsheet provided by the Cal Water.

Table 3
Reservoirs - Bear Gulch System

Tank/ Reservoir ID	Description	Volume (MG)	Bottom Elevation (ft)	Overflow Elevation (ft)	Diameter (ft)	Service Zone
T-002-T1	Lake (Bear Gulch WTP)	0.26	194	219	42	220
T-002-T2	Lake (Bear Gulch WTP)	0.51	194	218	60	220
T-005-T6	Intermediate	0.11	381	399	32	400
T-005-T8	Intermediate	0.26	381	402	46	400
T-005-T9	Intermediate	1.07	373	400	82	400
T-006-T1	Coombsville	0.20	560	584	38	590
T-007-T1	Woodside Highlands	0.11	780	798	32	795-1
T-015-T1	Woodside Knolls	0.03	453	467	20	590
T-016-T1	Woodside Res.1	1.09	567	590	90	590
T-017-T1	Alpine Hills	0.26	692	719	41	715
T-019-T1	Ridgeway	0.52	565	593	56	590
T-019-T2	Ridgeway	0.53	563	594	54	590
T-021-T1	Arrowhead	1.03	628	660	74	660
T-021-T2	Arrowhead	1.03	628	660	74	660
T-022-T1	Canada	0.47	783	802	65	805
T-025-T1	Woodside Oaks	0.11	814	834.5	30	835
T-027-T1	Westridge	0.76	790	815	72	815
T-028-T1	Ladera	0.20	650	682	33	680
T-029-T1	Ormondale	0.12	637	653	35	660
T-029-T2	Ormondale	0.12	637	653	35	660
T-029-T3	Ormondale	0.16	637	654	40	660
T-030-T1	Portola	1.02	937	964	80	960
T-031-T1	Summit	0.15	1072	1092	36	1090
T-032-T1	Wayside	0.26	995	1026	38	1025
T-033-T1	Los Trancos	0.010	575	591	10	1055
T-034-T1	Sunrise	0.075	1046	1056	25	1055
T-036-T1	Bonita	0.125	1241	1265	30	1265-1
T-037-T1	Spanish	0.055	1416	1436	22	1435
T-038-T1	Vista Verde	0.212	1575	1599	39	1600
T-039-T1	Pony Tracks	0.282	1856	1888	39	1890

SFPUC Turnouts

SFPUC turnouts are modeled as fixed grade reservoirs with the hydraulic grade line representing the SFPUC turnout normal operating grade line. Turnouts BG-01, -02, -03, -04, -05, -06, and -07 feed zone 220. Turnouts BG-05 and -06 feed zone 319 as well. Table 4 summarizes the model data for the SFPUC connections, and shows the location and downstream delivery zone.

Table 4 SFPUC Connections - Bear Gulch System				
Connection Number	**Model ID**	**Meter Size (inches)***	**Location**	**Delivers to Zone**
BG-01	SFPUC-301	1-6", 1-8"		220
BG-02	SFPUC-295	1-4", 1-6" per schematic		220
BG-03	SFPUC-284	2 - 4" per schematic		220
BG-04	SFPUC-297	1 – 6"		220
BG-05	SFPUC-319	2-6"		220
BG-06	SFPUC-319-3	2-8"		220, 319A, Sta. 20
BG-07	SFPUC-319-2	1-8", 2-6"		220, Sta. 04

*Meter assumed to be capable of conveying flow equal to sum of valve capacities at turnout.

Pressure Reducing Valves

There are 41 valve stations within the Bear Gulch system. Eighteen pressure zones are served exclusively by PRVs. Seven pressure zones use PRVs as a backup to the normal supply provided by either pump stations or turnouts. PRVs are included in the model with a setting to control the downstream pressure. Table 5 summarizes the model data for the PRVs. PRV discharge settings were provided by Cal Water.

Table 5 PRV Stations					
PRV Number	**Location**	**Size (inch)**	**Supplied From**	**Delivered To**	**Outlet Pressure Setting (psi) (1)**
PRV-1025-850-1		2	795	7951	30
PRV-1025-7952-1		4	1025	7952	30
PRV-1025-800-1		12	1025	800	26 (2)
PRV-1055-1055-1		8	1055	1055	90
PRV-1055-1055-2		2	1055	1055	87
PRV-12651-1055-1		6	1265-1	1055	105
PRV-12651-12652-1		2	1265-1	1265-2A	55
PRV-12651-12652-2		2	1265-1	1265-2A	92
PRV-12651-12652-3		4	1265-1	1265-2A	45
PRV-12651-12652-4		2	1265-1	1265-2A	45
PRV-12652-12651-1		2	1265-2B	1265-1	42
PRV-12652-12651-2		4	1265-2B	1265-1	42
PRV-12652-12651-3		4	1265-2B	1265-1	27
PRV-12652-12651-4		2	1265-2B	1265-1	27
PRV-1600-12651-1		12	1600	1265-1	10
PRV-1600-12652-1		6	1600	1265-2B	60
PRV-1600-12652-2		3	1600	1265-2B	60
PRV-1600-1435-1		12	1600	1435	12
PRV-1890-1600-1		6	1890	1600	18
PSV-PS8-T6		6	590	Coombsville Tank	80 (2)
PRV-284-220-1		6	SFPUC	220	64(2)
PRV-284-220-2		6	SFPUC	220	75
PRV-284-220-3		12	SFPUC	220	75
PRV-297-220-1		6	SFPUC	220	71
PRV-301-220-1		12	SFPUC	220	80

Table 5
PRV Stations

PRV Number	Location	Size (inch)	Supplied From	Delivered To	Outlet Pressure Setting (psi) [1]
PRV-319-220-1		12	SFPUC	220	50
PRV-319-220-2		12	SFPUC	220	18
PRV-319-220-3		12	SFPUC	220	18
PRV-319-220-4		10	319-A	220	49
PRV-400-220-1		6	400	220	12
PRV-400-265-1		4	400	265	40
PRV-400-319-1		4	400	319A	80
PRV-400-319-3		4	400	319A	86
PRV-475-395-1		2	475	395	72
PRV-560-440-1		6	560	440	65
PRV-590-400-1		4	560	400	49
PRV-590-475-1		3	590	475	49
PRV-590-475-2		3	590	475	49
PRV-590-475-3		2	590	475	49 [2]
PRV-590-500-1		3	590	500	60
PRV-590-525-1		3	590	525	76
PRV-590-590-4		18	590	590	115
PRV-655-510-1		4	655	510	38
PRV-660-660-1		8	660	660	135
PRV-680-560-1		1.5	680	560	46
PRV-680-560-2		6	680	560	46
PRV-680-560-3		4	680	560	60
PRV-680-560-4		4	680	560	43
PRV-715-675-1		4	715	675B	60 [2]
PRV-715-675-2		4	715	675B	60 [2]
PRV-805-590-1		12	805	590	58
PRV-805-640-1		2	805	640	58
PRV-815-440-1		4	815	440	93
PRV-815-655-1		4	815	655	31
PRV-815-680-1		4	815	680	60
PSV-815-680-2		4	815	680	53 [3]
PRV-815-715-1		12	815	715	42 [2]
PRV-815-715-2		6	815	715	6
PRV-910-835-1		4	910	835B	48
PRV-910-835-2		4	910	835B	48
PRV-960-750-1		12	960	750	80
PRV-960-960-1		6	960	960	74
PRV-960-960-2		6	960	960	74
PRV-960-960-3		6	960	960	173 [2]

[1] Outlet pressure setting provided by Cal Water unless noted otherwise.

[2] Outlet pressure setting estimated to match zone grade line.

[3] Upstream pressure setting estimated to match 815 zone grade line.

Emergency Standby Connections to Other Cities

Emergency standby connections to and/or from other cities are included in the model as a fixed grade reservoir. These standby connections are closed in the model, and can be opened as appropriate for future analysis. Table 6 summarizes emergency standby connections.

Table 6
Emergency (Standby) Connections to Other Cities - Bear Gulch System

Connection Number	Water Supplied From Neighboring Agency	Location	Delivers to BG Zone
SB-MP-1	Menlo Park		680
SB-RC-1	Redwood City		145
SB-RC-2	Redwood City		145
SB-MP-2	Menlo Park		145
SB-MP-3	Menlo Park		145

Demand Allocation

Demands were allocated to the appropriate junctions (nodes) of the Bear Gulch system model. Below is a description of the process for allocating existing and future demands.

Existing Demands

The overall average day demand for the system is 13.4 mgd, which includes unaccounted for losses that occur in the system between the customer and the production flow meters. Demand from the former Los Trancos system is also included in that average demand. The daily diurnal fluctuation of demand was calculated to have a peaking factor of 1.7 times the average daily demand.

Demands were allocated to the appropriate junctions (nodes) of the water system hydraulic model. The allocation of existing demands used the detailed water consumption data by individual customer account provided by Cal Water from their water billing database.

For all of the system except the former Los Trancos system, which was acquired in 2005, year 2004 customer data was used to assign demands to the model. Cal Water provided historical billing data for the former Los Trancos system for the time period from May 2005 through April 2006, which is later than the time period of the Bear Gulch system billing data. In order to input similar time-period demands into the model, the demands from Los Trancos was scaled back by a percentage equal to the average growth in the Bear Gulch area from the previous 5 years. Per the Bear Gulch Urban Water Management Plan, the average residential growth between 2001 and 2005 was 2.93 percent each year. Thus the Los Trancos demands were scaled to 82.4 * 0.0293 = 80 gpm.

Customer data (average daily demand for each customer) was allocated to the nearest model node using GIS and model tools. A 5 percent multiplier was applied to the allocated consumption data to incorporate system losses (losses between supply

source and customer). This method of allocating existing demands automatically accounts for large users and for variations in usage (demand per service) among different types of residential and non-residential customers.

The street addresses for each customer account were geo-coded using GIS tools and geographic data from TeleAtlas North America Inc. Geocoding is the process of assigning x and y coordinates to an address by comparing the descriptive addresses in the billing database to those present in the GIS layer of street center lines. Once the customer addresses were geocoded, then the water usage data could be allocated to the model nodes.

After the geocoding process was complete, the "Demand Allocator" extension in H2OMAP was used to allocate demands to water junctions. The closest node method was selected to assign demands from the geocoded billing addresses to the closest node in the model. For each of the nodes, all billing records are summed to represent the total demand imposed on that node.

For each of the nodes, billing records in all revenue classes are summed to represent the total demand imposed on that node. Billing revenue classes were preserved in the model by keeping each revenue class in a separate demand field as shown below:

Model Demand Field	Cal Water Revenue Class
Demand1	n/a, Income derived from operating property
Demand2	1, Residential metered
Demand3	2, Business metered
Demand4	3, Industrial metered
Demand5	7, Irrigation metered
Demand6	8, Other sales and service
Demand7	11, Public Authorities metered
Demand8	13, Other water utilities
Demand9	15, Multiple residences
Demand10	none assigned

Table 7 shows the existing demands by pressure zone that were allocated to the model nodes.

Table 7 ***Existing Modeled Demands by Pressure Zone***		
Zone	***Average Day Demands Including Unaccounted-for Water[1]***	
	gpm	***MGD***
220	5,476.0	7.89
265	8.3	0.01
319-A	35.2	0.05
319-B	125.7	0.18
319-C	7.2	0.01
395	6.2	0.01
400	795.4	1.15
440	45.3	0.07
470	64.9	0.09
475-A	24.9	0.04
475-B	24.7	0.04
500	7.5	0.01
510	13.1	0.02
525	6.7	0.01
560	12.3	0.02
590	1,220.1	1.76
640	59.8	0.09
655	13.1	0.02
660	258.8	0.37
675-A	95.0	0.14
675-B	21.5	0.03
680	4.2	0.01
715	265.6	0.38
750	57.6	0.08
795-1	15.1	0.02
795-2	0.5	0.00
800	6.0	0.01
805	88.9	0.13
815	256.0	0.37
835-A	30.0	0.04
835-B	0.8	0.00
850	3.5	0.01
880	3.8	0.01
910	52.7	0.08
960	42.3	0.06
1025	43.6	0.06
1055	16.2	0.02
1090	19.3	0.03
1265-1	23.3	0.03
1265-2A	4.0	0.01
1265-2B	5.1	0.01
1265-2C	1.2	0.00
1435	9.5	0.01
1600	12.3	0.02
1890	8.8	0.01
Total	**9,291**	**13.38**

[1] Unaccounted-for water has averaged about 3.5% over the last 15 years, after reaching a high of about 5% in the early 1990's.

The geocoding engine assigns a score to each candidate address in order to determine how closely each one matches the address that is geocoded. Each potential candidate address is assigned a score from 0 to 100. The score of potential candidate addresses will be lower if address components are misspelled (for example, the street name is misspelled), incorrect (for example, the street number of the address does not fall within the address range for the candidate), or missing (for example, if the street name in the billing database not exist in GIS layer).

These scores were evaluated to determine the accuracy of the geocoding process. The Cal Water billing database has 17518 records for year 2004 with 8937 gpm total water usage (not including 5% system losses). Of the total records, 95 percent received a score between 80 and 100 indicating that they were allocated correctly. Only 5 percent received a score below 80 indicating that they were not geocoded correctly for the allocation. The 5 percent of records below 80 accounted for 412 gpm demand, or 4.6 percent of the total usage. Of the 412 gpm that were not correctly geocoded, CDM manually allocated 143 gpm, or 1.6 percent of the total usage, to the nearest node by using reference maps. Of the remaining unassigned demand, 269 gpm, or 3 percent of total usage, all but 3 gpm were distributed evenly into the nodes within the zipcode of the unmatched address. In summary, 99.97 percent of total water usage listed in the billing database has been accounted for in the model.

Future Demands

For future demands, the system-wide future service and demand information developed as part of the master plan (as discussed in Sections 2 and 3 of the master plan report) provided the basis for determining where future incremental increases in services and demands would occur. Incremental future demands were determined based on planning information regarding future development/redevelopment projects obtained from local planning agencies. For the buildout model scenario, these incremental future demands were allocated to the appropriate model nodes.

Table 8 summarizes the modeled buildout average day demands by pressure zone, including a 5 percent allowance for unaccounted-for water. The buildout average day demand in Bear Gulch is estimated at 14.5 mgd, which is an incremental increase of 1.1 MGD over the existing model demands.

The incremental future demands were allocated to model nodes based on the location of proposed development projects and re-development areas identified by the local planning agencies as described in Section 2 of the master plan report. The estimated incremental future average day demands at nodes were estimated based on the anticipated future development that would be served from those nodes and unit demand factors. The unit demand factors used for the future Bear Gulch demands were: 660 gpd per service per single family service; 3660 gpd per service for multiple family services (assuming 20 units per service); and 1000 gpd per service for commercial/business.

The incremental future demands at nodes were assigned to the appropriate model database fields broken down by the various billing revenue classes, as discussed for the existing demands.

Table 8
Buildout Modeled Demands by Pressure Zone

Zone	*Average Day Demands including Unaccounted-for Water*[1]	
	gpm	*MGD*
220	5,969.6	8.60
265	8.3	0.01
319-A	35.2	0.05
319-B	125.7	0.18
319-C	7.2	0.01
395	6.2	0.01
400	870.6	1.25
440	45.2	0.07
470	65.5	0.09
475-A	24.9	0.04
475-B	25.7	0.04
500	7.5	0.01
510	13.5	0.02
525	6.7	0.01
560	12.3	0.02
590	1,337.9	1.93
640	61.2	0.09
655	13.4	0.02
660	284.5	0.41
675-A	98.0	0.14
675-B	21.5	0.03
680	4.2	0.01
715	288.1	0.41
750	57.6	0.08
795-1	15.1	0.02
795-2	0.5	0.00
800	6.0	0.01
805	88.9	0.13
815	281.8	0.41
835-A	30.0	0.04
835-B	0.8	0.00
850	3.5	0.01
880	3.8	0.01
910	52.7	0.08
960	42.3	0.06
1025	43.6	0.06
1055	16.2	0.02
1090	19.3	0.03
1265-1	23.3	0.03
1265-2A	4.0	0.01
1265-2B	5.1	0.01
1265-2C	1.2	0.00
1435	9.5	0.01
1600	12.3	0.02
1890	8.8	0.01
Total	**10,059**	**14.49**

[1] Unaccounted-for water has averaged about 3.5% over the last 15 years, after reaching a high of about 5% in the early 1990's.

Diurnal Pattern

A diurnal pattern is required for extended period simulations. A diurnal pattern shows the hourly variations in customer demand (hourly peaking factors) over a 24-hour period. Diurnal patterns are typically developed from historic hourly flow data that is analyzed to determine variations in customer demands that have been adjusted to account for flows going into storage or passed through to other zones, i.e., during parts of the day, some flows in the system may be going to re-fill storage rather than to meet customer demands. If this detailed system-specific information is not available, then CDM reviews diurnal pattern information developed by other agencies to recommend a typical diurnal pattern for the analysis.

Figure 2 shows the diurnal pattern used for the Bear Gulch system. Figure 9 is a dimensionless profile that shows the ratio of the hourly flow to the average daily flow rate over a 24-hour period (starting with 0 hours at midnight). The hourly factors are applied to the average daily flow to obtain the hourly flow rates. It is based on diurnal patterns developed for the Bear Gulch system using actual hourly flow data from a 24 hour period beginning July 28, 2005. These diurnal patterns reflect the variation of customer demands over a 24-hour period. The diurnal pattern for customer demand accounts for use of storage within the system, e.g., filling of storage and taking water out of storage to meet demands.

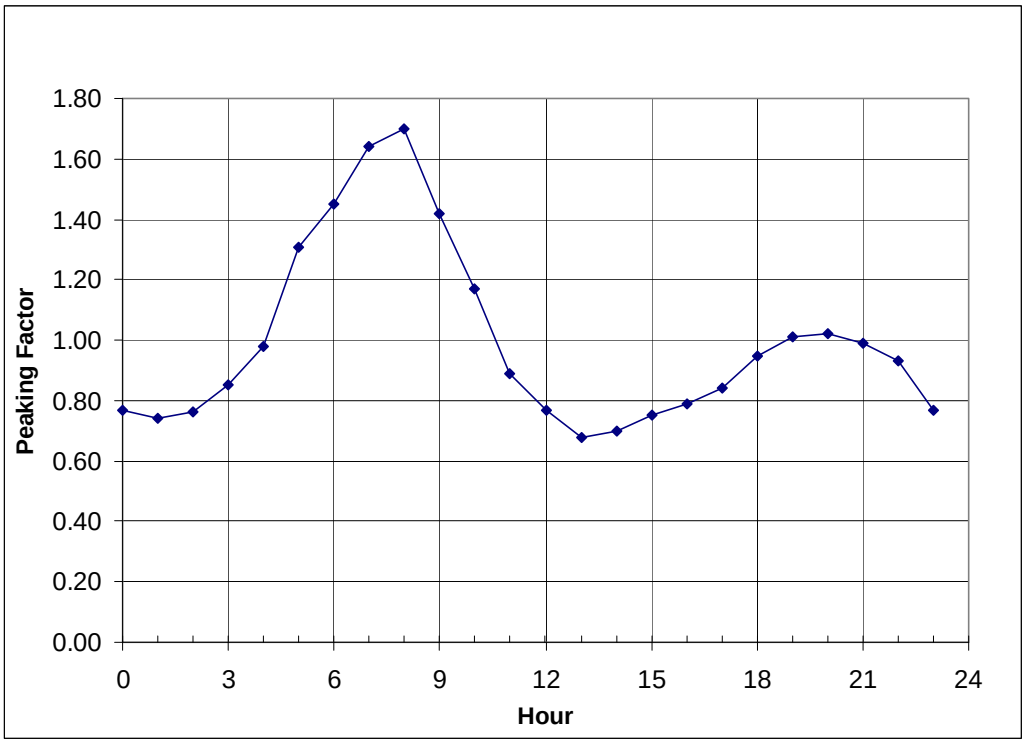

Figure 2
Diurnal Pattern for Bear Gulch System

Because there was not enough data to create a diurnal pattern based on the entire Bear Gulch system, a diurnal pattern was developed with data from zones 265, 319, 400 and 470. For the purpose of creating a diurnal pattern, this cluster of zones had the most complete data among the available data provided by Cal Water. Cal Water was able to provide us with hourly flow data for pump stations 04, 05, and water levels for the Intermediate tanks. The demand diurnal was created by summing hourly inflows and outflows and tank level changes within these zones.

Some assumptions were made in creating the diurnal based on the specified zones. Inflow data of a pressure reducing valve (PRV) from a zone 590 and outflow data of a PRV serving zone 319 were not available for in this diurnal pattern. Flow from pump station 18 is inferred by trends on the discharge pressure chart.

The peaking factor calculated by this zone 400 demand diurnal was 1.66, therefore a peak hour to maximum day peaking factor of 1.7 was used.

Based on the model extended period simulation verification runs, diurnal curves were adjusted for some pressure zones, based on comparisons with SCADA data. Table 11 summarizes the zones where diurnal curve adjustments were made.

Model Calibration

The purpose of model calibration was to adjust pipe roughness values to more closely match the head losses and pressures actually observed during hydrant tests. Based on the hydrant flow test data, the observed pressure drop at the residual hydrant over the duration of the test is related to the diameter and roughness of the pipe in the vicinity of the tested hydrants. This relationship is the basis for the adjustments in roughness values made during model calibration. The methodology and findings are described in more detail below.

The model was calibrated based on 31 hydrant tests performed in locations throughout the system. At least one test was performed on each major zone. Based on the difference in hydrant pressure drop between the model and field data, pipeline roughness coefficients, Hazen-Williams C-values, were adjusted in the model. C-values were adjusted in groupings by zone, pipe material and pipe diameter.

Hydrant Flow Tests

Cal Water staff conducted hydrant tests between November 17 and December 6, 2005 at 31 locations within the Bear Gulch system, including the former Los Trancos system. Five locations were re-tested on November 5, 2007 because either field data was determined to be inaccurate, or an incorrectly configured valve was found in the field. Figure 3 shows the locations of the hydrant tests used for the calibration runs. These locations included at least one location in each major zone. Up to five hydrant tests were conducted in the largest zones that are spread out over a greater area, such as the Zone 220. No tests were conducted in a few very small zones served by PRVs, since a calibration effort was not warranted for those zones.

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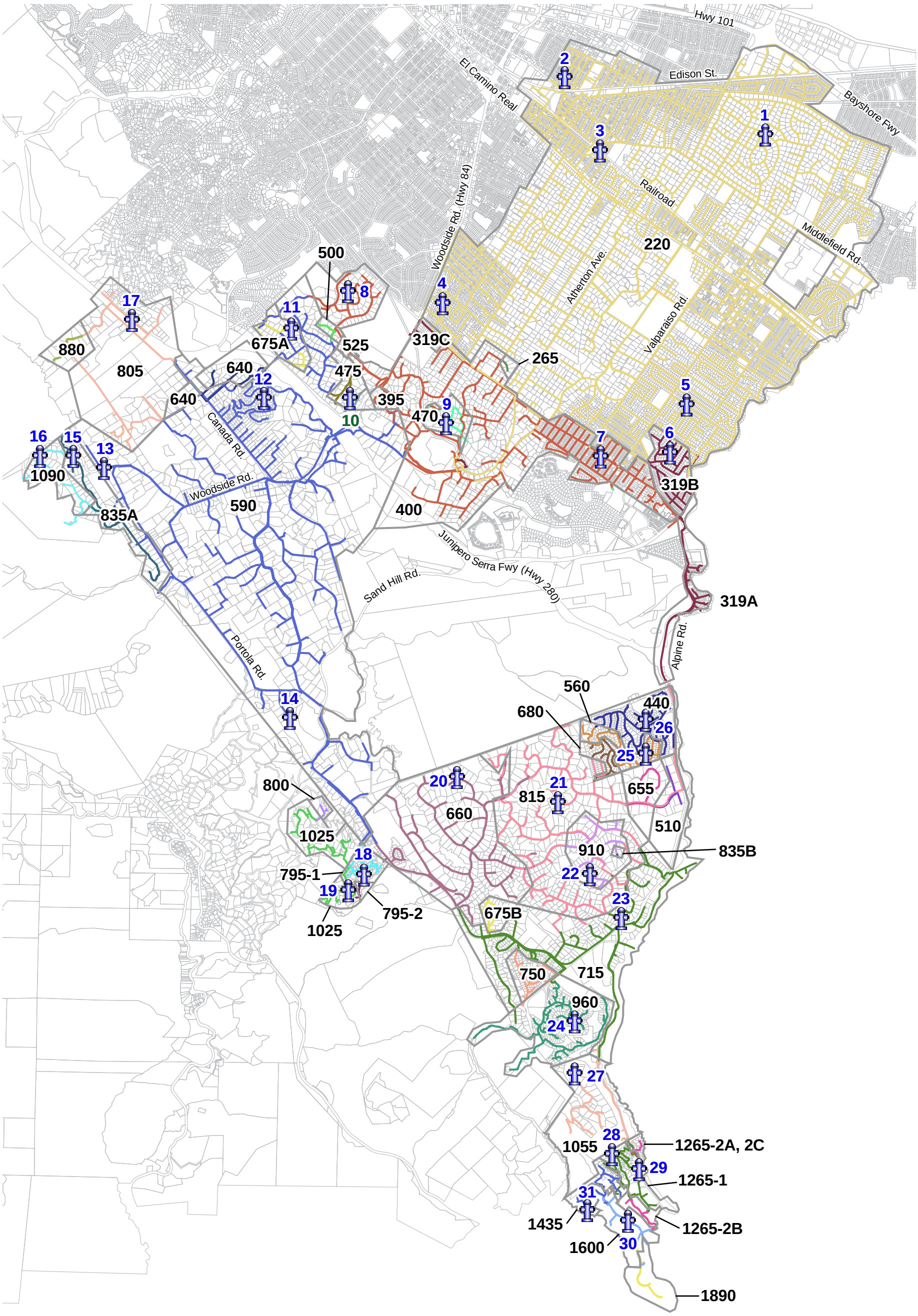

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CDM

Figure 3
Bear Gulch Hydrant Test Locations

The specific locations were identified based on the following characteristics: 1) not too close to a reservoir or turnout; 2) on a 6-, 8-, or 10-inch pipe - since if pipes are too large, it is difficult to generate sufficient head loss during a hydrant test to detect changes due to pipe roughness; and 3) accessibility and safety considerations for staff conducting the tests.

The first step in the hydrant tests was to record the static pressure at each test location. Then, the flow hydrant was opened and the pitot pressure, which can be correlated to hydrant flow rate, and the residual pressure were measured with the hydrant open and flowing. The observed flow rate was then determined based on the observed pitot pressure. Static and residual pressures were recorded at nearby observation hydrants near the test hydrant.

For hydrant testing, Cal Water utilizes diffusers with built-in pitot gauges procured from Pollard. Pollard provides an instrument-specific chart that relates flowrate to pitot pressure. Flow rates can also be calculated based on equations in the National Fire Protection Association (NFPA) Manual 291 "Recommended Practice for Fire Flow Testing and Marking of Hydrants". Pitot pressures typically fluctuate during testing and an "average" is typically used. A pressure fluctuation of +/- 2 psi would result in a flow rate variation of +/- 4 to 10 percent.

Input Data for Calibration Runs

As noted above, hydrant testing was conducted between November 17 and December 6, 2005, and on November 5, 2007. Cal Water provided CDM with system data for the days of the tests, along with hydrant test data. The system data included: circular charts and spreadsheets of reservoir levels, circular charts of pump operations, and daily production records for pump stations and turnouts. The system data was used in the model calibration runs to set reservoir levels, pump on/off status, and turnout head/flow conditions to simulate actual system conditions during the hydrant tests.

One calibration scenario was set up with 64 time steps to simulate the 32 hydrant tests (one location was tested with two different system conditions). Each hydrant test comprised two time steps of the model run. The first time step of each hydrant test represented static conditions before the hydrant was turned on. The second time step represented residual conditions when the hydrant was flowing. Daily production records were provided by Cal Water for the test days, and the model average daily demands were adjusted to match daily production for each test day.

For each hydrant test (or every two time steps), system demands, relevant pump operations and relevant tank levels were set to represent conditions at the time of the hydrant test. The appropriate multiplier from the diurnal curve was used to simulate the demands at the time of each hydrant test. Because the diurnal curve used in the model is general for the entire system, model demands are expected to approximate actual demands at the time of the test, which were not known.

Calibration Method

Pipe roughness values in the model are represented by the Hazen-Williams roughness coefficient, or C-value, which is inversely proportional to head loss. High C-values correspond to relatively smooth pipes with small head losses. Most pipelines in good condition or with interior linings have C-values ranging from 120 to 140. Pipelines with extensive corrosion, such as unlined cast-iron mains, could have C-values as low as 70 or 80 which corresponds to relatively rough pipes with higher head losses. During the calibration process, in areas where modeled pressure drops were larger than observed pressure drops, the C-values are increased, and vice versa.

Preliminary roughness factors were identified to use as a starting point for the calibration process, based on CDM experience with other water systems in the area, industry standards such as AWWA, and other sources, including Haestad, relevant text books, and available pipe age information. The preliminary factors (C-values) were adjusted as needed during the model calibration process described in the subsequent sections. The preliminary (starting) and recommended (final) roughness factors based on the calibration findings are presented later in this memorandum.

Once the calibration model scenario was set up using system data provided by Cal Water, each test location was analyzed for the following two conditions (two time steps):

1) With no flow at the hydrant location to simulate closed hydrant or "static" conditions; and

2) With a demand equal to the hydrant flow applied at the hydrant location to simulate flowing hydrant conditions.

For static conditions, model results were compared with operating data to make sure results were consistent with observations. For example, model results were reviewed to make sure tanks were filling, draining or closed, consistent with system data.

Modeled static pressures were also compared with actual (observed) static (pre-test) pressures. However, these comparisons were not used for calibration purposes because, under low flow conditions, modifying roughness values does not produce a large change in static pressure. An error in static pressure is most likely due to another source, such as errors in ground elevation. Modeled ground elevations were assigned using a Digital Elevation Model (DEM) derived from USGS topographic maps. DEMs with a 10-meter (33-foot) resolution were used.

Locations where large differences in static pressure were observed are noted as areas requiring potential future refinement (in the summary table of calibration results discussed later in this section). CDM also recommends that for future hydrant testing, Cal Water consider using GPS units to verify hydrant test elevations as part of the field data collection. This information could then be used to further refine the model.

Once model results were checked, the difference in pressure between the two runs (non-flowing hydrant and flowing hydrant) was compared with the pressure drop observed during hydrant testing. By comparing the pressure drop rather than modeled and measured pressures, potential errors due to incorrect model elevations were eliminated.

The calibration process consisted of changing pipe roughness values until the difference between observed and modeled pressure drops reached a minimum or acceptably low value. The model was considered to be calibrated when the modeled pressure drop was within +/- 5 psi of observed pressure drops at two or more observation locations. This is the AWWA Engineering Computer Applications Committee recommended criterion for model calibration for models to be used for planning applications.[1] Generally, roughness factor adjustments were made to groups of pipes based on pipe material and diameter.

In some instances, model results could not be adjusted to obtain results within +/- 5 psi of observed values, without selecting unrealistic Hazen-Williams C-values. Some possible sources of error that may cause poor agreement between modeled and observed pressures include: errors or anomalies in model data or model configuration, node elevation errors, not modeling all small diameter pipes, outdated or unknown pump curves, uncertainties in estimated pipe roughness factors, not having complete information on system conditions during the field tests, and poorly calibrated measuring equipment.

For locations with significant differences between modeled and observed pressures, the following steps were taken to investigate the source of differences:

- Elevation verification - checked node and reservoir elevations in the model.
- Geometric verification – checked for missing pipes or incorrect diameters in the model.
- Distribution of supply from tanks, pumps, and/or turnouts was then investigated, to see whether the results may have been affected by the way these sources are modeled. The relative contribution of supply from the various sources may significantly affect headlosses in the system.

For tests where the pressure difference was still significant after conducting the above three steps, CDM and Cal Water reviewed results and identified possible field checks, and Cal Water performed further field investigations. Using the results of Cal Water's investigations, CDM applied relevant changes to the model. Through this iterative approach, good agreement was obtained at 26 of 31 locations. For remaining locations, CDM has identified future activities that Cal Water could undertake to refine the model in the future.

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1 AWWA Engineering Computer Applications Committee, 1999."Calibration Guidelines for Water Distribution System Modeling." 1999 AWWA Information Management Technology Conference Proceedings.

Calibration Results

During the calibration process, revisions were made to the model as needed in order to correct geometric anomalies in the modeled system, and adjust the pipe roughness factors to reasonable values.

Table 9 summarizes the results from the calibration analysis after reasonable adjustments were made to the model.

Field information provided by Cal Water listed in the table includes: test number, test location, test date and time, hydrant outlet size, pitot pressure, measured static pressure and measured residual pressure. Using the test location description, CDM located the correct hydrant on Cal Water maps, and selected the nearest model node (or added a model node if needed) to represent the hydrant location.

Using the field data provided by Cal Water, the hydrant flow rate was computed from the pitot pressure reading and the static HGL was computed from the model elevation and static pressure reading. Table 9 also shows key model results for flows and pressures. The last two columns of the table present the comparison of the measured and modeled static pressure, and the comparison of the measured and modeled residual pressure drops.

Model results were considered to match field data well if the following criterion was met: Field measured pressure drop and the modeled pressure drop are within 5 psi for two or more observation hydrants. At locations with data provided for only one observation hydrant, the calibration process was considered successful if the single observation hydrant met the 5 psi criterion.

Twenty-six out of thirty-one hydrant tests matched field data well. In Table 9, yellow shaded cells represent the five tests that did not match field data well.

Initially, twenty-one out of thirty-one hydrant tests were considered to match field data well. After reviewing locations with Cal Water, Cal Water field-checked the ten locations that did not match well and provided additional data, including new test data from locations that were re-flowed in November 5, 2007. In Table 1, re-flowed locations are highlighted with brown shading. Of the ten tests that did not match well, five were resolved and five remain unresolved.

The five remaining unresolved hydrant tests represent 5 zones and 9.6% of the total Bear Gulch system demand. Four of the five tests are in zones that are small, representing 1.2% of the total system demand. One test is located in zone 400, which represents 8.4% of total system demand. Cal Water district staff checked for unintentionally open valves between zone 400 and adjacent zones, but found none. For this test location, CDM has provided recommendations for future follow-up by Cal Water to refine the model.

A more detailed discussion is provided below for the 10 locations where further investigation was conducted to address discrepancies between modeled results and field data.

Table 9
Summary of Hydrant Flow Test Data and Calibration Results - Bear Gulch System

			DEM Data	Field Data										Computed by CDM		Model Data						Comparison		
Test	Zone	Hydrant Location (Hydrant #)	Elevation	Test Date	Test Time	Hydrant Type	Observed Hydrant Flow	Outlet Size #1	Outlet Size # 2	Pitot #1	Pitot #2	Static Pressure	Residual Pressure	Pressure Drop (Static - Residual)	Computed Static HGL	Model ID	Model Fire Flow	Static Pressure	Residual Pressure	Pressure Drop (Static - Residual)	Static HGL	Static Pressure (Model - Field)	Pressure Drop (Model - Field)	Comments
1	220	Juniper & Catalpa	36	11/17/2005	2:00 PM	Flow	1423	2.5	2.5	18	18	72	54	18	202	J-220-1763	1425							
		Green Oaks & James	28			Observation						74	61	13	199	J-220-0766		79	65	14	211	5	1	
		Linden & Catalpa	45			Observation						68	52	16	202	J-220-0041		72	59	13	211	4	-3	
		Green Oak & Rosewood	35			Observation						66	50	16	187	J-220-0055		77	63	14	211	11	-2	
		James & Middlefield	39			Observation						69	54	15	198	J-220-1771		75	63	12	211	6	-3	
2	220	San Mateo & Hurlingame	20	11/5/2007	10:36 AM	Flow	1840	2.5	2.5	NA	NA	86	54	32	219	J-220-2545	1840							Hydrant re-tested on November 5, 2007, resulting in matching pressure drops for all four hydrant tests in zone 220.
		Stanford and Middlefield	22			Observation						0	0		22	J-220-1680		61	35	26	163	NA	NA	
		FairOaks & Oakside	19			Observation						83	70	13	211	J-220-0305		62	42	20	163	-21	7	
		Redwood Junction	23			Observation						85	62	23	219	J-220-0258		61	42	19	164	-24	-4	
		Hampshire & San Mateo	23			Observation						84	61	23	217	J-220-2559		61	35	26	163	-23	3	
3	220	Glendale & Amhearst	36	11/17/2005	3:08 PM	Flow	1898	2.5	2.5	32	32	73	58	15	205	J-220-0876	1898							
		5th Ave & El Camino	41			Observation						68	62	6	198	J-220-2355		73	60	13	210	5	7	
		Amhearst & El Camino	42			Observation						67	55	12	197	J-220-0197		73	62	11	211	6	-1	
		El Camino & Almandral	47			Observation						63	56	7	192	J-220-1904		71	62	9	211	8	2	
		Stockbridge & Nora	44			Observation						69	59	10	203	J-220-3695		72	62	10	211	3	0	
4	220	Santiago & Hull	82	11/17/2005	3:39 PM	Flow	1883	4.5	NA	36	NA	60	12	48	221	J-220-0169	1883							
		Alameda & Hull	108			Observation						48	43	5	219	J-220-3698		47	26	20	216	-1	15	
		Santa Clara & Selby	77			Observation						60	40	20	216	J-220-4406		59	36	23	213	-1	3	
		Woodside & Santa Clara	76			Observation						58	38	20	210	J-220-0416		60	36	23	214	2	3	
		Alameda & Nassau	113			Observation						44	33	11	215	J-220-3067		44	24	20	215	0	9	
5	220	Olive & Stanford	97	11/17/2005	4:02 PM	Flow	919	2.5	NA	30	NA	49	41	8	210	J-220-3367	922							
		Santa Cruz & Olive	94			Observation						49	45	4	207	J-220-3528		51	44	7	212	2	3	
		Olive & Middle	92			Observation						52	45	7	212	J-220-3363		52	46	6	212	0	-1	
		Stanford & Lemon	104			Observation						42	37	5	201	J-220-4327		47	41	6	212	5	1	
		Oakdel & Lemon	105			Observation						44	38	6	207	J-220-1344		47	41	6	212	3	0	
6	319	Doris - midblock	109	12/6/2005	3:29 PM	Flow	581	2.5	NA	12	NA	94	26	68	326	J-319-206	582							
		Oak Del & Stanford	113			Observation						91	65	26	323	J-319-165		93	62	31	327	2	5	
		Oak Del & Oak Knowl	113			Observation						91	65	26	323	J-319-157		93	62	31	327	2	5	
		Palo Alto & Leland	133			Observation						77	70	7	311	J-319-139		84	70	15	327	7	8	
		Oak - midblock	110			Observation						84	82	2	304	J-319-032		44	44	0	212	-40	-2	
7	400	Oakley & Alameda	127	11/18/2005	10:55 AM	Flow	3216	4.5	NA	35	NA	110	70	40	381	J-400-0297	3218							8" and 10" pipe along Reservoir Rd have 90 and 30 ft/kft headlosses, respectively, during hydrant flow.Check valves from zone 319 may have opened in field. GIS or system map did not show check valves. Per Cal Water, There are no open gate valves from other zones and no upsized pipes near Reservoir Rd that aren't in GIS.
		Alameda & Manzanita	130			Observation						114	70	44	394	J-400-0389		97	42	55	354	-17	11	
		Alameda & Cedar	122			Observation						115	67	48	388	J-400-0559		100	38	62	354	-15	14	
		Alameda & Gordon	137			Observation						105	58	47	379	J-400-0867		94	22	72	354	-11	25	
		Alameda & Sharon	156			Observation						97	48	49	380	J-400-0661		86	14	71	354	-11	22	
8	400	Northridge	247	11/18/2005	9:33 AM	Flow	440	2.5	NA	7	NA	55	0	55	374	J-400-0046	440							
		Pulgas Estates	283			Observation						70	21	49	445	J-400-0356		34	-22	56	361	-36	7	
		Woodside & Northridge	215			Observation						73	28	45	383	J-400-0217		64	11	53	361	-9	8	
		Woodside & High	235			Observation						65	44	21	385	J-400-1004		56	39	17	363	-9	-4	
		Sheridan @ Woodside	361			Observation						103	103	0	599	J-590-0312		97	97	0	584	-6	0	
9	470	Ridgeview & Alta Vista	323	11/5/2007	11:01 AM	Flow	919	2.5	NA	NA	NA	108	80	28	573	J-470-048	924							Retest: Pstat=79 psi on circ chart. No Pdrop during test hour 11:01, but at 12:00, P drops to 67 psi. Used that as the residual P at the hydro tank in model.
		Ridgeview & Fletcher	239			Observation						104	81	23	479	J-470-006		103	83	20	477	-1	-3	
		Fletcher & Station 11	297			Observation						76	57	19	473	J-470-014		78	65	14	477	2	-5	
10a	475	Oakhaven @ end	257	11/5/2007	11:30 AM	Flow	605	2.5	NA	NA	NA	106	18	88	502	J-475-019	607							Test 10a was performed with both PRVs open.
		Kenmore @ Woodside	374			Observation						70.6	4.7	65.9	537	J-590-0999		97	39	58	598	26	-8	Hydrant in a different zone, separated by PRV
		Woodside & OakHaven	294			Observation						105	22	83	537	J-475-006		88	12	76	497	-17	-7	
		Woodside & High	238			Observation						105.5	88	17.5	482	J-400-0272		41	37	3	332	-65	-14	Hydrant in a different zone, separated by PRV
		Ridgeway past Crest	512			Observation						NA	NA			J-590-0282		NA	NA					Hydrant in a different zone, separated by PRV
10b	475	Oakhaven @ end	257	11/5/2007	11:45 AM	Flow	581	2.5	NA	NA	NA	110	18	92	511	J-475-019	582							Test 10b was performed with the Lynn Way PRV closed.
		Kenmore @ Woodside	374			Observation						78.9	0	78.9	556	J-590-0999		97	52	45	598	18	-34	Recorder reading drops to zero psi during flow, and recovers to 65 psi momentarily (82% of static pressure before flow) before dropping to zero again.
		Woodside & OakHaven	294			Observation						112	0		553	J-475-006		81	4	77	497	-31		Recorder reading drops to zero psi during flow, and stays at zero after flow ends.
		Woodside & High	238			Observation						105.5	84	21.5	482	J-400-0272		46	30	15	332	-60	-6	
		Ridgeway past Crest	512			Observation						NA	NA			J-590-0282		NA	NA					
11	675	Cragmont Court	496	11/18/2005	10:29 AM	Flow	856	2.5	NA	26	NA	75	#N/A	#N/A	669	J-675-057	857							Changed AC pipes from 130 to 120 in Z675
		130 Crest	500			Observation						80	52	28	685	J-675-034		78	47	31	680	-2	3	Unrealistic to reduce c-value further.
		300 Ridgeway	531			Observation						67	46	21	686	J-675-011		65	46	19	680	-2	-2	To match residual pressures, created pattern for HP19: HGL=680 static, and 652 ft during fireflow.
		Ridgeway & Cinnibar	540			Observation						59	39	20	676	J-675-019		61	43	18	680	2	-2	
		Crest & Cragmont	523			Observation						42	35	7	620	J-675-056		68	35	33	680	26	26	

Brown shading represents re-flowed hydrants.
Yellow shading represents tests that were not considered to match field data well.

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Test	Zone	Hydrant Location (Hydrant #)	Elevation	Test Date	Test Time	Hydrant Type	Observed Hydrant Flow	Outlet Size #1	Outlet Size # 2	Pitot #1	Pitot #2	Static Pressure	Residual Pressure	Pressure Drop (Static - Residual)	Computed Static HGL	Model ID	Model Fire Flow	Static Pressure	Residual Pressure	Pressure Drop (Static - Residual)	Static HGL	Static Pressure (Model - Field)	Pressure Drop (Model - Field)	Comments
12	590	Highland Tr / Alta Mesa	428	12/6/2005	1:45 PM	Flow	769	2.5	NA	21	NA	50	39	11	544	J-590-0803	769							Changed AC pipes from 130 to 120 in Z590
		Glenwood & Canada	402			Observation						97	94	3	626	J-590-0055		93	92	0	615	-4	-3	Most pipes near this fh test are AC with cvalue 120.
		Glenwood & Alta Vista	413			Observation						68	53	15	570	J-590-1067		88	87	0	615	20	-15	additional c-value adjustments cannot be justified.
		Jane & 280 easement	516			Observation						35	25	10	597	J-590-0371		34	24	10	596	-1	0	
		Ridgeway at 280 ease	520			Observation						32	24	8	594	J-590-0295		31	22	8	591	-1	0	
13	590	Kings Mt & Greer	450	11/18/2005	11:24 AM	Flow	1803	4.5	NA	11	NA	80	30	50	635	J-590-0267	1803							
		Tripp & Kings Mt	425			Observation						88	37	51	628	J-590-0050		83	25	58	617	-5	7	
		Tripp near Tripp Ct	428			Observation						90	40	50	636	J-590-0045		82	28	54	617	-8	4	
		Kings Mt. near Josselyn	408			Observation						87	46	41	608	J-590-1047		91	42	49	617	4	8	
		Kings Mt. & Manuella	413			Observation						92	63	29	625	J-590-1113		89	56	33	617	-3	4	
14	590	End of Phillip	373	11/21/2005	9:30 AM	Flow	1034	2.5	NA	38	NA	100	39	61	604	J-590-0348	1045							
		Portola @ Bridge	360			Observation						107	92	15	607	J-590-0627		105	92	13	603	-2	-2	
		Mt. Home & Vintage	433			Observation						84	74	10	627	J-590-0030		74	65	9	605	-10	-1	
		Mt. Home & Blue Ridge	431			Observation						73	67	6	599	J-590-1283		76	68	8	606	3	2	
		Woodside & Turkey Farm	459			Observation						74	70	4	630	J-590-0986		66	59	6	610	-8	2	
15	835	Patrol & Patrol Court	675	11/5/2007	12:20 PM	Flow	692	2.5	NA	NA	NA	60	24	36	814	J-835-059	693							
		Patrol & Entrance	581			Observation						116	95	21	849	J-835-011		107	78	29	827	-9	8	
		558 Patrol	600			Observation						102	90	12	836	J-835-024		99	83	16	827	-3	4	Hydrant re-tested on November 5, 2007.
		465 Summit Springs	593			Observation						57	55	2	724	J-835-054		102	101	1	828	45	-1	
		Summit Sp. & Partition	517			Observation						0	0		517	J-835-018		135	134	1	829			
16	1090	Roan & Patrol	891	11/18/2005	12:09 PM	Flow	650	2.5	NA	15	NA	80	20	60	1076	J-1090-025	652							
		40 Roan	#N/A			Observation						70	23	47		no node								
		End of Roan	879			Observation						80	44	36	1064	J-1090-039		88	63	25	1082	8	-11	
		560 Summit Sp.	864			Observation						96	90	6	1086	J-1090-019		94	89	5	1082	-2	-1	
		Station 24 discharge	793			Observation						132	125	7	1098	J-1090-036		125	119	6	1082	-7	-1	
17	805	Canada & Jefferson	519	11/18/2005	12:34 PM	Flow	1342	2.5	2.5	15	17	130	40	90	819	J-805-095	1342							
		Canada & Palm	560			Observation						118	31	87	833	J-805-037		102	20	82	796	-16	-5	
		Canada & Godetia	494			Observation						144	57	87	826	J-805-092		131	47	84	796	-13	-3	
		Canada & Runnymeade	485			Observation						140	58	82	808	J-805-049		135	52	83	796	-5	1	
		214 Raymundo	649			Observation						119	41	78	924	J-805-086		64	40	24	796	-55	-54	
18	7951	Santa Maria & Trinity	672	12/6/2005	2:18 PM	Flow	671	2.5	NA	16	NA	60	24	36	810	J-7951-005	671							Cal Water will check hydrant locations for this test.
		Santa Maria & Trinity	679			Observation						48	27	21	790	J-7951-105		51	48	4	797	3	-17	Can't adjust cvalues any further. D_dP higher in field than model.
		Santa Maria & Tynan	740			Observation						24	8	16	796	J-7951-046		25	23	2	797	1	-14	No other pipes to revise. Turned off both pumps to zone, pump 6 Coombsville
		Santa Maria & Russel	644			Observation						51	27	24	762	J-7951-117		66	63	4	797	15	-20	Model is operating as predicted. Headloss occurring per hazen williams equations.
		Santa Maria & Leroy	581			Observation						98	73	25	808	J-7951-106		93	90	4	797	-5	-21	
19	1025	Wayside	754	12/6/2005	2:46 PM	Flow	919	2.5	NA	30	NA	104	54	50	994	J-1025-155	919							
		Wayside @ easement	738			Observation						97	0	97	962	J-1025-149		122	111	10	1019	25	-87	Model underpredicts headloss compared to that in the field. Cal Water will check hydrant locations.
		Russell & Tynan	759			Observation						90	57	33	967	J-1025-212		114	106	8	1022	24	-25	
		2nd Hydrant past ease	615			Observation						67	35	32	770	J-7952-014		81	81	0	802	14	-32	
		4th hydrant past ease	690			Observation						40	13	27	783	J-7952-009		48	48	0	802	8	-27	
20	660	Ramoso	543	11/21/2005	10:02 AM	Flow	691	2.5	NA	17	NA	40	20	20	635	J-660-124	692							Changed 4" and 6" AC pipes from 130 to 120. Did not change 8" pipes from 130 to 120 because it made less than 1psi difference in obs fh 1 and 2.
		Cervantes & Westridge	457			Observation						81	79	2	645	J-660-099		82	80	2	647	1	0	
		Paloma & Westridge	527			Observation						52	45	7	647	J-660-040		52	50	3	647	0	-4	
		Mapache & Mapache Ct	424			Observation						100	88	12	655	J-660-019		97	83	13	647	-3	1	Pressure drop in obs fh 3 and 4 increased by up to 2 psi due to change in cvalue from 130 to 120.
		Mapache & Naranja	434			Observation						90	84	6	642	J-660-058		92	86	6	647	2	0	
21	815	Degas @ end	556	11/21/2005	10:25 AM	Flow	919	2.5	NA	30	NA	90	60	30	764	J-815-154	922							
		Westridge & Cervantes	687			Observation						54	52	2	812	J-815-223		59	53	6	823	5	4	
		Westridge & Goya	599			Observation						91	83	8	809	J-815-205		99	91	8	827	8	0	
		Gold. H. & Meadow	492			Observation						128	123	5	788	J-815-144		144	138	6	825	16	1	
		Golden Hill & Fawn	663			Observation						66	63	3	815	J-815-018		70	64	6	824	4	3	
22	910	Toro & Golden Oak	779	11/21/2005	10:48 AM	Flow	964	2.5	NA	33	NA	70	40	30	941	J-910-024	964							
		Golden Oak & Sta 17	729			Observation						46	46	0	836	J-815-086		39	39	0	819	-7	0	
		Golden Oak & Granada	791			Observation						74	54	20	962	J-910-010		67	38	29	945	-7	9	Reduce HP Level until d_dp matches field, because in reality, Hydro tank level will drop during fh flow.
		305 Golden Oak	753			Observation						77	54	23	931	J-910-014		83	58	25	945	6	2	
		395 Golden Oak	732			Observation						90	65	25	939	J-815-082		38	37	0	818	-52	-25	
23	715	45 Bear Gulch	504	11/21/2005	11:35 AM	Flow	2040	2.5	2.5	37	37	85	55	30	701	J-715-101	2043							
		Valencia & Bear Gulch	570			Observation						65	51	14	720	J-715-045		58	43	15	703	-7	1	
		75 Bear Gulch	541			Observation						87	68	19	742	J-715-100		69	50	20	701	-18	1	
		Alpine & HillBrook	487			Observation						95	83	12	707	J-715-138		87	61	25	687	-8	13	
		Alpine & Golden Oak	416			Observation						140	124	16	739	J-715-258		123	105	18	701	-17	2	

Brown shading represents re-flowed hydrants.
Yellow shading represents tests that were not considered to match field data well.

Table 9
Summary of Hydrant Flow Test Data and Calibration Results - Bear Gulch System

			DEM Data	Field Data										Computed by CDM		Model Data						Comparison		
Test	Zone	Hydrant Location (Hydrant #)	Elevation	Test Date	Test Time	Hydrant Type	Observed Hydrant Flow	Outlet Size #1	Outlet Size # 2	Pitot #1	Pitot #2	Static Pressure	Residual Pressure	Pressure Drop (Static - Residual)	Computed Static HGL	Model ID	Model Fire Flow	Static Pressure	Residual Pressure	Pressure Drop (Static - Residual)	Static HGL	Static Pressure (Model - Field)	Pressure Drop (Model - Field)	Comments
24	960	Horseshoe & Hawk Vw	846	11/21/2005	1:32 PM	Flow	950	2.5	NA	32	NA	58	48	10	980	J-960-0107	950							
		Horseshoe & Coyotte	770			Observation						82	75	7	960	J-960-0018		81	72	9	956	-1	2	
		Horseshoe & Quail	712			Observation						122	119	3	994	J-960-0053		106	101	5	956	-16	2	
		Horseshoe & Indian	675			Observation						117	115	2	946	J-960-0007		122	118	4	956	5	2	
		Indian Cross & Thistle	709			Observation						113	101	12	970	J-960-0112		107	104	3	956	-6	-9	
25	560	320 Garbarda	349	11/21/2005	1:57 PM	Flow	787	2.5	NA	22	NA	90	25	65	557	J-560-057	787							Test 25 was not re-flowed because storage tank was out of service at the time.
		171 Garbarda	441			Observation						115	12	103	706	J-560-035		59	30	30	577	-56	-73	Computed HGL of field static pressure is 706', much higher than zone grade of 560'.
		380 Percora	455			Observation						85	20	65	652	J-560-074		53	34	19	577	-32	-46	Computed HGL of field static pressure is 652', much higher than zone grade of 560'. Difference in static pressure may be due to measurement error. Pressure drop difference may be due to partially closed valves.
		Gabarda near Dedalera	385			Observation						78	8	70	565	J-560-045		83	21	62	577	5	-8	
26	440	W. Floresta & La Cuesta	344	11/21/2005	2:16 PM	Flow	580	2.5	NA	12	NA	58	25	33	478	J-440-094	631							Fed through only PRVs, closed PRV-560-440-1 because it was set to give zone a higher HGL (518 ft), while PRV-815-440-1 is set for HGL=478ft.
		Erica & Corona	287			Observation						75	66	9	460	J-440-067		83	67	16	478	8	7	Changed all pipes (only 4 and 6" diams) from 130 to 120 cvalue
		La Mesa & La Mesa Ct	293			Observation						76	62	14	468	J-440-077		80	64	16	478	4	2	
		S. Balsamina & La Mesa	308			Observation						66	49	17	461	J-440-050		74	64	9	478	8	-8	Static pressure is high in model. Assumed PRV-560-440-1 closed. Assumed pitot pressure reading is 17% low.
		315 La Cuesta	288			Observation						83	64	19	480	J-440-097		82	66	17	478	-1	-2	
27	1055	RedBerry	872	11/21/2005	2:50 PM	Flow	2718	2.5	4.5	42	9	75	50	25	1045	J-1055-052	2718							
		RedBerry & Buck Mead	880			Observation						69	28	41	1039	J-1055-047		77	38	39	1058	8	-2	
		Buck Mead & Blue Oak	857			Observation						85	47	38	1053	J-1055-061		87	55	32	1059	2	-6	
		Los Trancos & Buck Me	754			Observation						119	78	41	1029	J-1055-116		133	124	10	1062	14	-31	Suspect partially closed valve between hyd -061 and -116
		End of Buck Mead	928			Observation						50	34	16	1044	J-1055-038		55	34	21	1055	5	5	
28	12651	Los Trancos Circle	969	11/21/2005	3:14 PM	Flow	822	2.5	NA	24	NA	118	105	13	1242	J-12651-054	822							
		1083 Los Trancos	907			Observation						140	120	20	1231	J-12651-127		152	139	13	1258	12	-7	
		1220 Los Trancos	1072			Observation						77	69	8	1250	J-12651-134		81	75	5	1258	4	-3	
		Bonita & Los Trancos	1108			Observation						55	51	4	1235	J-12651-073		65	61	4	1258	10	0	
		1152 Los Trancos	997			Observation						100	87	13	1228	J-12651-099		113	100	13	1258	13	0	
29	12651	152 Ramona	890	11/5/2007	12:45 PM	Flow	1500	2.5	NA	NA	NA	145	125	20	1225	J-12651-165	1500							Hydrant re-tested on November 5, 2007.
		135 Ramona	903			Observation						188	101	87	1337	J-12651-164		154	92	62	1258	-34	-25	
		281 Ramona	1000			Observation						114	63	51	1263	J-12651-199		112	62	50	1258	-2	-1	
		336 Ramona	1080			Observation						89	55	34	1286	J-12651-113		93	58	34	1258	4	0	
30	1600	Old Spanish & Los Pied.	1378	11/21/2005	3:52 PM	Flow	839	2.5	NA	25	NA	92	37	55	1590	J-1600-031	839							
		271 Old Spanish	1409			Observation						78	17	61	1589	J-1600-029		80	20	60	1594	2	-1	
		331 Old Spanish	1400			Observation						74	25	49	1571	J-1600-100		84	34	50	1594	10	1	
		Vista Verde & Old Span	1418			Observation						69	30	39	1578	J-1600-003		76	37	39	1594	7	0	
		76 Vista Verde	1506			Observation						33	14	19	1583	J-1600-018		38	22	16	1594	5	-3	
31	1435	Joaquin & Alpine	1122	11/21/2005	4:17 PM	Flow	1256	2.5	2.5	14	14	130	28	102	1422	J-1435-052	1256							
		45 Joaquin	1184			Observation						104	16	88	1425	J-1435-051		104	11	93	1425	0	5	
		60 Joaquin	1245			Observation						73	6	67	1414	J-1435-150		78	4	74	1425	5	7	
		Joaquin & Old Spanish	1383			Observation						24	0	24	1438	J-1435-001		18	-4	22	1425	-6	-2	
		76 Old Spanish	1290			Observation						58	30	28	1424	J-1435-024		58	33	25	1425	0	-3	

Brown shading represents re-flowed hydrants.
Yellow shading represents tests that were not considered to match field data well.

Initial Discrepancies Resolved with Additional Data

- Zone 220, Tests 1-5 (test 2 re-tested): This zone has the largest demand with 5,500 gpm average day demand that supplied via PRVs at SFPUC turnouts. Initially, tests 2 and 3 did not meet the 5 psi criterion. Review of the model with Cal Water revealed that turnout BG-04 was not modeled in the correct location. This was corrected in the model.

  Also, Cal Water found a closed 8-inch gate valve in the field near test number 2 at San Mateo and Hurlingame. After opening the valve, the hydrant was re-flowed in November 2007. With new pressure data from test 2 and with the correctly modeled turnout, all zone 220 tests 1 through 5 met the 5 psi criterion.

- Zone 470, Test 9 (re-tested): This is a hydropneumatic zone with 0.08 mgd (57 gpm) of demand. The flow hydrant was located at Ridgeview and Alta Vista. In the initial test, the model under-predicted headloss by 12-17 psi in this zone. Model results could not be matched because station 11 operation was unknown. Therefore, this hydrant was re-tested on November 5, 2007, reporting on station 11 operation. As a result of the re-test, modeled pressure drop matches field data well.

- Zone 835, Test 15(re-tested): This zone has an average demand of 0.04 mgd (31 gpm) and is supplied by pump station 24. A 100,000 gallon storage tank resides at station 25, Woodside Oak. In the initial test, field measured pressure drops at the observation hydrants were inconsistent with each other. Two observation hydrants are separated by 830 feet of 6-inch AC pipeline between the flow hydrant and Woodside Oak reservoir. One of them overpredicted pressure drop by 9 psi, while the other underpredicted by 6 psi. Therefore, this hydrant was re-tested on November 5, 2007. As a result of the new flow data, modeled pressure drop matches pressure data for two out of three observation hydrants.

- Zone 1265-1, Test 29 (Re-tested): This zone is supplied by pump station 34 and has a 125,000 gallon storage tank at Station 36 Bonita. The model under-predicted headloss by 14 to 15 psi. Adjusting C-values to increase headloss will increase the modeled pressure drop by a few psi, which is not enough to match the pressure drop measured in the field. A possible reason that the model results did not match field data may be if there are any partially closed valves between Bonita tank and the flow hydrant. Cal Water checked the area closed or partially closed valves but did not find any. Maintenance work was performed on a PRV since the original flow test, so it was retested on November 5, 2007. From the new test data, modeled pressure drop matches field measured pressure drop within 5 psi for two out of three observation hydrants.

Initial Discrepancies Not Resolved With Additional Data

- Zone 400, Test 7: One out of two tests locations in Zone 400 matched field data to within 5 psi. Test 7 over-predicted headloss by 26 to 45 psi at all observation hydrants. Zone 400 has an average demand of 1.12 mgd (780 gpm) and is supplied by Station 4 and the Lake tanks. There are two PRV stations in the east side of zone 400 that supply zone 319. The model has one check valve in the vicinity of the hydrant location, at Santa Cruz Boulevard and Sand Hill Road. This valve allows flow from zone 319 to zone 400 when a low pressure occurs in zone 400, and was open in the model, during the hydrant flow. The low modeled pressures suggest that there may be other check valve connections to zone 319 or zone 220. Neither the system map nor GIS revealed other check valves near the hydrant test location. Cal Water searched for unintentionally open valves between zone 400 and adjacent ones, but found none.

  The reservoirs at Station 5, Intermediate tanks, provide storage for zone 400. Along Reservoir Road, a 4,000 feet section of 10-inch pipeline in series with a 200-foot section of 8-inch connects the reservoirs to the fire hydrant test area. During the test, model results show 2,000 gpm flows through this section and incurs 20-30 ft/kft headloss in the 10-inch pipe, and 90 ft/kft in the 8-inch pipe. Per Cal Water, the area between Station 5 and the test location does not have new or upsized pipes in the field that are not on the system map or GIS.

  This location was not re-tested. In the future, Cal Water could perform new hydrant testing and monitoring in this area and use this information to refine the model.

- Zone 475, Test 10 (re-tested): Two PRVs (one at Lynn Way and one at Kenmore/Woodside) serve this zone, which has an average demand of 0.06 mgd (40 gpm). Cal Water provided a setting of 49 psi for both PRV's which results in a modeled hydraulic grade line ranging from 483 to 498 feet, based on model elevations. These grade lines are slightly higher than but close to the zone operating gradient of 475. From the initial test, field measured static pressure in this zone indicated a hydraulic grade line that was considerably higher than the zone operating gradient of 475 for the pressure zone. Cal Water field investigation revealed that the PRV at Lynn Way was installed backwards. The PRV was installed correctly and on November 5, 2007, the hydrant was re-tested twice. The first test (10a) was with both PRVs open, while the second test (10b) was with the PRV at Lynn Way closed. In test 10a, the model under predicts pressure drop by 7 to 8 psi in two of the three observation hydrants.

  In test 10b, the model underpredicts by 6 psi in one of the three observation hydrants. Pressure in the second observation hydrant drops to zero during hydrant flow. In the third observation hydrant pressure dropped to zero psi during the flow and never recovered after the flow ended. C-values of cast iron pipes in this zone are set to a lowest reasonable value of 85, while the asbestos cement pipes have a c-value of 130. A sensitivity study revealed that setting asbestos cement

pipes to 120 makes negligible difference in the results. Therefore, c-values for asbestos cement pipelines were left at 130.

- Zone 560, Test 25: This zone is supplied by zone 680 through three PRV stations along Pecora Way, Gabarda Way and Coquito Court. The Coquito PRV station is set at 60 psi per Cal Water provided data, and sets the zone grade line at 577 feet in the model. The other two PRVs are set at lower pressures, and are normally closed. Field static pressures at the observation hydrants result in a grade line that ranges between 565 and 706 feet. The one observation hydrant that has a model result within 5 psi of observed conditions has a computed static gradient of 565. In the model, the two observation hydrants near the PRVs underpredict pressure drop by 46 to 72 psi. Computed static gradients at these hydrants are significantly higher than 577. Possible differences may be from measurement error at these locations, or due to a partially closed valve between the PRVs and the flow hydrant. A partially closed valve would not explain the high static pressure readings at these two locations. Cal Water planned on re-testing this location, but because the storage tank (Ladera) was out of service at the time, hydrant testing was not performed. If desired, Cal Water could retest this location in the future and use information to refine the model in this area.

- Zone 795-1, Test 18: This zone is supplied by two pumps at Coombsville station 6. The zone has a 100,000-gallon storage tank at Woodside Highland Station 7. It has an average demand of 0.02 mgd (16 gpm). The model under-predicted headloss by 15-22 psi in this zone. Pipe diameters in the model correspond to GIS data. C-values in the asbestos cement pipelines were adjusted to 120, which is the lowest reasonable value for a pipe of this material. Possible cause for mismatch in model and field data may be from a partially closed valve near the flow hydrant at Santa Maria Street and Trinity Lane. Another possibility is that the observation hydrants in the model are not in the correct location. CDM requested confirmation of hydrant locations but did not obtain that information. If desired, Cal Water could re-check locations and perform new hydrant testing, if needed, as a future model refinement.

- Zone 1025, Test 19: This zone has an average demand of 0.07 mgd (46 gpm). The zone is supplied by pump station 7, and has storage at station 32, Wayside tank. The model under-predicts headlosses that occur near the hydrant test location. C-values of the concrete lined and coated pipes near this hydrant were set to 85, which is low for pipes of this material. The computed static gradient of two of the tests that do not match are 200 feet lower than the gradients computed at other locations. Possible reasons that model results and field data do not match is that partially closed valves exist near the hydrant test, or field measurement error. Another possibility is that the observation hydrants in the model are not in the correct location. CDM requested confirmation of hydrant locations but did not obtain that information. If desired, Cal Water could re-check locations and perform new hydrant testing, if needed, as a future model refinement.

Recommended Roughness Factors (C-Values)

Based on the calibration analysis, C values in the model were adjusted to improve the agreement between the observed field data and predicted model results. For each calibration location, adjustments to pipe roughness were compiled taking into account the diameter and material. Adjustments to C-values were then applied to pipes with the same attributes in that pressure zone.

Table 10 summarizes the recommended overall roughness values, which are based on the calibration analysis, and are also consistent with the reasonable values typically specified in standard references. For planning purposes, relatively conservative values were selected to provide a factor of safety for aging of pipes over time.

The ranges shown in Table 11 are due to the fact that the C-value varies between zones based on the results of the calibration adjustments. For example, the C-value for an 8-inch asbestos cement pipe in one zone may be different than that for an 8-inch asbestos cement pipe in another zone.

Table 10
Bear Gulch System
Recommended Pipe Roughness Factors for Hydraulic Evaluation Based on Calibration Analysis

Pipe Material	*Pipe Diameters (in)*	*Preliminary C-Values Used as Starting Point*	*Recommended C-Values from Calibration Analysis*
Asbestos Cement, Transite, Concrete Cylinder Pipe, Cement Lined & Coated, Cement Lined Cast Iron	2-4	120-130	120-130
	6	120-130	120-130
	8	100-130	85-130
	10-18	130	120-130
	20-24	130	130
Cast Iron	1-4	75-100	85-120
	6-12	70-110	90-130
	16-24	120	120
Ductile Iron	2-4	85-120	85-120
	6-8	120-130	120-130
	10-18	120-130	120-130
Copper	1-2	120	120
Polyethylene (PE), Polyvinyl Chloride (PVC)	2-12	100-130	120-130
Steel	2-18	120-130	100-130
Unknown or Blank	2-16	100-130	120-130

Overall Calibration Findings

Overall, the model is predicting reasonable results and can be used to predict system performance under existing demand conditions.

In general, definitive standards to assess the accuracy of model calibration for water distribution system have yet to be agreed upon or established. A general criterion

suggested by the AWWA Engineering Computer Applications Committee is that the difference between measured and modeled values should be within a range of +-5 psi for a model to be considered calibrated for planning applications.

The overall calibration results based on the available data indicate that the model is a reasonable representation of the system. Twenty-six out of thirty-one test locations were within 5 psi of the measured pressure drop. The other five locations with discrepancies are discussed above in detail under "Calibration Results". The discrepancies may be due to inaccuracy of field measurements or lack of detailed information on system operations on the test day. In these locations, CDM has recommended future actions that Cal Water could take to further refine the model.

Model Extended Period Verification

The calibrated static hydraulic model was run for an extended period simulation, and compared with historical operating data. To verify the model, CDM simulated historic operating conditions on the following days using system data provided by Cal Water:

- Maximum demand day of July 29, 2005, with the treatment plant not operating, 20.45 MGD.
- High demand day of July 24, 2006, with the treatment plant operating, 24.14 MGD.
- Minimum demand day of January 22, 2006, with the treatment plant operating, 4.96 MGD.

For each selected day, Cal Water provided the data available on SCADA needed for the verification. The high demand and minimum demand day verifications used the model verified for the maximum day as a starting point. Further adjustments were then made.

The verification method and results for each verification day are described below. The maximum demand day is the most important period for verification, since it is typically the period for which hydraulic stresses are highest under normal operating conditions. The maximum demand day is also the basis for determining required facility capacities.

CDM's original scope also called for extended period simulation analysis of two other days. CDM and Cal Water agreed to eliminate these two other days to focus more time and resources on the hydrant test calibration and maximum demand day verification runs. The maximum and minimum days included for the verification are expected to bracket the anticipated range of operating conditions.

Purpose of Model Verification

For the model verification, model results are compared with the actual (observed) system data. If the model is reasonably accurate, modeled pump station flows and suction and discharge pressures should match actual (observed) flows and pressures, and modeled reservoir levels should track actual (observed) levels.

Depending on the data available, different levels of verification can be performed. Where detailed information is available (zone inflows, outflow and reservoir levels) that allows calculation of pressure zone demands, hourly zone demands can be calculated. The model is then set up to reproduce both observed demands and operating conditions (pump starts/stops), and model results are reviewed to determine how well the model predicts zone operations (pump station flows, suction and discharge pressures, reservoir levels). Similarly, if pump station flow, suction and discharge pressure information is available, the pump total dynamic head and flow, based on measurements, can be compared with pump performance in the model, and model results adjusted to get the best fit of actual pump performance conditions.

Where system information is incomplete and a specific diurnal curve for the zone cannot be constructed, the model is run for a 24-hour period with the daily system demand set to match actual daily demand, and model trends are reviewed for consistency with operating data, recognizing that hourly trends may differ from observed. Although this comparison is more qualitative, the model's ability to represent observed conditions can still be assessed by evaluating parameters such as reservoir level operating ranges, and degree of cycling, to determine consistency with observed conditions. Because flows are not recorded at all pump stations or regulating stations in the Bear Gulch system, the model verification used this second approach.

Input Data for Verification Runs

Cal Water provided system data for the selected days for CDM's use in the verification. This field data was used as follows:

- For tanks, electronic files or circular charts were provided showing water elevation data. Electronic data was recorded at 15 minute intervals, while circular charts were analog lines spanning either one day or one week. Initial reservoir levels at midnight were set to match those in the files.

- For pump stations, electronic files or circular charts were provided showing pressure data. Electronic data was recorded at 15 minute intervals, while circular charts were analog lines spanning either one day or one week. The circular charts used in the initial draft report for both pump station pressures and tank levels were found to be from an incorrect day. Proper data was subsequently provided and the model re-verified. This report shows the revised results. Pressures were taken at pump station suction and/or discharge points.

- For turnouts, daily production report sheets were provided showing total flow for the day.

- Pressure settings at the PRV stations in the system from Table 3-6.

- Pump performance curves provided by Cal Water.

Verification Methods

If the model is an accurate representation of the physical system, modeled pump station suction and discharge pressures should reasonably match observed pressures from the field data, and modeled reservoirs should operate within similar levels and cycling frequencies as observed conditions in the field data. The calibrated model from the hydrant test calibration was used for the verification runs.

The 24-hour simulation was set up to represent the actual maximum day conditions using the system data provided by Cal Water. Available discharge pressures, suction pressures, and reservoir level trends were used as the basis of comparison. The verification analysis evaluated whether the modeled results generally tracked the observed system performance trends in the field data.

Maximum Demand Day, July 29, 2005

Reservoir level data was provided for all the tanks. Several points of comparison were used to determine how well the modeled reservoir levels matched those measured in the field. The general trend of a reservoir was considered to match field data if the data matched in the following three ways:

- Reservoir levels throughout the 24-hour period in the model correspond to levels in measured in the field;
- Filling and drafting trends in the model are consistent with measured trends; and
- Upper and lower water levels in the model correspond to measured upper and lower levels.

Discharge pressures were provided for all pump stations, and suction pressure for some. For facilities with data provided, modeled pressure results were plotted against field pressure data. Modeled pressures were compared to field data in the following ways:

- Pressures throughout the 24 hour period in the model correspond to field measured pressures;
- Increasing or decreasing modeled pressure trends are consistent with field measured trends; and
- Pressure limits are within a similar range of the field measured range.

Comparisons consisted of evaluating reservoir levels and cycling trends for consistency with operating data and comparing modeled pump station pressures with observed. Where differences were observed, adjustments were made to model pump flow-head curves, station elevations or zone diurnal curves to better match field data. Changes to pump flow-head curves and station elevations were applied to both high demand and minimum demand day verifications. Zone diurnal curves were applied only to the high demand day verification because diurnal patterns on a minimum demand day can be significantly different from higher demand days.

Therefore, specific zone diurnals for minimum demand day were applied only as needed.

High Demand Day with Plant On, July 24, 2006

Because total demand on the high demand day was similar to that of maximum demand day, operation of most facilities within the system is expected to be similar. The major difference is in the operations of the treatment plant and zones linked to it. Verification consisted of comparing the model with field data in areas that are hydraulically affected by the treatment plant operation.

The verification analysis of the hydraulically affected area included downtown pressure in zone 220, Lake tank levels, Intermediate tank levels, and station 5 discharge pressure. Modeled pressure trends and tank levels were compared to field data in the same way as verification for maximum demand day described in the previous section.

Minimum Demand Day with Plant On, January 22, 2006

The verification run for the minimum demand day is based on the model verified for the maximum day as the starting point. This verification checks the effect of the various other operating conditions to determine if any additional model refinements are needed. CDM simulated historic operating conditions for the minimum day, January 22, 2006, as determined by Cal Water.

Reservoir level data was provided for all tanks. Several points of comparison were used to determine how well the modeled reservoir levels matched those measured in the field. The general trend of a reservoir was considered to match field data if the data matched in the following ways:

- Maximum reservoir levels throughout the 24-hour period in the model are within 2 to 3 feet of the maximum level measured in the field; and
- Minimum reservoir levels throughout the 24-hour period in the model are within 2 to 3 feet of the minimum level measured in the field.

For each day, discharge pressures were provided for all pump stations, and suction pressures (SCADA) for some. Modeled pressures were compared to field data in the following ways:

- Maximum pressures throughout the 24 hour period in the model are within 5 to 6 psi of the maximum field measured pressure; and
- Minimum pressures throughout the 24 hour period in the model are within 5 to 6 psi of the minimum field measured pressure.

Verification Results

Results for the three extended period verification days are presented below.

Verification Results for Maximum Demand Day

For maximum demand day, the model matched field data well for 22 out of 23 tank levels, and for all 21 station pressures provided by Cal Water. The maximum day verification run with the available system data indicate that the calibrated model provides a reasonable representation of the system performance under high demand conditions, which are the most stressful for the system and the basis for facilities sizing.

The analysis also found that the pump station 04 flow meter has flow readings that exceed the flows reported from production records for BG-07 turnout, which supplies the pump station. CDM recommends calibration of the pump station 04 flow meter.

Table 11 presents the key results from the verification runs for each reservoir and pump station, including changes to pump flow-head curves, station elevations, and zone-specific diurnal curves. Attachment 1 provides plots for the maximum day verification showing: hourly modeled and measured water level at each reservoir; hourly modeled and measured pressure at each pump station; and diurnal curves for zones with different diurnal patterns than that shown in Figure 2.

Table 11
Summary of Verification Results - Bear Gulch System
Maximum Demand Day (July 29, 2005)

Facility	*ID*	*Cal Water Field Data*	*Comments*
Pumps			
02 Lake	PMP-002-B		Not part of model
	PMP-002-C		
	PMP-002-D		
Lower BG Creek	PMP-003-E		Not part of model
	PMP-003-F		
Station 04	PMP-004-C		No pressure data given
	PMP-004-D		
	PMP-004-F		
	PMP-004-G		
	PMP-004-H		
05 Intermediate	PMP-005-J	PSI-05-DIS	General trend in model matches field data. Discharge elevation adjusted to 370 feet.
	PMP-005-K		
	PMP-005-L		
	PMP-005-M		
	PMP-005-N		
06 Coombsville	PMP-006-A		No field data given
	PMP-006-B		
07 Woodside Highlands	PMP-007-B		No field data given
	PMP-007-C		
08 Portola Booster	PMP-008-B	PRESS-08-SUCT, PRESS-08-DISCH, Circular Chart Suction	Suction: General trend in model matches field data. PRV setting changed from 50 psi to 54.76 psi. Zone 590
	PMP-008-C		
	PMP-008-D		Discharge: General trend in model matches field data. Discharge elevation adjusted to 415 feet. Zone 660
	PMP-008-E		

Table 11
Summary of Verification Results - Bear Gulch System
Maximum Demand Day (July 29, 2005)

Facility	***ID***	***Cal Water Field Data***	***Comments***
11 Alta Vista Booster	PMP-011-A	Circular Chart Discharge Pressure	General trend in model matches field data.
	PMP-011-B		
	PMP-011-C		
Station 13	PMP-013-B	Circular Chart Suction and Discharge Pressure	Suction: General trend in model matches field data. Zone 660
	PMP-013-C		Discharge: General trend in model matches field data. Zone 715
Station 14	PMP-014-A		No field data given
15 Woodside Knolls	PMP-015-A	Circular Chart Discharge Pressure	General trend in model matches field data. Discharge elevation adjusted to 462 feet.
16 Woodside Reservoir	PMP-016-A	PRESS-16-SUCT	General trend in model matches field data.
17 Alpine Hills - Serves Zone 815	PMP-017-A	Circular Chart 17A Discharge Pressure	General trend in model matches field data. Discharge elevation adjusted to 712 feet.
17 Alpine Hills - Serves Zone 910	PMP-017-B	Circular Chart 17B, C Discharge Pressure	General trend in model matches field data.
	PMP-017-C		
Station 18	PMP-018-A	Circular Chart Discharge Pressure	Normal operating pressure is 130-140 psi, per Cal Water J. Gomez. Model averages 140 psi. Circular chart averages 170 psi. General trend in model matches field data per Cal Water.
19 Ridgeway	PMP-019-A	PRESS-19-DISCH and Circular Chart Discharge	General trend in model matches field data.
	PMP-019-B		
Station 20	PMP-020-A	Circular Chart Discharge Pressure	General trend in model matches field data.
	PMP-020-B		
Station 21	PMP-021-A	Circular Chart Discharge Pressure	General trend in model matches field data. Discharge elevation adjusted to 639 feet.
22 Canada	PMP-022-A	PRESS-22-DISCH and Circular Chart Discharge Pressure	General trend in model matches field data.
	PMP-022-B		
Station 23	PMP-023-A	PRESS-23-SUCT	General trend in model matches field data.
	PMP-023-B	Circular Chart Discharge Pressure	General trend in model matches field data. Discharge elevation adjusted to 478 feet. Pump curve adjusted to match flow into zone 805 and on/off record in "alarm data".

Table 11
Summary of Verification Results - Bear Gulch System
Maximum Demand Day (July 29, 2005)

Facility	***ID***	***Cal Water Field Data***	***Comments***
Station 24	PMP-024-A	Circular Chart Suction Pressure	General trend in model matches field data.
	PMP-024-B	Circular Chart Discharge Pressure	General trend in model matches field data.
25 Woodside Oaks	PMP-025-A		No field data given for maximum demand day. Discharge elevation adjusted to 825 feet for minimum demand day verification.
	PMP-025-B		
Station 26	PMP-026-A	Circular Chart Discharge Pressure	General trend in model matches field data.
	PMP-026-B		
27 Westridge	PMP-027-A	Circular Chart Discharge Pressure	General trend in model matches field data. Discharge elevation assumed to be 810 feet.
33 Los Trancos	PMP-033-A		No field data given
	PMP-033-B		
35 Buck Meadows	PMP-035-A		No field data given
	PMP-035-B		
36 Bonita	PMP-036-A		No field data given
	PMP-036-B		
Station 38	PMP-038-A		No field data given
	PMP-038-B		
Tanks			
02 Lake	T-002-T1	LAKE-TNK-1	General trend in model matches field data.
	T-002-T2	LAKE-TNK-2	
05 Intermediate	T-005-T6	INT-TNK-6	General trend in model matches field data.
	T-005-T8	INT-TNK-8	Zone 400 diurnal pattern modified to match tank cycling pattern. Diurnal has a peaking factor of 3.0.
	T-005-T9	INT-TNK-9	Zone 400 diurnal pattern modified to match tank cycling pattern. Diurnal has a peaking factor of 3.0.
06 Coombsville	T-006-T1	Coombsville (SCADA and Circular Chart)	General trend in model matches field data.
07 Woodside Highlands	T-007-T1	Highlands (SCADA and Circular Chart)	General trend in model matches field data.
15 Woodside Knolls	T-015-T1		No field data given
16 Woodside Reservoir	T-016-T1	WoodsideRes	General trend in model matches field data.
17 Alpine Hills	T-017-T1	AlpineHill (SCADA and Circular Chart)	General trend in model matches field data. Zone 715.

Table 11
Summary of Verification Results - Bear Gulch System
Maximum Demand Day (July 29, 2005)

Facility	***ID***	***Cal Water Field Data***	***Comments***
19 Ridgeway	T-019-T1	Circular Chart	General trend in model matches field data.
	T-019-T2	Circular Chart	General trend in model matches field data.
21 Arrowhead	T-021-T1	Circular Chart	General trend in model matches field data. Zone 660 diurnal modified to match Arrowhead tank levels. Circular chart pen may have shifted during second half of day. Zone 660
	T-021-T2		
22 Canada	T-022-T1	Canada (SCADA and Circular Chart)	General trend in model matches field data. Modified diurnal in zone 805 to match Canada tank levels. Peaking factor adjusted to 2.5.
25 Woodside Oaks	T-025-T1	Station 25 Woodside Oaks	General trend in model matches field data.
27 Westridge	T-027-T1	Westridge	General trend in model matches field data. Zone 815 diurnal pattern modified by increasing peaking factor to 3.0.
28 Ladera	T-028-T1	Ladera (SCADA and Circular Chart)	General trend in model matches field data.
29 Ormandale	T-029-T1	Circular Chart	General trend in model matches field data.
	T-029-T2	Circular Chart	General trend in model matches field data.
	T-029-T3	Circular Chart	Modeled tank drains 3 ft lower than circular chart data indicates. Zone 660
30 Portola	T-030-T1	Portola (SCADA and Circular Chart)	General trend in model matches field data.
31 Summit	T-031-T1	Summit	General trend in model matches field data.
32 Wayside	T-032-T1	Wayside (SCADA and Circular Chart)	General trend in model matches field data.
33 Los Trancos	T-033-T1		No field data given
34 Sunrise Tank	T-034-T1		No field data given
36 Bonita	T-036-T1		No field data given
37 Spanish Tank	T-037-T1		No field data given
38 Verde Vista	T-038-T1		No field data given
39 Pony Tracks	T-039-T1		No field data given

Station elevation adjustments made to Maximum demand day verification also made in high demand and minimum demand day verifications.

Initially, eight tank levels and 13 station pressures in the model did not match field data well. Review with Cal Water staff revealed that field data used was from an incorrect day. In addition to providing properly dated charts, Cal Water provided additional operating information via series of phone conferences and emails. As a result, all but one of the tank level and station pressure discrepancies between the model and field were resolved. The one tank where discrepancies were unresolved, Ormondale tank 3, is described in detail in the bullet point for zone 660.

The following points describe model configuration changes made in order to match model data to field data.

- Zone 400: Station 4 pumps F, G, H and I supply zone 400, which has an average demand of 1.12 mgd (780 gpm). Modeled Intermediate tank levels for zone 400 match levels shown in SCADA. The general diurnal established for the Bear Gulch system did not adequately represent the diurnal pattern seen in zone 400. Therefore, a diurnal curve specific to zone 400 was created, which has a peaking factor of 3.0 at 8 AM.

  Per SCADA, pump station 04 F, G, H, and I (04 C is not on SCADA) averages 7,100 gpm, while its source, BG-07, averages 6,000 gpm. The treatment plant was not operating on maximum demand day. Because SCADA reported station 04 flow exceeds production flow from the turnout, CDM recommends calibrating the flow meter at station 04. The same flow discrepancy was observed in the high demand and minimum demand days.

- Zone 590: This zone, which is supplied mainly by pump station 5, and occasionally by station 18, has storage from reservoirs at Station 6 Coombsville, Station 19 Ridgeway, Station 15 Woodside Knolls, and Station 16 Woodside Reservoir. Pump station 16 pumps out of the ground level storage reservoir at station 16, Woodside into zone 590. Pump station 6 Coombsville, located on the south end of the zone, pumps out of zone 590 into zone 795-1. Coombsville can be backfilled by zone 660 via a normally closed valve, which may be open during high demand periods. In the same area, booster pump station 8 feeds zones 660 and higher. Pump station 23, located on the northwest side, feeds zones 805 and 880. Stations 15, 19, and 24 deliver water from zone 590 into upper zones.

  While station 5 is the main feed from zone 400 to zone 590, station 18 also delivers water from zone 400 to zone 590 and is commonly used as a booster to supplement the filling of Ridgeway tanks during high demand and/or hot days. The circular chart for station 18 discharge shows an average of 170 psi, which corresponds to an HGL of 712 feet at station elevation 308 feet, much higher than the overflow elevation of 592 feet at Ridgeway tanks. In the model, pump station 18 operates the entire day, with an average pressure of 140 psi, which corresponds to an HGL of 631 feet, and is consistent with station 5 discharge pressure of 115 psi, or 647 feet HGL.

  Pressures were reviewed with John Gomez of Cal Water's district operations staff, who noted that normal pressures at station 18 are in the 130-140 psi range, as shown in the weekly circular chart dated 7/20/05-7/27/05 just prior to the 7/29/2005 maximum demand day. Mr. Gomez also noted that construction near station 18 and Ridgeway tanks occurred around the summer of 2005. After construction in this area, operators noticed higher pressures near Station 18 and problems re-filling Ridgeway tanks. A closed valve was found in the area and was re-opened. Pressure in the area then dropped to normal levels, and resulted in Ridgeway filling properly. This may explain the high pressure seen on the station 18 discharge circular chart for the week of 7/29/05, but not the previous week.

For station 18 discharge, the average pressure in the model, 140 psi, matches the average pressure according to Mr. Gomez.

At station 8, the Coombsville fill valve, which is listed as having a 50 psi setting in the piping drawing, was set to 54.76 psi in order to match pressures in zone 590.

- Zone 660: On the west side, booster pump station 8 Portola is the only supply into zone 660, which has an average demand of 0.39 mgd (270 gpm). Station 13 pumps from zone 660 to supply zone 715. Pump stations 14 and 21 pump from zone 660 into zone 815.

  Zone 660 has two sets of storage tanks, station 29 Ormondale and station 21 Arrowhead, that are separated by approximately 12,000 feet of pipeline.

  The model was configured with pump station 14 off, an altitude valve on Ormondale that allows water to drain into zone 660, Arrowhead floating on zone 660, and a diurnal pattern specific to zone 660 that included a peaking factor of 1.7 at 8 AM and 1.4 at 5 PM. As a result, modeled Ormondale tank 3 level drops about 3 feet lower than the circular chart shows. However, the cycling pattern of drafting and filling is similar. Ormondale tank 3 level in the model is the only parameter in the maximum day verification that did not match field data well.

  Arrowhead tank 3 levels in the model matches data from the first half of the day well, up to hour 14. The circular chart containing hour 15 to the end of the day seems to be shifted two feet lower than the previous day chart. A 2-foot step decrease between 1 PM and 2 PM can be seen the Arrowhead tank level circular chart dated 7/28/05. Because a step change in a tank level seems unlikely, no further model adjustments were made.

  Zone 660 pressure data can be seen from station 8 discharge and 13 suction measurements. Elevation of station 8 discharge was changed from 405 feet to 415 feet. As a result, modeled pressures from these two measurements match field data well.

- Zone 805: This zone is fed by pump station 23 and has storage at station 22 Canada tank. Zone outflows include pump station 22 and backup PRVs at Albion and Olive that feed zone 590 and 640. With pump 23 A running for the length of time indicated by SCADA alarm data, Canada tank was over-filling. Therefore, the performance curve for pump 23A was reduced to match total demand needed for zone 805 and upper zone 880. The diurnal for zone 805 was then modified in order to match the hourly fluctuation of Canada tank as recorded in the field. A peaking factor of 2.5 occurs at 4 AM while a smaller peaking factor of 1.5 occurs at 1 PM. With these modifications, the model matches field data well.

- Zone 715: This zone is supplied by pump station 13 and has one storage tank, Alpine Hills station 17.

In reviewing discharge pressure with Cal Water, John Gomez indicated that station 13 discharge pressure reading on the circular chart is low by about 30 psi. Review of model and field data indicates a difference of 38 psi. By adding 38 psi to the circular chart values, model results for both maximum day and minimum day match field data well. Results for both maximum and minimum day are with 38 psi added to the circular chart values.

- Zone 815: This zone is fed by pump stations 20, 17A, 21, and 14, in order of decreasing pumping priority, during the summer. In winter, when demand is lower, station 21 is operated as the lead station in order to use water from the treatment plant. Westridge tank holds 0.75 MG of storage for zone 815.

  In reviewing data for the verification day, Cal Water discovered that the circular chart for station 17A discharge pressure was 20 psi lower than actual. The model matches field data well when 20 psi is added to the values on the circular chart and station elevation is assumed to be 700 feet instead of 692 feet that is shown on the schematic.

  CDM found that while the overall supply to the zone matched observed data, Westridge hourly tank operating trends did not match. CDM modified the Zone 815 diurnal curve to have a peaking factor of 3.0, which resulted in the model matching Westridge tank levels well.

- Zone 910: This hydropneumatic zone is supplied by two pump stations, 27 and 17 B and C. Per Cal Water's John Gomez, discharge pressure for 17B and C averages 105 psi, which is consistent with the circular chart dated July 29, 2005. The model matches what both J. Gomez and circular chart from July 29, 2005 indicate.

  Station 27 discharge pressure in the model matches field data well assuming station elevation is 810 feet. Per Cal Water schematic, station elevation is between 790 and 814 feet.

- Zone 960: Pump station 26 has a ground elevation of 588 feet according to the schematic. It is the only supply into zone 960, which has 1 MG storage at station 30 Portola tank. The tank level in the model matches field data well.

  Per Cal Water, the circular chart for station 26 discharge pressure is 22 psi lower than actual. Elevation of station 26 is 588 feet per schematic. At that elevation, the model matches circular chart if the chart was 15 psi lower than actual pressure. Model and chart comparisons are shown with the 15 psi added to the circular chart values. Circular chart values for minimum day verification were also increased by 15 psi, which matched model data well.

Results for High Demand Day with Treatment Plant On

The High Demand Day focused on review of facilities in the vicinity of the WTP. Good agreement between model results and field data was obtained for all facilities. The high demand day verification run indicates that the calibrated model provides a reasonable representation of the performance of the treatment plant during high

demand conditions. Model results verify that the treatment plant is accurately represented in the model.

Similar to the Maximum Day findings, the pump station 04 flow meter has flow readings that exceed the flows reported from production records for BG-07 turnout and the Bear Gulch WTP, which supply the pump station. CDM recommends calibration of the pump station 04 flow meter.

Table 12 presents the key results from the verification runs for the reservoirs and pump stations affected by the operation of treatment plant. Attachment 2 provides plots for the maximum day verification showing: hourly modeled and measured water level at the reservoirs and hourly modeled and measured pressure at the pump stations.

Table 12
Summary of Verification Results - Bear Gulch System
High Demand Day, 24.1 MGD, Plant On, Monday 7/24/2006

	Model ID	***Cal Water Field Data*** [(1)(2)]	***Comments***
Tanks			
02 Lake	T-002-T1	LAKE-TNK-1	Tanks 1 (42' diam) and 2 (60') modeled as one equivalent sized tank w diam 73'.
	T-002-T2	LAKE-TNK-2	General trend in model matches field data.
05 Intermediate	T-005-T6	INT-TNK-6	General trend in model matches field data.
	T-005-T8	INT-TNK-8	General trend in model matches field data.
	T-005-T9	INT-TNK-9	General trend in model matches field data.
Pressures			
Downtown	J-220-2872	Circular Chart Downtown	General trend in model matches field data.
05 Intermediate	PMP-005-J	PSI-05-DIS	General trend in model matches field data.
	PMP-005-K		
	PMP-005-L		
	PMP-005-M		
	PMP-005-N		

(1) Tank field data: SCADA reservoir levels unless noted as circular chart.
(2) Pump station field data:
a) SCADA data if noted as PRESS-##-DISCH or PSI-##-DIS (discharge pressure), or PRESS-##-SUCT (suction pressure).
b) Circular chart if noted.

As indicated on Table 12, the high demand day verification analysis showed good agreement between model results and field data for all facilities. Key findings for the maximum day verification are summarized below:

Per Cal Water operations, treatment plant output is selected by the operators such that the flow rate can remain constant over an extended period of time. Operators prefer to adjust tank levels in upper zones in order to maintain constant output from the plant. Station 4 remains on to help distribute water from the treatment plant. If water levels at the Lake tanks become too high, output of the plant will be reduced as a last resort.

When the plant is operating, the Lake tanks are used to maintain a minimum contact time for chlorine disinfection. Ammonia injection, the final step for chloraminating the water, occurs at the outlet of the Lake tanks before entering the distribution system. SFPUC water, which is also chloraminated, is mixed with treatment plant water downstream of the ammonia injection point. An 'H' valve regulates the flow of SFPUC water being injected into the treated water stream and must be adjusted when treatment plant output changes.

The Lake and Intermediate tanks were evaluated for this high demand day verification. Pressures that were evaluated were zone 220 from the recorder located in the downtown area and station 5 discharge. Production from SFPUC turnout BG-07 in Bear Gulch yard and from the treatment plant was evaluated as well.

Water levels in Lake tanks 1 and 2 are equal, being hydraulically connected and at the same ground elevation. For modeling purposes, the two tanks are modeled as one with an equivalent diameter. In order to match the daily cycling pattern of the tanks, the diurnal pattern for zone 400 was adjusted to have a peaking factor of 2.5 at 7 AM. As shown in the attachment, the model matches field data well for Lake and Intermediate tank levels.

The treatment plant output is modeled as an inject to match the output recorded on a circular chart recorder. The average effluent flow was 1,630 gpm for the high demand day.

Flow from turnout BG-07 averages 4,700 gpm according to production report, and is consistent with the model, which produced 4,690 gpm.

As observed in the maximum demand day verification, SCADA-reported pump station flow (which doesn't include pump 4C, which was also operating) exceeds production data. Per SCADA, pump station 4 F, G, H and I (pump 4C is not recorded by SCADA) averages 7,100 gpm. Cal Water production data for the treatment plant is 1,630 gpm and for the turnout BG-07 is 4,700 gpm, for a total production of 6,330 gpm. CDM recommends that Cal Water calibrate the flow meter.

Results for Minimum Demand Day with Treatment Plant On

For all 29 tank levels and 22 of 23 pump station pressures, the model matched field data well. The minimum demand day verification run indicates that the calibrated model provides a reasonable representation of the performance of the treatment plant during high demand conditions. Because the treatment plant was operating on minimum demand day, as it was on high demand day, the model results further verify that the treatment plant is accurately represented in the model.

During low demand months, Cal Water installs a temporary PRV on the discharge side of pump station 04 to distribute treatment plant water to zone 220. The plant was operating during the minimum day demand and, as verification results indicate, is accurately represented in the model.

Table 13 summarizes the verification results for the minimum demand day. Modifications to pump flow-head curves or station elevations are the same as that found in the maximum demand day verification, which can be found in Table 12.

Table 13
Summary of Verification Results - Bear Gulch System
Minimum Demand Day - Sunday January 22, 2006

	Model ID	*Cal Water Field Data (1)(2)*	*Maximum Field - Maximum Model*	*Minimum Field - Minimum Model*	*Comments*
Tanks			**(ft)**	**(ft)**	
02 Lake	T-002-T1	LAKE-TNK-1	-0.3	0.6	Lake tanks 1 and 2 modeled as one tank, to eliminate numerical instability in modeled tank flows.
	T-002-T2	LAKE-TNK-2	-0.3	0.6	
05 Intermediate	T-005-T6	INT-TNK-6	0.0	-0.1	
	T-005-T8	INT-TNK-8	0.0	0.2	Intermediate tanks 8 and 9 modeled as one tank, to eliminate numerical instability in modeled tank flows.
	T-005-T9	INT-TNK-9	0.0	0.2	
06 Coombsville	T-006-T1	Combsville (SCADA and Circular Chart)	1.2	-0.1	
07Woodside Highlands	T-007-T1	Highlands (SCADA and Circular Chart)	-1.0	0.8	
16 Woodside Reservoir	T-016-T1	WoodsideRes	0.3	0.5	
17 Alpine Hills	T-017-T1	AlpineHill (SCADA and Circular Chart)	0.1	-0.2	
19 Ridgeway	T-019-T1	Circular Chart	-0.7	-0.4	
	T-019-T2		0.3	1.2	
21 Arrowhead	T-021-T1	Circular Chart	0.5	0.3	
	T-021-T2		0.2	-0.1	
22 Canada	T-022-T1	Canada	0.1	0.1	
25 Woodside Oaks	T-025-T1	Station25 Woodside Oaks	-0.3	0.3	
27 Westridge	T-027-T1	Circular Chart	1.3	-0.8	Modified diurnal in zone 815 for minimum demand day.
28 Ladera	T-028-T1	Ladera (SCADA and Circular Chart)	-0.1	0.0	
29 Ormondale	T-029-T1	Ormondale 1	0.1	0.0	
	T-029-T2	Ormondale 2	0.6	-0.6	
	T-029-T3	Ormondale 3	-0.1	-0.1	
30 Portola	T-030-T1	Portola (SCADA and Circular Chart)	-0.2	0.0	
31 Summit	T-031-T1	Summit	0.2	-0.2	
32 Wayside	T-032-T1	Wayside (SCADA and Circular Chart)	-0.5	0.3	
33 Los Trancos	T-033-T1	Los Trancos	-0.1	0.2	
34 Sunrise Tank	T-034-T1	Sunrise Tank	0.1	-0.1	
36 Bonita	T-036-T1	Bonita	0.2	0.0	
37 Spanish Tank	T-037-T1	Spanish Tank	0.0	-0.1	
38 Verde Vista	T-038-T1	Verde Vista	-0.2	0.4	
39 Pony Tracks	T-039-T1	Pony Tracks	0.0	-0.6	

Table 13
Summary of Verification Results - Bear Gulch System
Minimum Demand Day - Sunday January 22, 2006

	Model ID	***Cal Water Field Data (1)(2)***	***Maximum Field - Maximum Model***	***Minimum Field - Minimum Model***	***Comments***
Pump Station Pressures			**(psi)**	**(psi)**	
Low Zone	na	Circular Chart Downtown	-0.1	-4.8	TO PRVs and PRV at BG Yard settings were lowered to about 202' HGL in zone 220 to match field data.
05 Intermediate	PMP-005-J	PSI-05-DIS	-2.1	-2.4	
	PMP-005-K				
	PMP-005-L				
	PMP-005-M				
	PMP-005-N				
07 Woodside Highlands	PMP-007-B	Circular Chart 07 Woodside Discharge	-1.8	3.8	
	PMP-007-C				
08 Portola Booster	PMP-008-B	PRESS-08-SUCT	7.9	13.4	Per SCADA, 8 suction reaches 109 psi, or 657' HGL based on 405' elevation. This is higher than zone 590 grade line at station 5, 630'.
	PMP-008-C				
	PMP-008-D	Circular Chart 08 Discharge	-2.0	2.1	
	PMP-008-E				
11 Alta Vista Booster	PMP-011-A	Circular Chart 11 Alta Vista Discharge	0.1	0.3	
	PMP-011-B				
	PMP-011-C				
Station 13	PMP-013-B	Circular Chart 13 Suction	-2.6	-0.6	Assuming circular chart was low by 5 psi, 5 psi was added to circular chart values.
	PMP-013-C	Circular Chart 13 Discharge	-2.1	-4.6	Assuming circular chart was low by 40 psi, 38 psi was added to circular chart values.
15 Woodside Knolls	PMP-015-A	Circular Chart 15 Woodside Knolls Discharge	-4.9	-4.3	During winter, zone is supplied by PRV from 805, and pump 15 does not operate. During summer, pump operates and is the main feed into the zone. Two check valves from 590 open and supply 640 in model.
16 Woodside Reservoir	PMP-016-A	PRESS-16-SUCT			
		Circular Chart 16 Woodside Reservoir Discharge	0.7	-1.0	Circular chart labeled "16 discharge" is same as the mislabeled SCADA parameter, PRESS-16-SUCT. This pressure is on discharge side of pump. SCADA seems to be reading too high, therefore the circ chart is used.
17 Alpine Hills - Serves Zone 910	PMP-017-B	Circular Chart 17B, C Alpine Hills Discharge	-1.1	4.9	
	PMP-017-C				

Table 13
Summary of Verification Results - Bear Gulch System
Minimum Demand Day - Sunday January 22, 2006

	Model ID	Cal Water Field Data [(1)(2)]	Maximum Field - Maximum Model	Minimum Field - Minimum Model	Comments
Station 18	PMP-018-A	Circular Chart 18 Discharge	-1.3	-3.9	
19 Ridgeway	PMP-019-A	PRESS-19-DISCH	-0.2	4.0	
	PMP-019-B				
Station 20	PMP-020-A	Circular Chart 20 Discharge	-1.3	-0.3	
	PMP-020-B				
Station 21	PMP-021-A	Circular Chart 21 Discharge	-2.8	0.2	
22 Canada	PMP-022-A	PRESS-22-DISCH	-0.4	-0.7	
	PMP-022-B				
Station 23	PMP-023-A	PRESS-23-SUCT	0.4	0.2	
	PMP-023-B	Circular Chart 23 Discharge	-2.5	-1.4	
Station 24	PMP-024-A	Circular Chart 24 Suction	-0.4	0.0	
	PMP-024-B	Circular Chart 24 Discharge	0.4	1.6	
25 Woodside Oaks	PMP-025-A	Circular Chart 25 Woodside Oaks Discharge	-4.2	-4.5	Increased 25 discharge node elev from 814 ' to 825'.
	PMP-025-B				
Station 26	PMP-026-A	Circular Chart 26 Discharge	-0.1	-2.6	Per Cal Water email 12/20/07, actual pressure is 22psi higher than circular
	PMP-026-B				chart indicates. Added 15 psi to circular chart in order to best match both max and min day.
27 Westridge	PMP-027-A	Circular Chart 27 Westridge Discharge	4.0	3.9	

(1) Tank field data: SCADA reservoir levels unless noted as circular chart.
(2) Pump station field data:
a) SCADA data if noted as PRESS-##-DISCH or PSI-##-DIS (discharge pressure), or PRESS-##-SUCT (suction pressure).
b) Circular chart if noted.
Station elevations are the same as that used in the maximum demand day verification.

Key findings for the minimum day verification include:

- For all 29 tanks, the modeled maximum and minimum water levels were within 1.5 feet or less of the maximum measured levels.
- For 22 out of 23 pump station pressures, the maximum and minimum values were within 5 psi of the field measured maximum and minimum values. Furthermore, of the 22 that matched, 60 percent of the modeled maximum and minimum values were within 3 psi of field measured values. Discussion of pump station 8 where pressures were not within 5 psi is included in the findings below.
- Zone 220 is supplied by SFPUC via turnouts BG-01 through BG-07. The PRVs regulate the pressure at which water is supplied. It is CDM's understanding that PRV settings at the SFPUC turnouts are changed as needed, based on system

demand conditions. In the model, settings were adjusted in order to match the circular chart pressure of the gage located in downtown in zone 220.

- Station 13 Suction Pressure

  Maximum pressure in the model was 8 psi higher than the field measured maximum, while minimum pressure in the model was 5.5 psi higher than the field measured minimum. After adjustments described below were made, the model and field data match well.

  Pump station 13 delivers water from zone 660 to zone 715 and is the only supply into zone 715. It is on level control from Alpine Hills tank. The station 13 circular chart measures both suction and discharge pressures on a daily circular chart recorder.

  Station 13 suction pressure recorded on the circular chart is about 8 psi lower than actual, when compared with two other pressure data in zone 660; discharge pressure at Portola station 8 and Arrowhead tank level.

  Cal Water personnel took a field measurement of station 13 discharge in January 2008, which was 66 psi. This is 8 psi higher than the 1/22/06 circular chart reading of 58 psi. This also suggests that the circular chart reader is 8 psi lower than actual. Assuming the circular chart reader is 8 psi lower than actual pressures, modeled station 13 suction pressure matches field data well.

  Results for the maximum day verification show that station 13 suction pressure recorded on the circular chart is about 5 psi higher than modeled pressure. The difference in results between maximum day and minimum day suggest that station 13 recorder may have shifted some time between the maximum day of July 29, 2005 and the minimum day of January 22, 2006. CDM recommends calibration of the pressure recorder.

- Station 13 Discharge Pressure

  Maximum pressure in the model was 38 psi higher than the field measured maximum, while minimum pressure in the model was 42.6 psi higher than the field measured minimum. After adjustments described below were made, the model and field data match well.

  In reviewing discharge pressure with Cal Water, John Gomez indicated that station 13 discharge pressure reading on the circular chart is low by about 30 psi. Review of model and field data indicates a difference of 38 psi. By adding 38 psi to the circular chart values, model results for both maximum day and minimum day match field data well. Comparisons of model and field data for both maximum and minimum day are shown with 38 psi added to the circular chart values.

  In January 2008, Cal Water personnel measured station 13 discharge pressure to be 89 psi. The 1/22/06 circular chart indicated pressure to be 48 psi, which

indicates that the recorder is about 40 psi lower than actual, consistent with CDM's adjustment of 38 psi.

- Station 8 Suction Pressure

  Maximum pressure in the model was 7.9 psi lower than the field measured maximum, while minimum pressure in the model was 13.4 psi lower than the field measured minimum.

  Station 8 delivers water from zone 590 to zone 660. With the pumps operating per SCADA alarm data, modeled station 8 suction pressure follows SCADA data, but is between 7.9 to 13.4 psi low. Per SCADA data, station 8 suction pressure reaches 109 psi, or 657 feet HGL based on 405 feet station elevation. This is higher than the grade line of zone 590, which is about 630 feet set by discharge pressure of pump station 5. CDM recommends calibration of the SCADA pressure recorder at station 8 suction.

  Elevation at the suction side of station 8 was not modified because at the current elevation, maximum day verification results matched well.

Overall, the minimum demand day verification analysis showed good agreement between model results and field data for the facilities, as indicated on Table 13.

Overall Verification Findings

For the maximum demand day verification, 22 out of the 23 tank levels match field data well. All 21 of the station pressures provided by Cal Water match field data well.

For high demand day with the plant operating, all modeled tank levels and pressures hydraulically affected by the treatment plant match field data well. This includes Lake and Intermediate tanks as well as downtown pressure and station 5 discharge pressure. For station 04, SCADA-reported flow (which doesn't include pump 4C, which was operating) exceeds production data, for sources supplying the pump station. CDM recommends that Cal Water calibrate the flow meter at station 04.

For minimum demand day with the plant operating, all 29 tanks in the model matched the maximum and minimum water levels measured in the field within 1.5 feet. For 22 out of 23 pump station pressures, the maximum and minimum values were within 5 psi of the field measured maximum and minimum values.

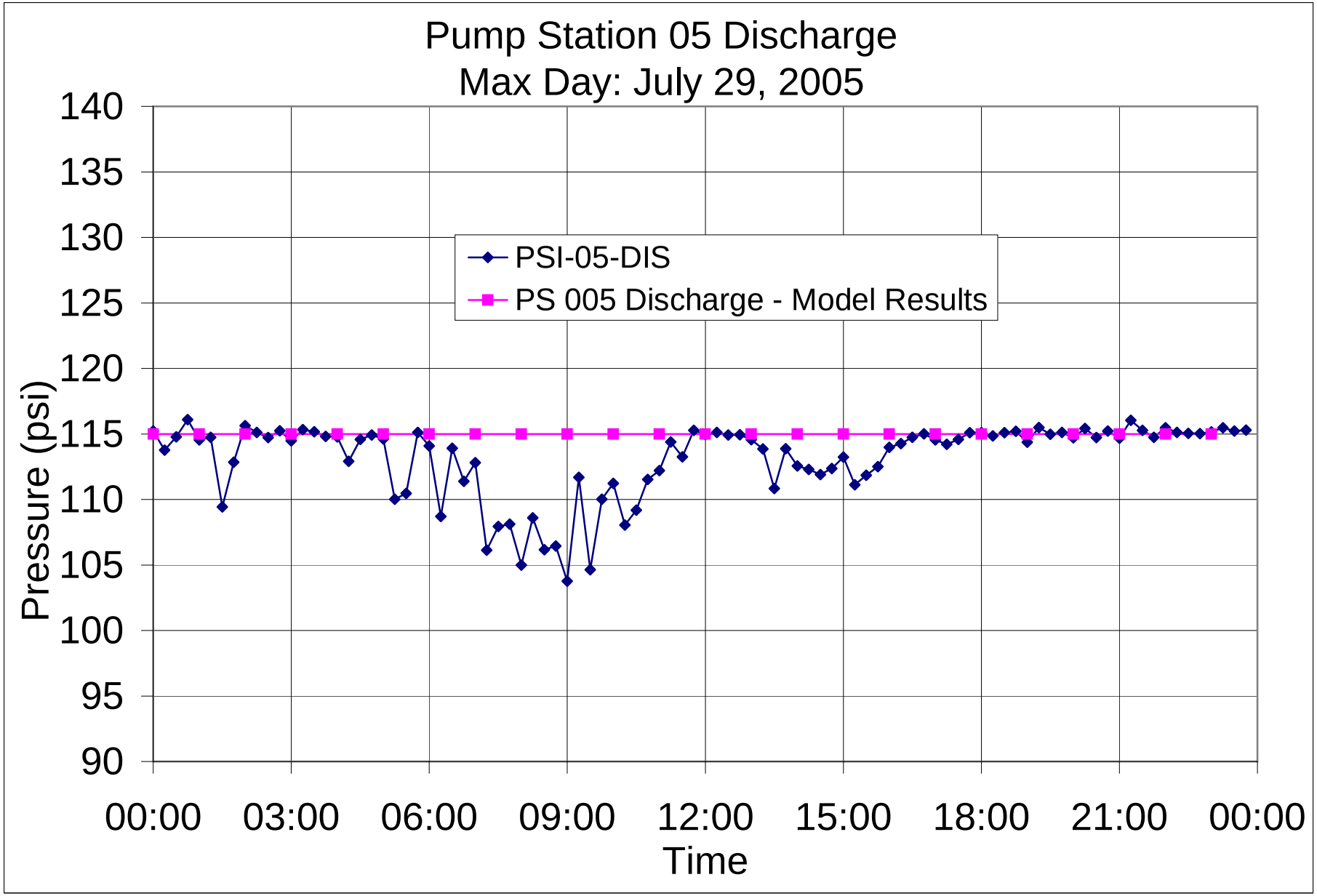
Remaining discrepancies may be due to inaccuracy of field measurements, manual operation of pump stations, open/closed valves in the field, or lack of detailed information on system operations on the test day. Additional information collected by Cal Water can be used to further refine the model in the future.

Based on the analysis, CDM considers the model to be sufficiently calibrated and verified for use in the Master Plan analysis of the Bear Gulch system, and for Cal Water use for operational evaluations.

To further refine the model for future evaluations, CDM recommends installing flow meters at each pump station, calibrating circular charts and providing reference elevations for pressure recorders at each station. Flow metering would also allow Cal Water to prepare system-specific and zone-specific diurnal curves.

Attachment 1

Maximum Demand Day Verification Charts



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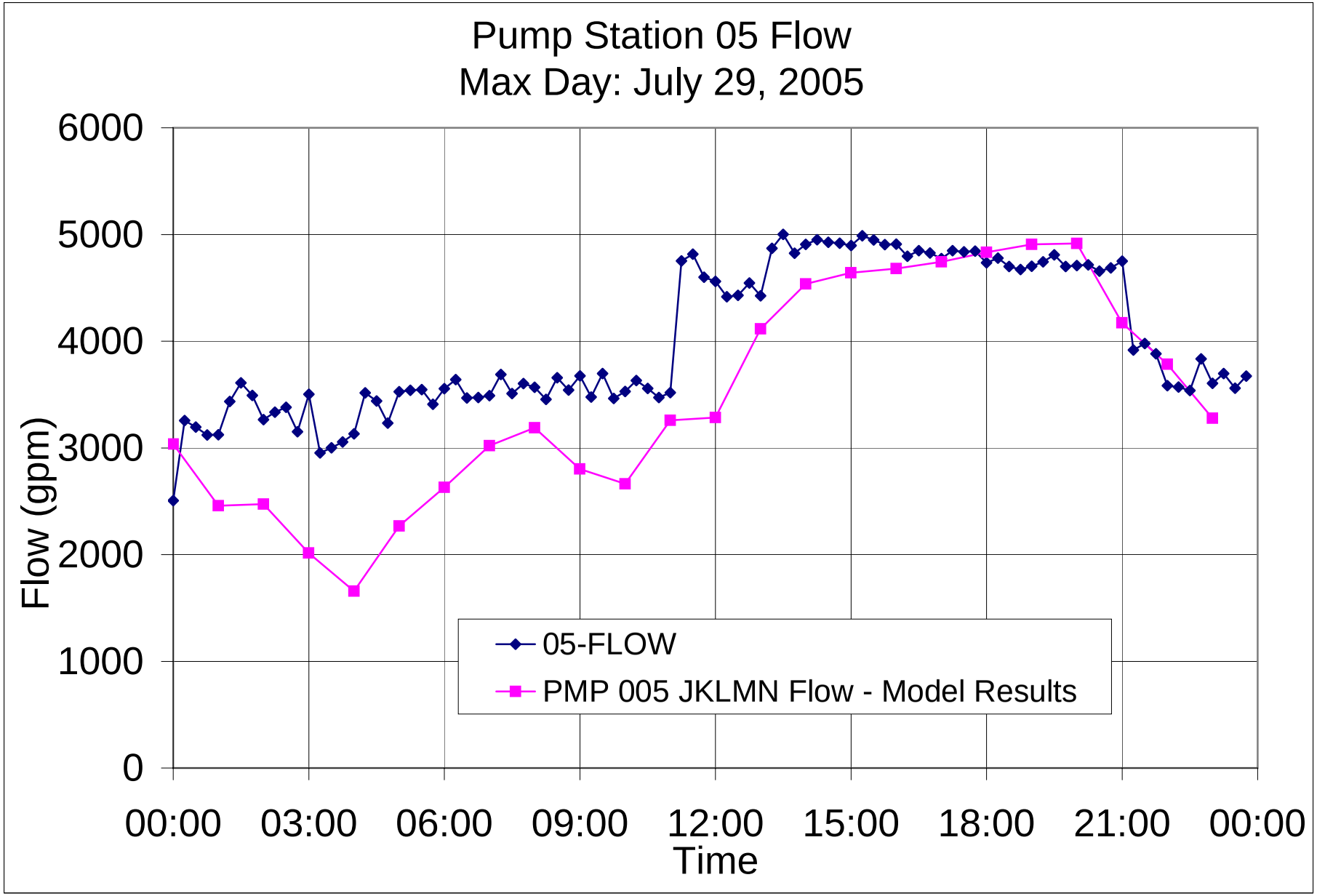

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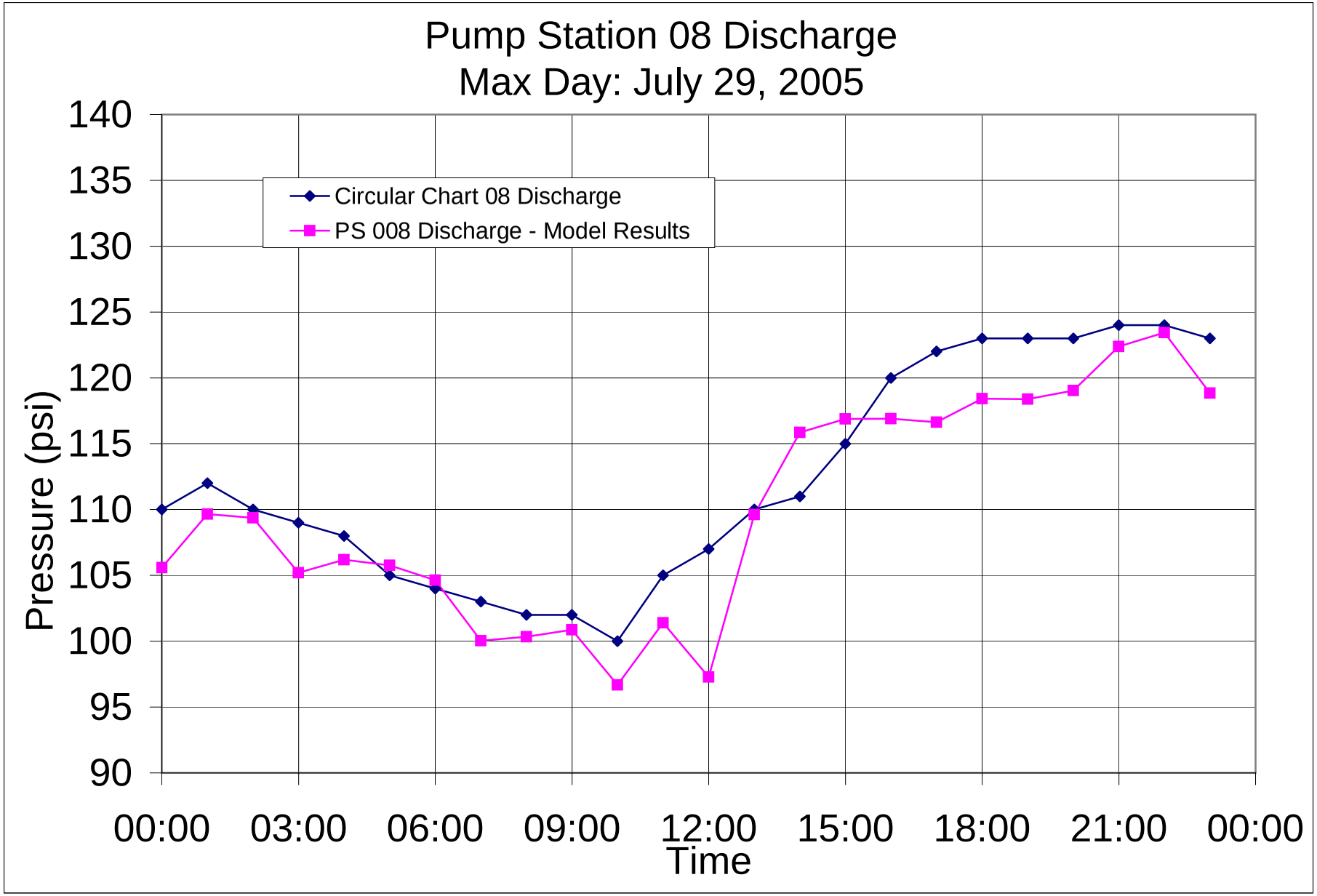

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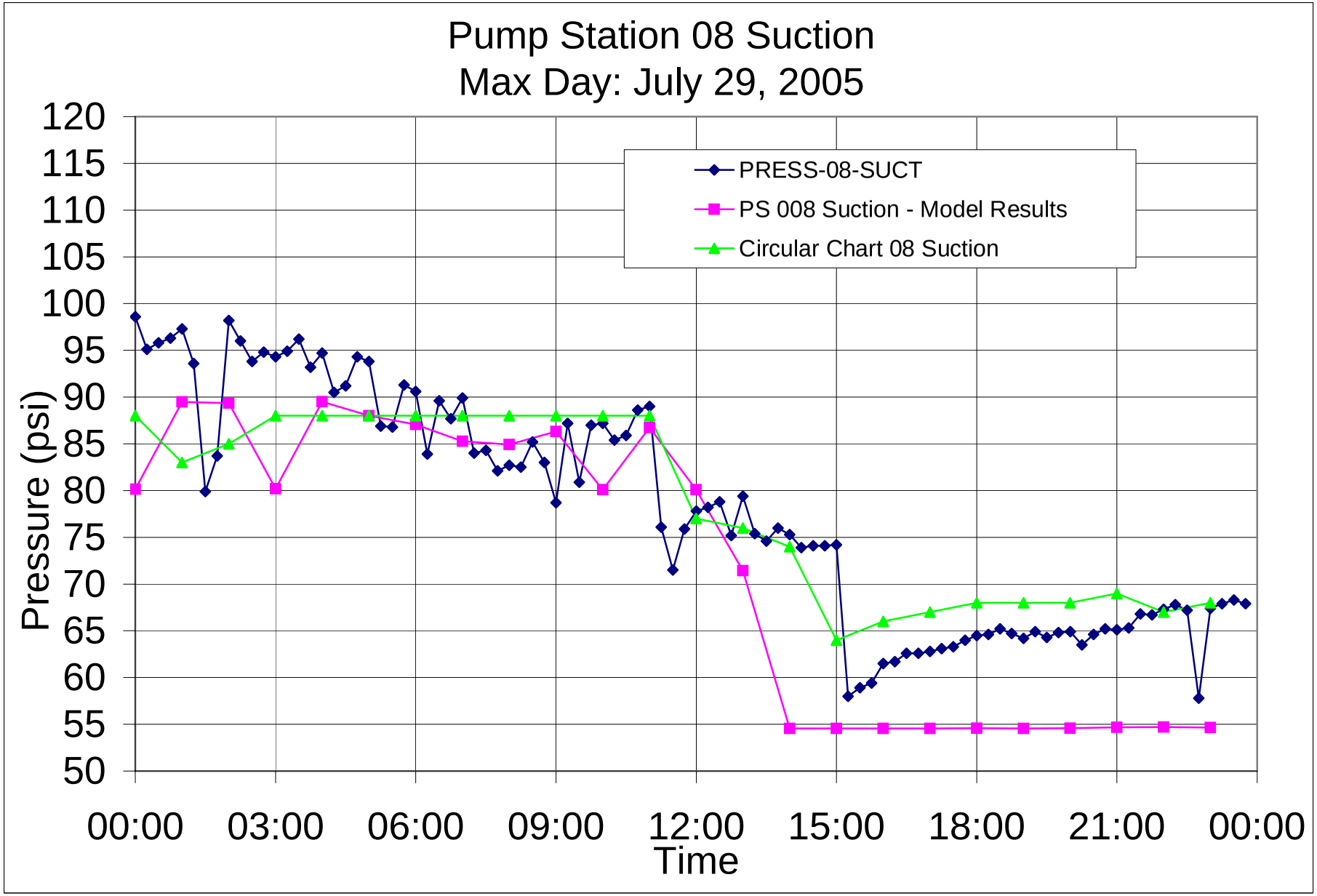

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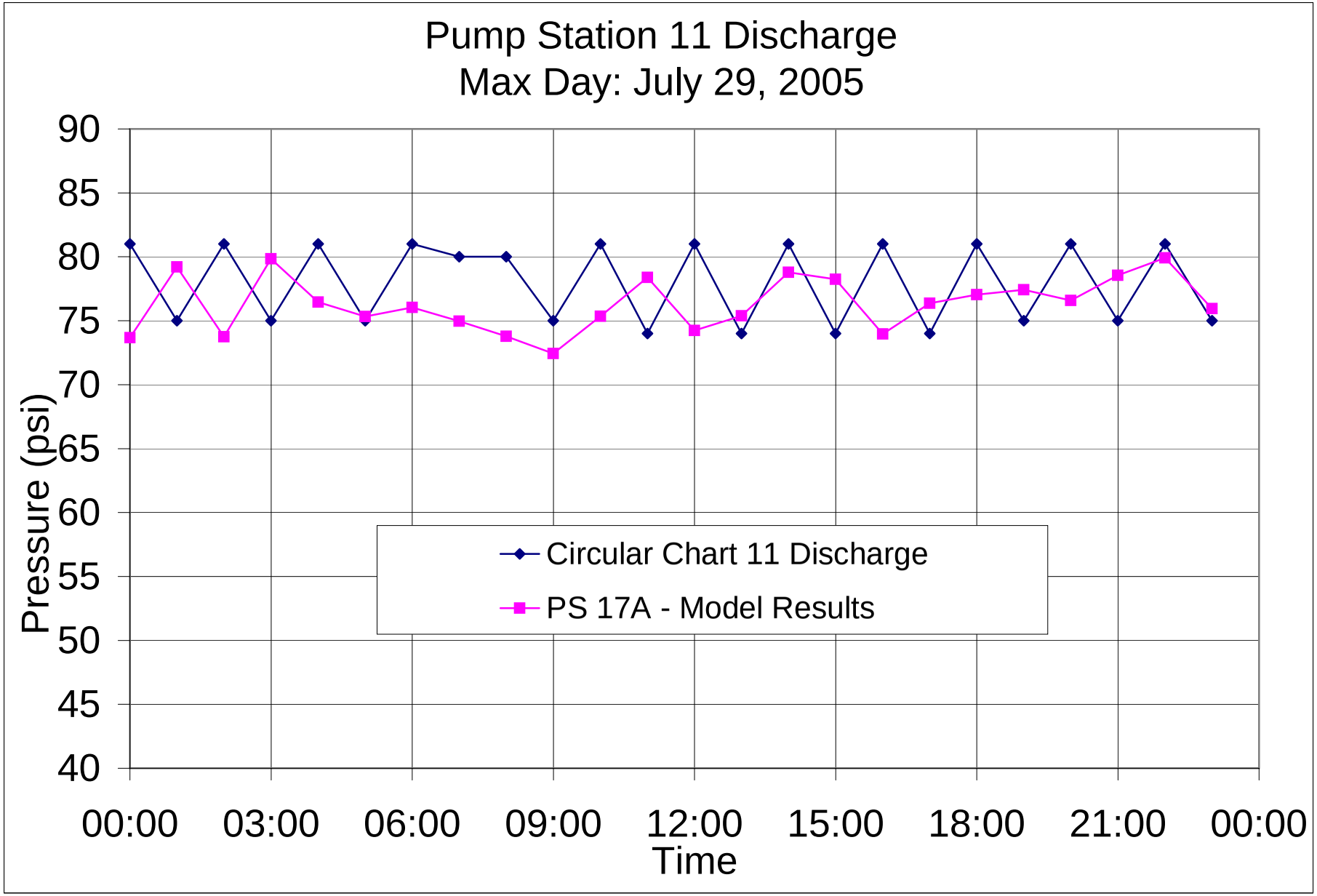

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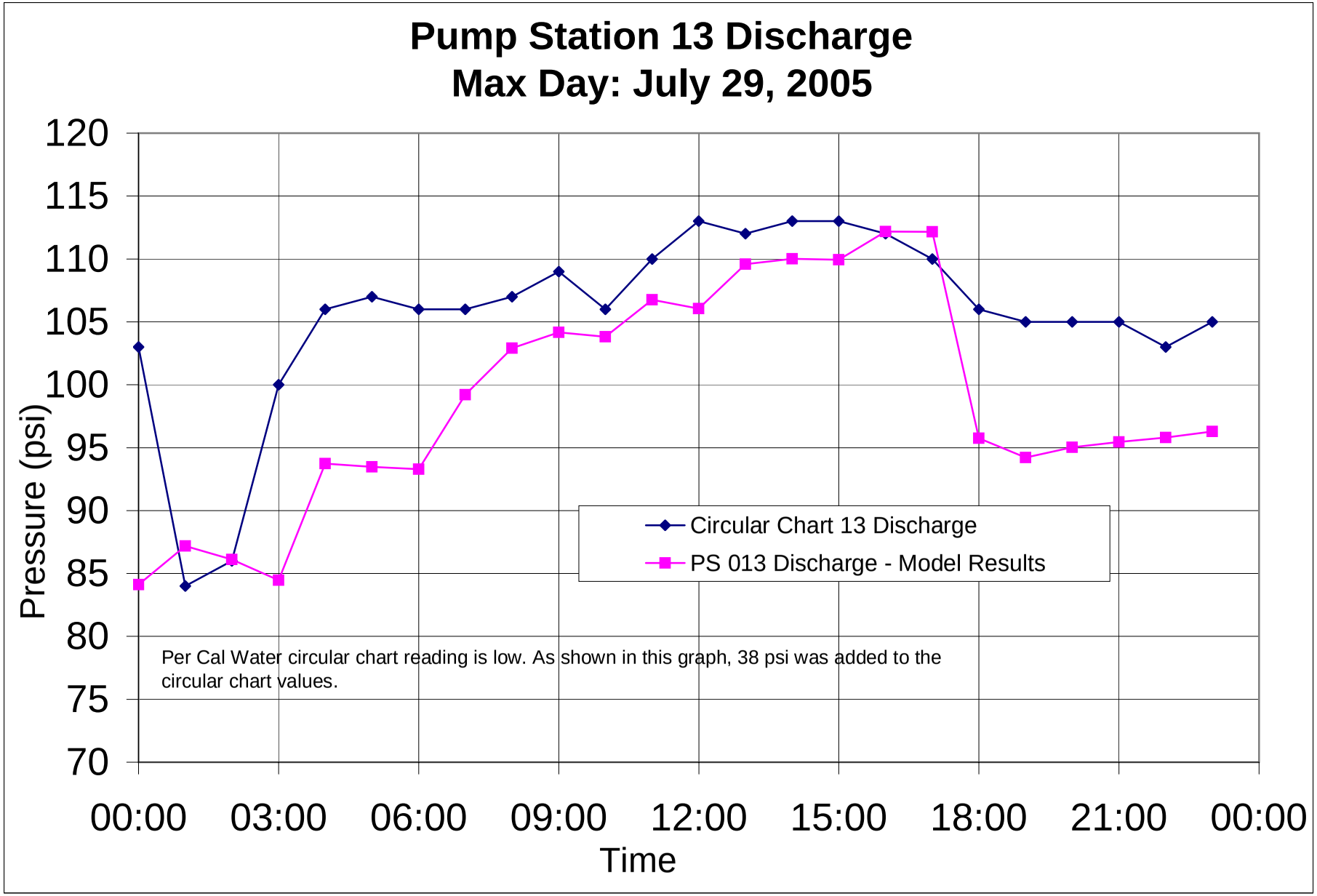

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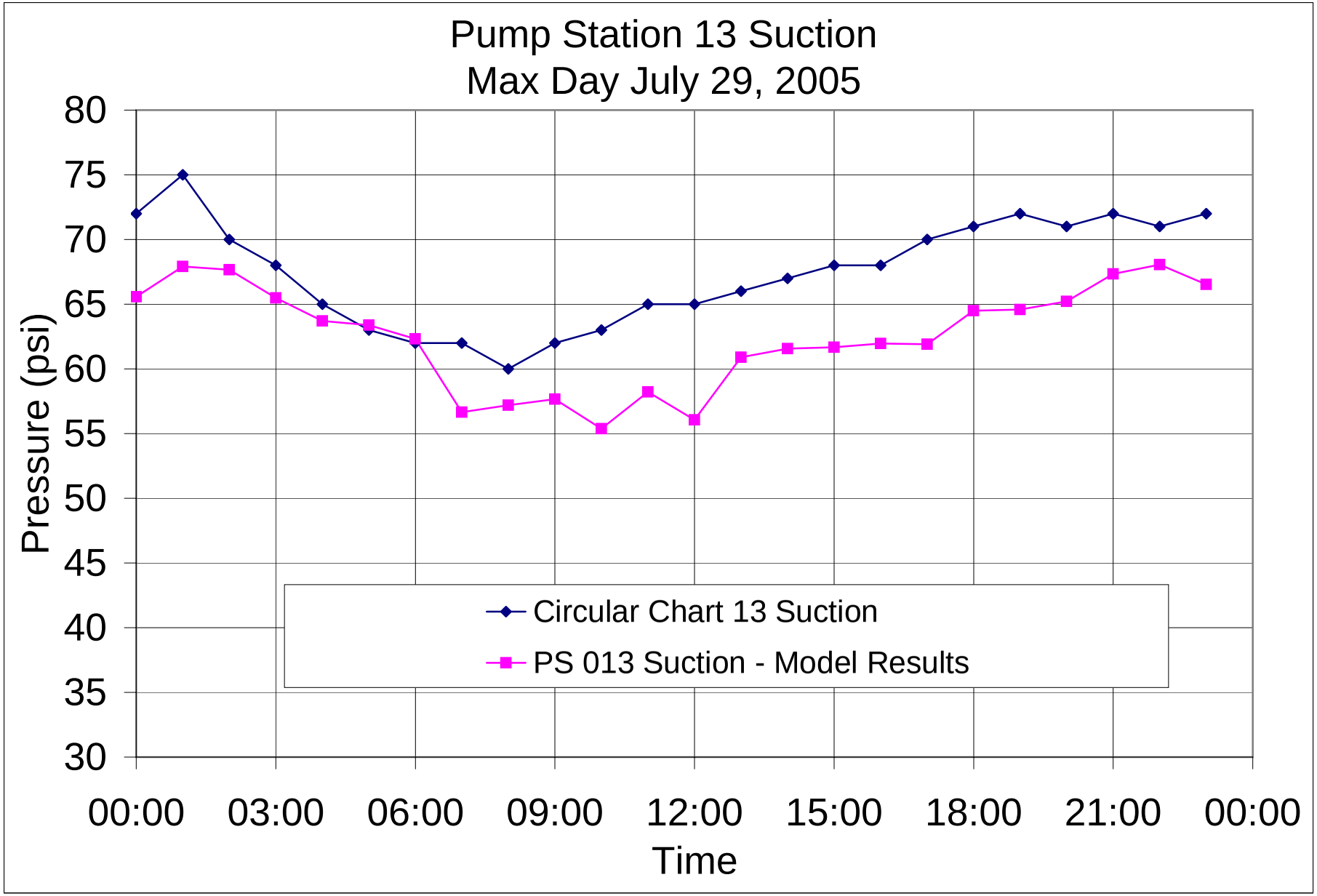

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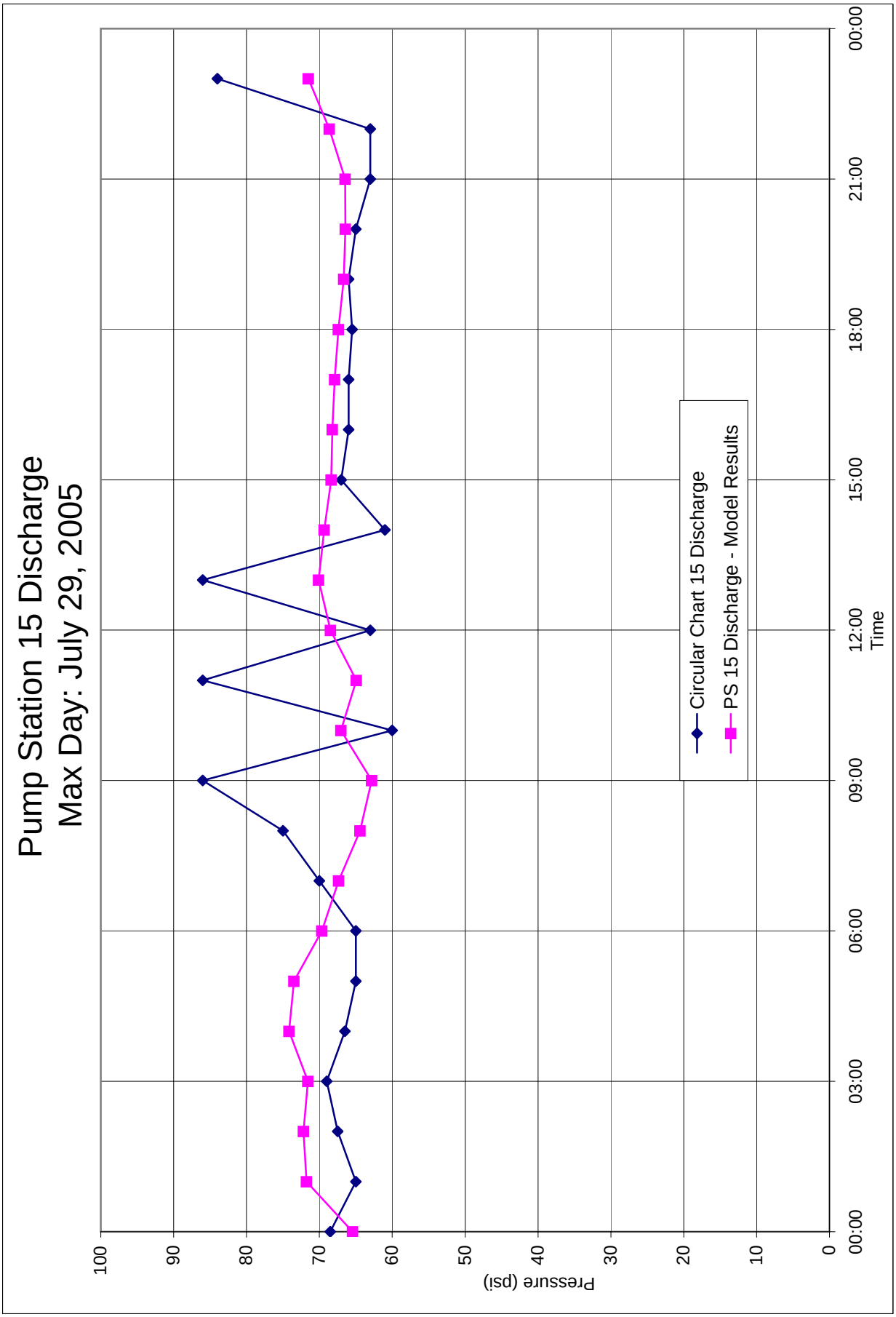

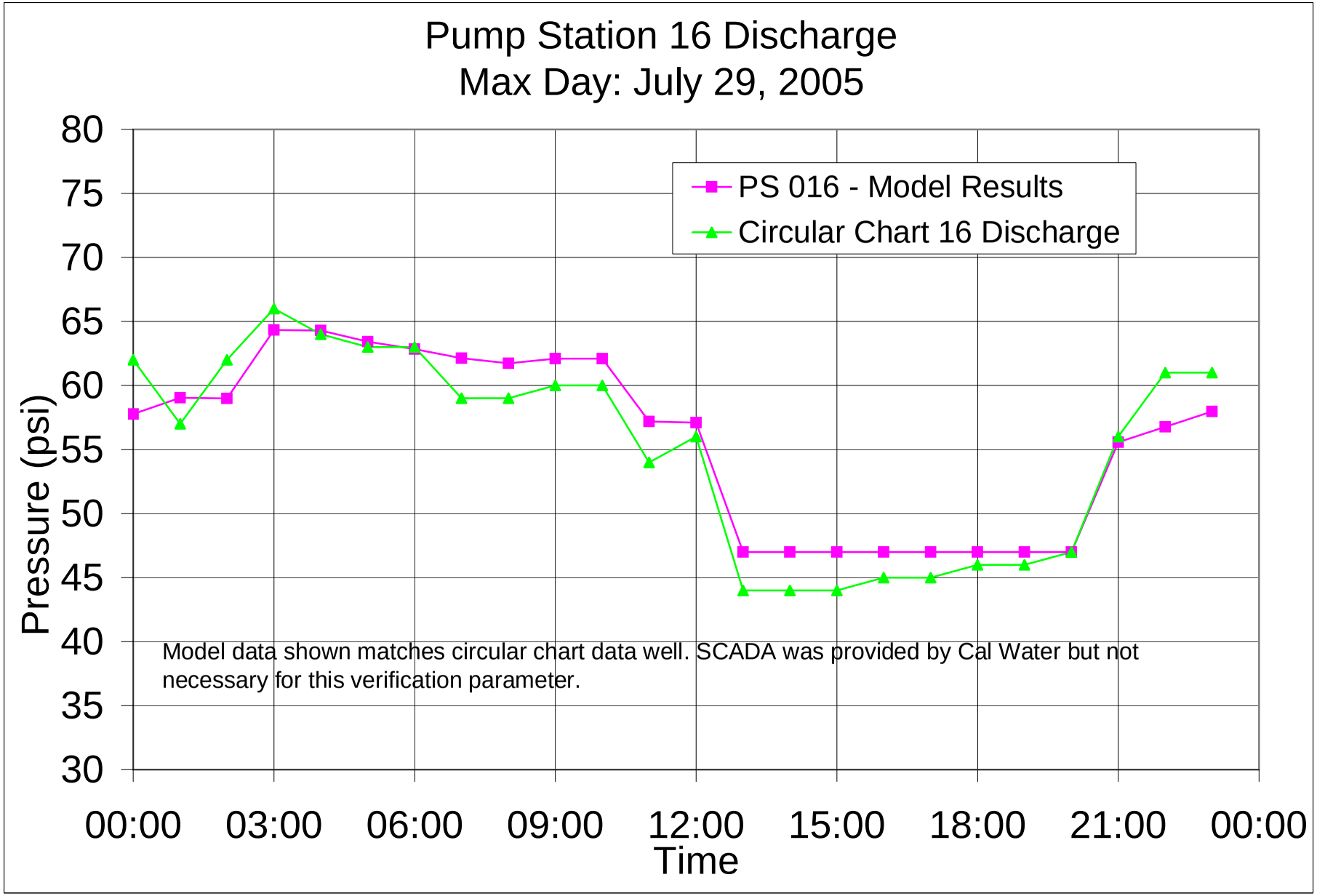

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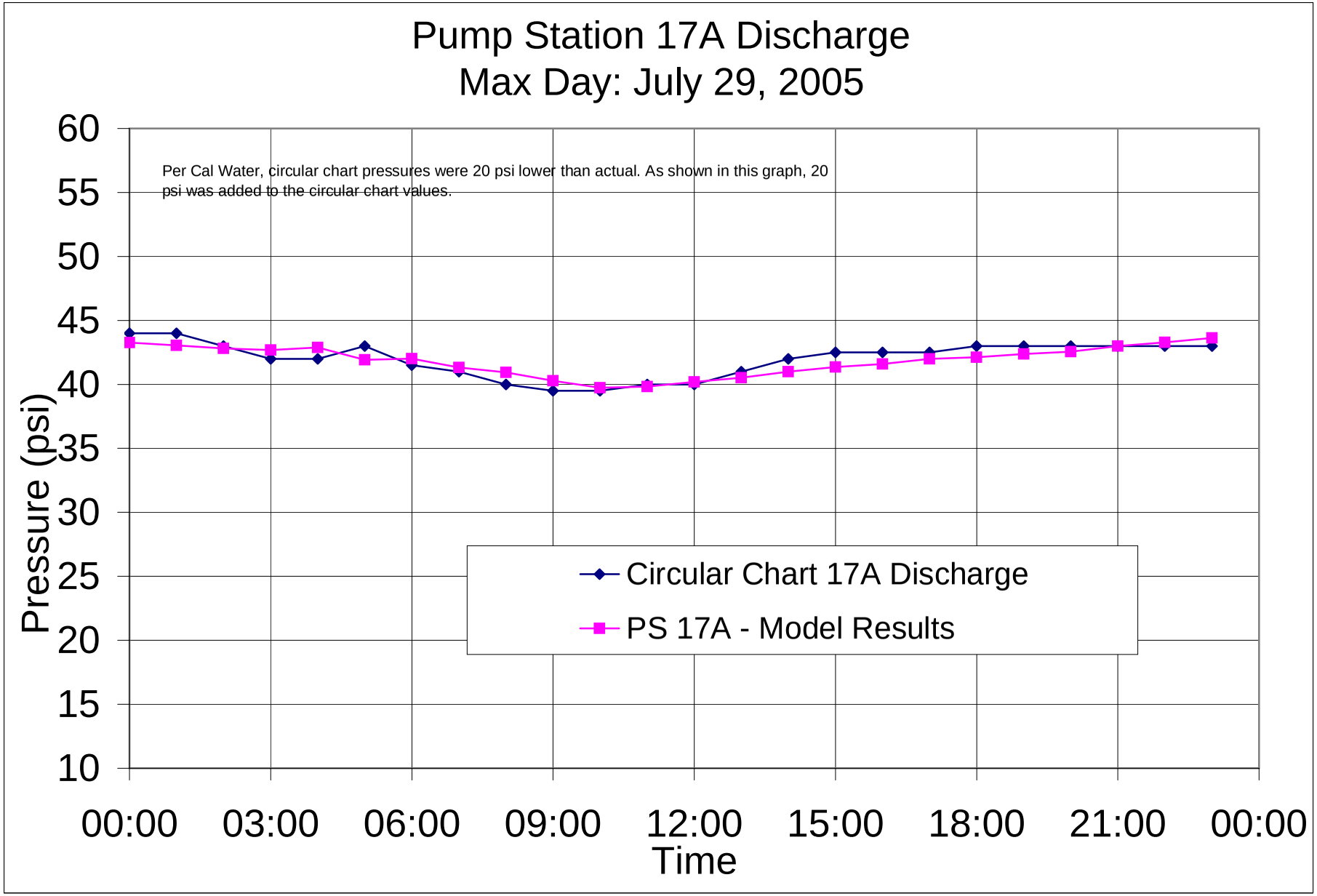

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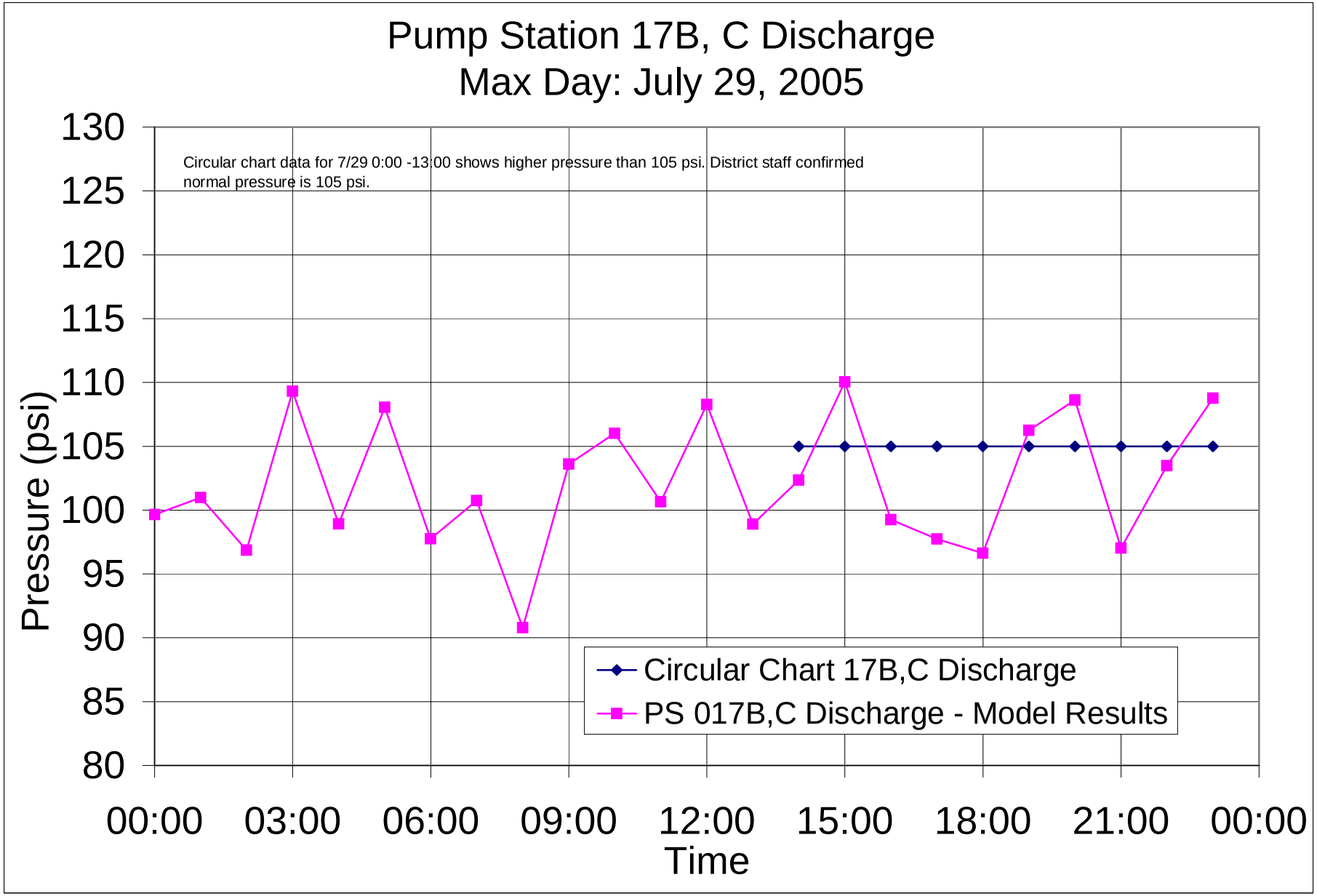

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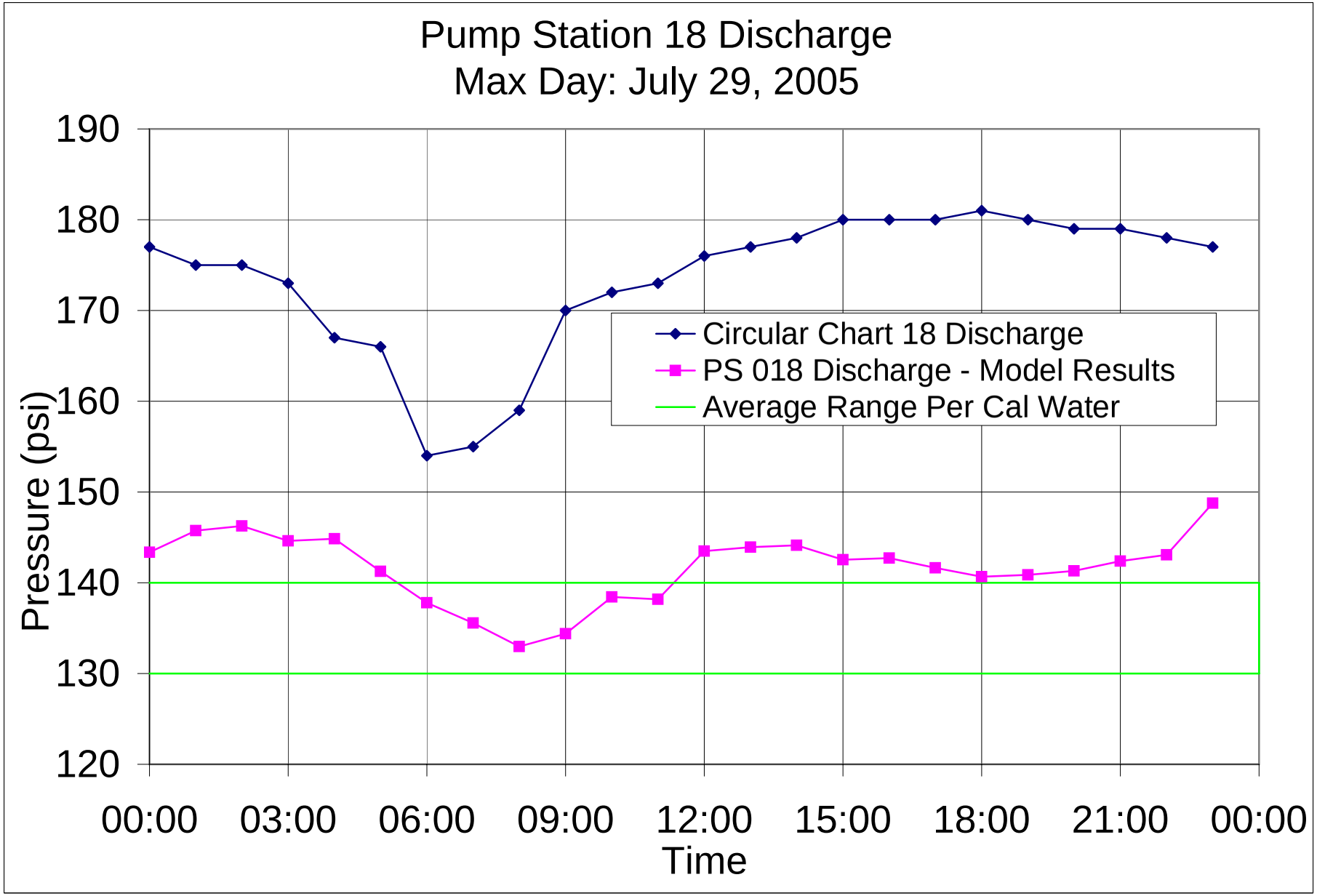

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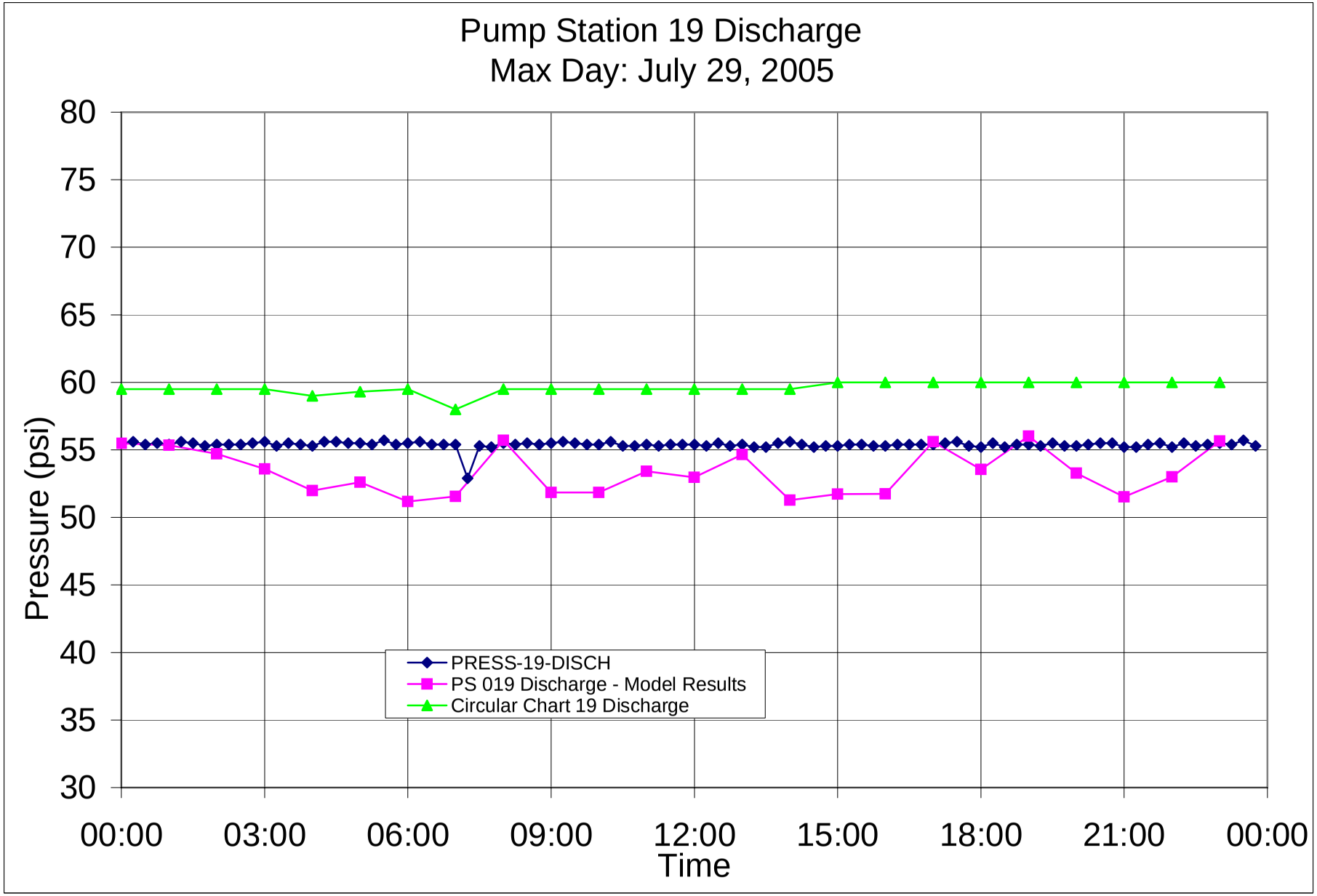

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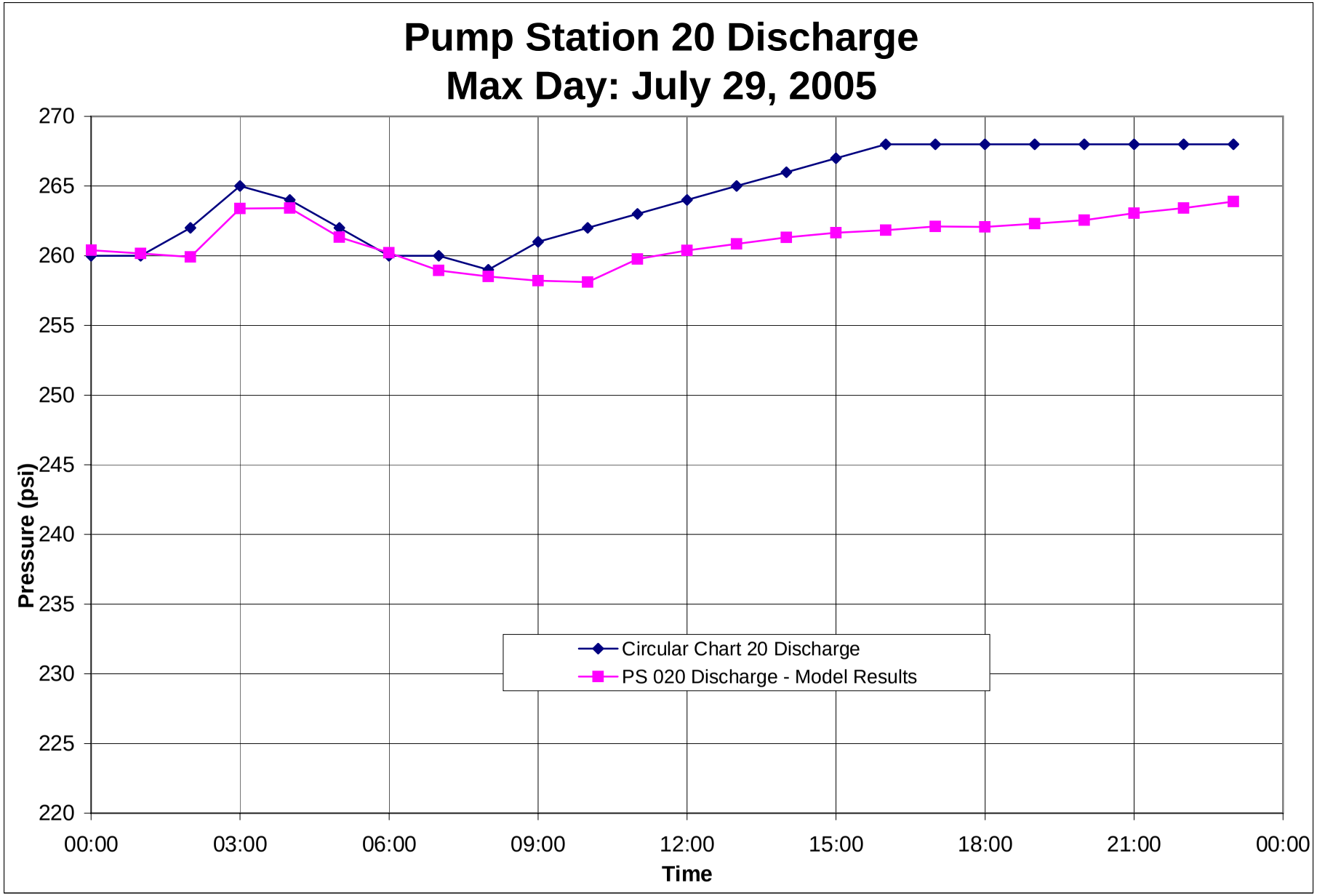

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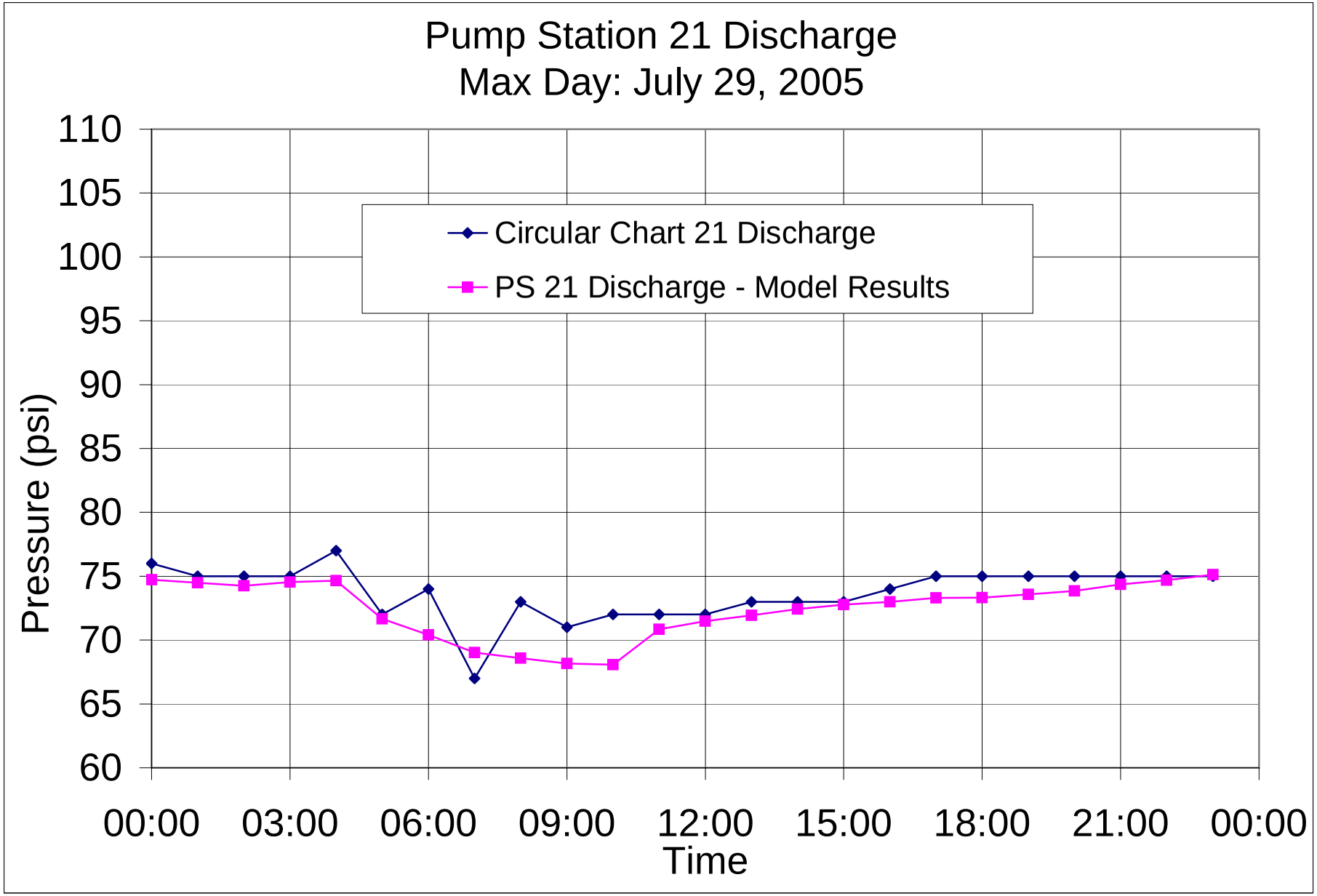

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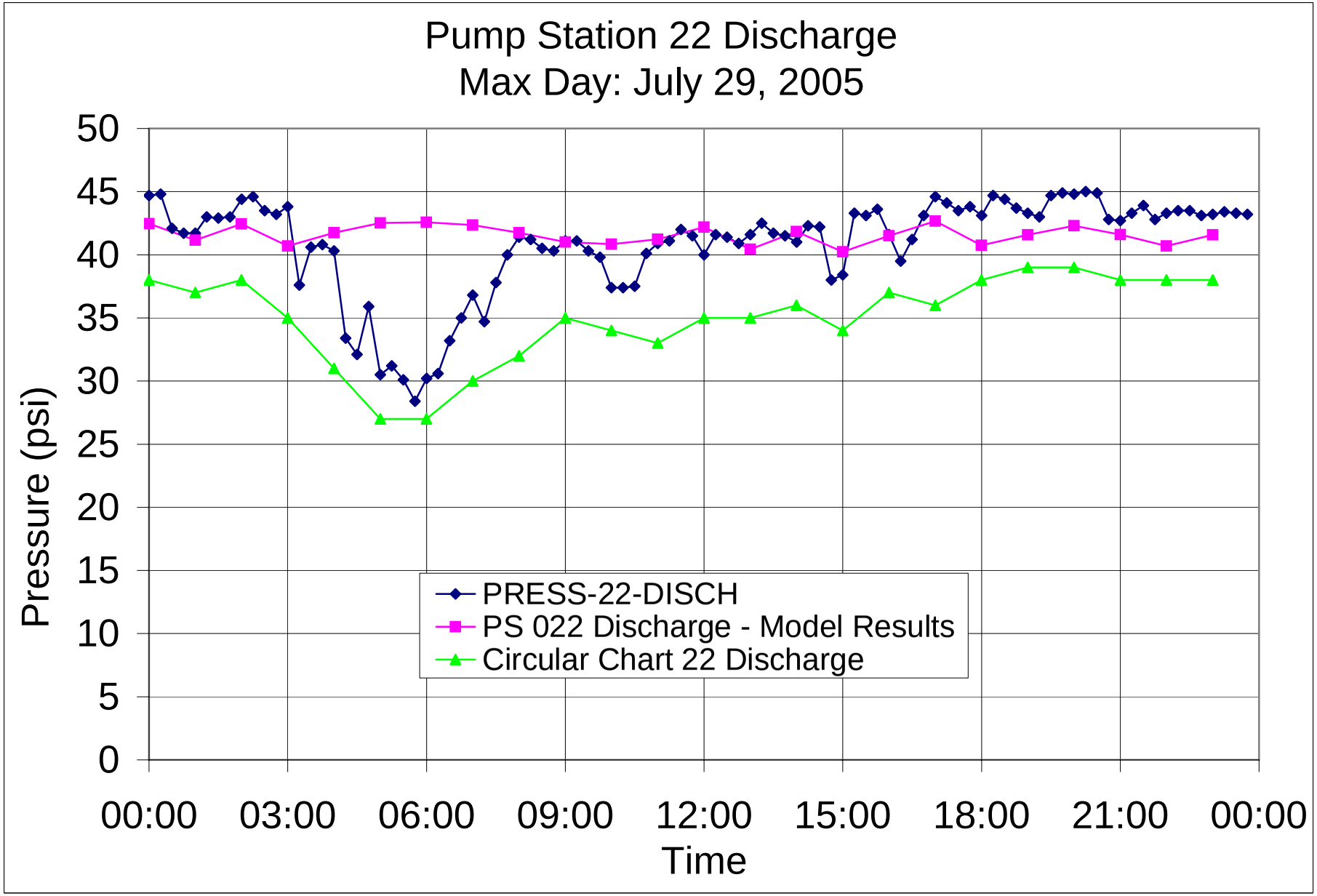

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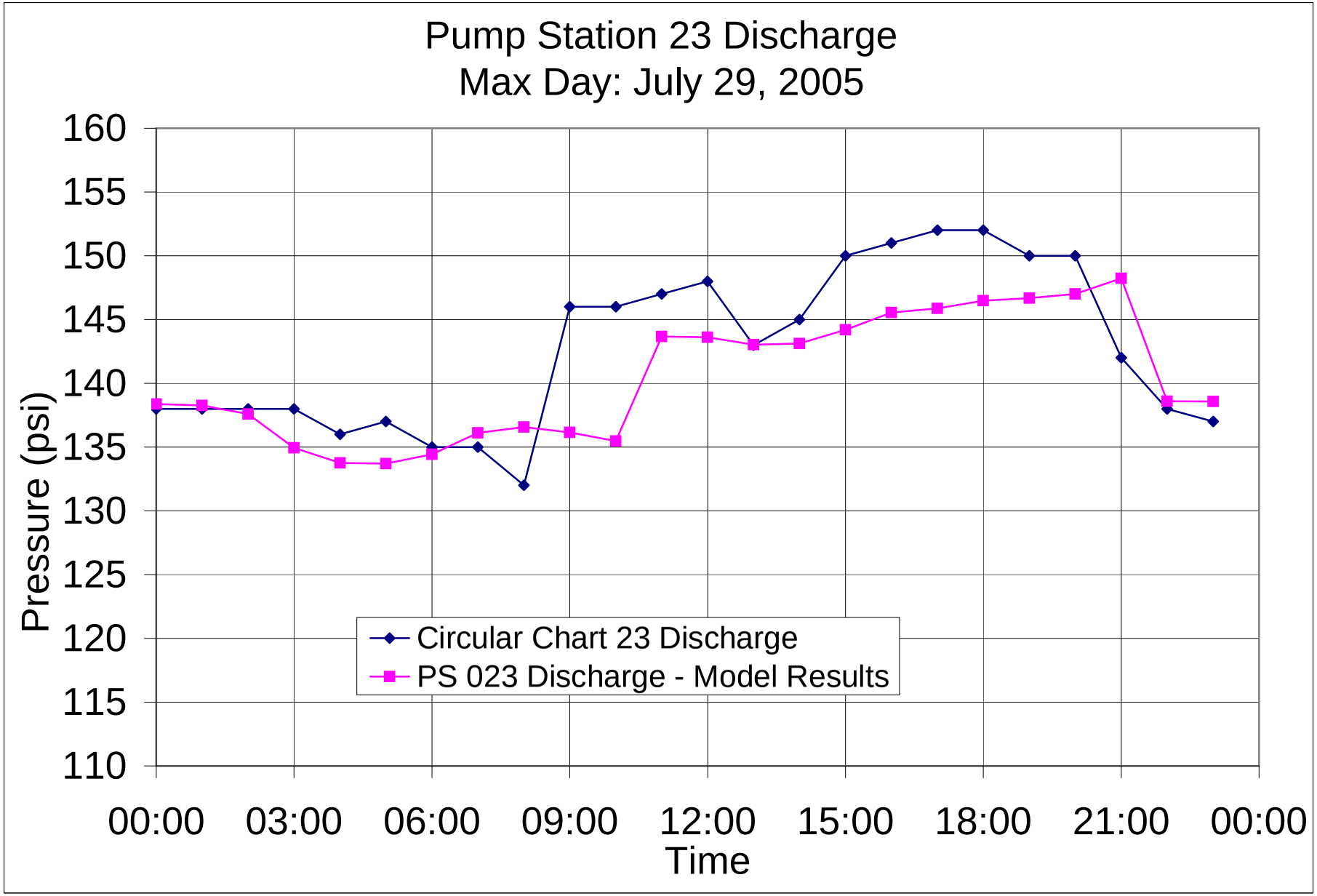

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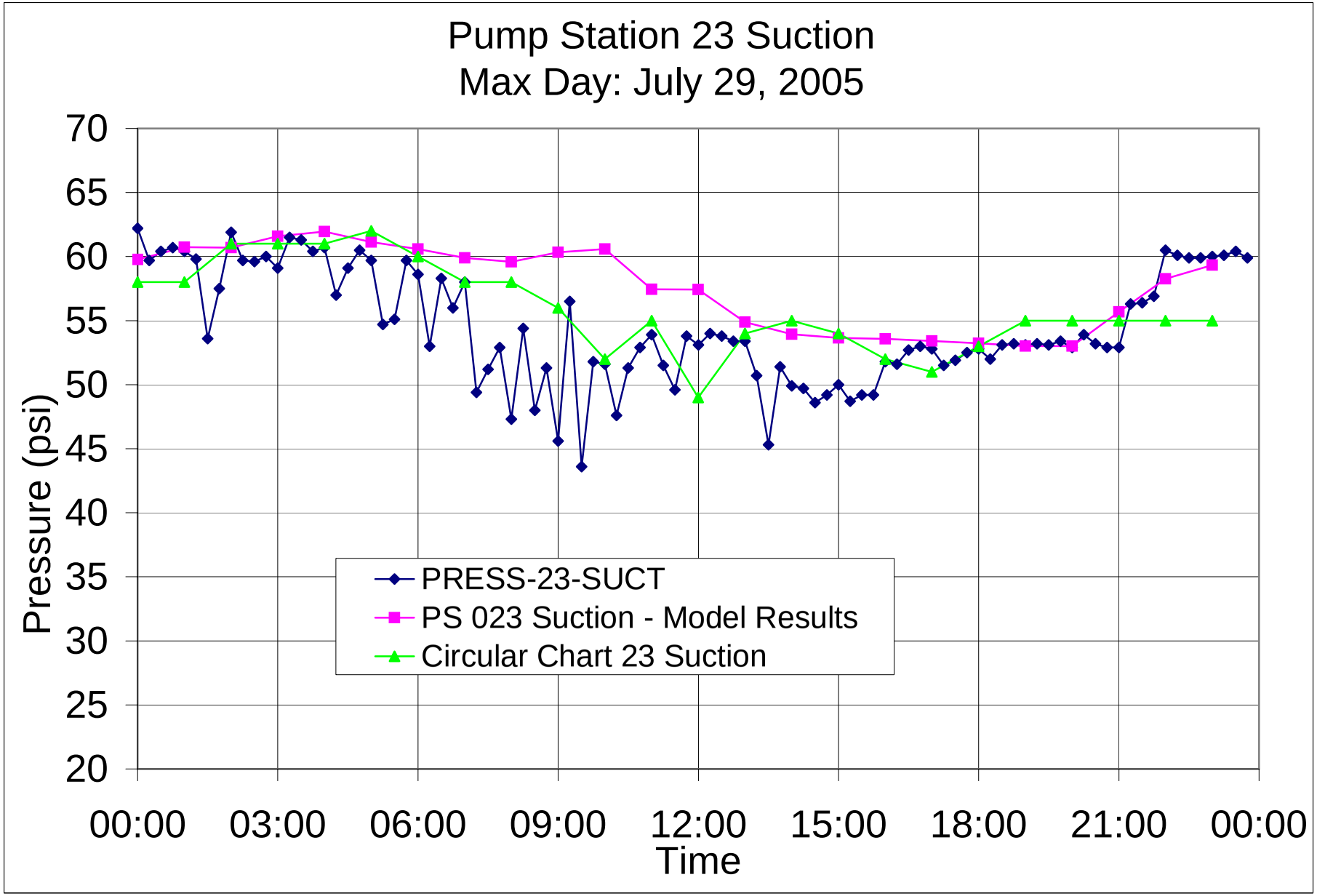

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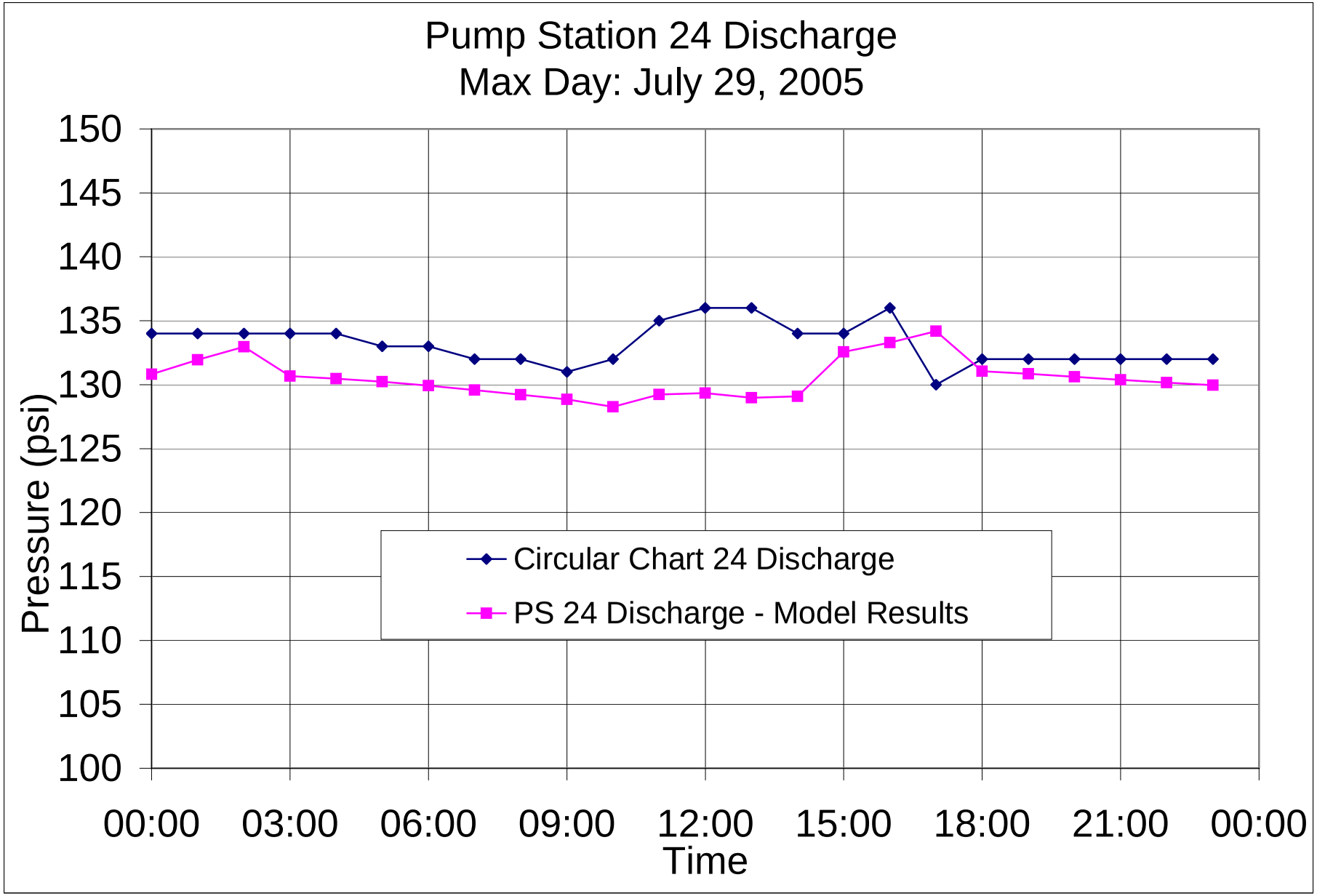

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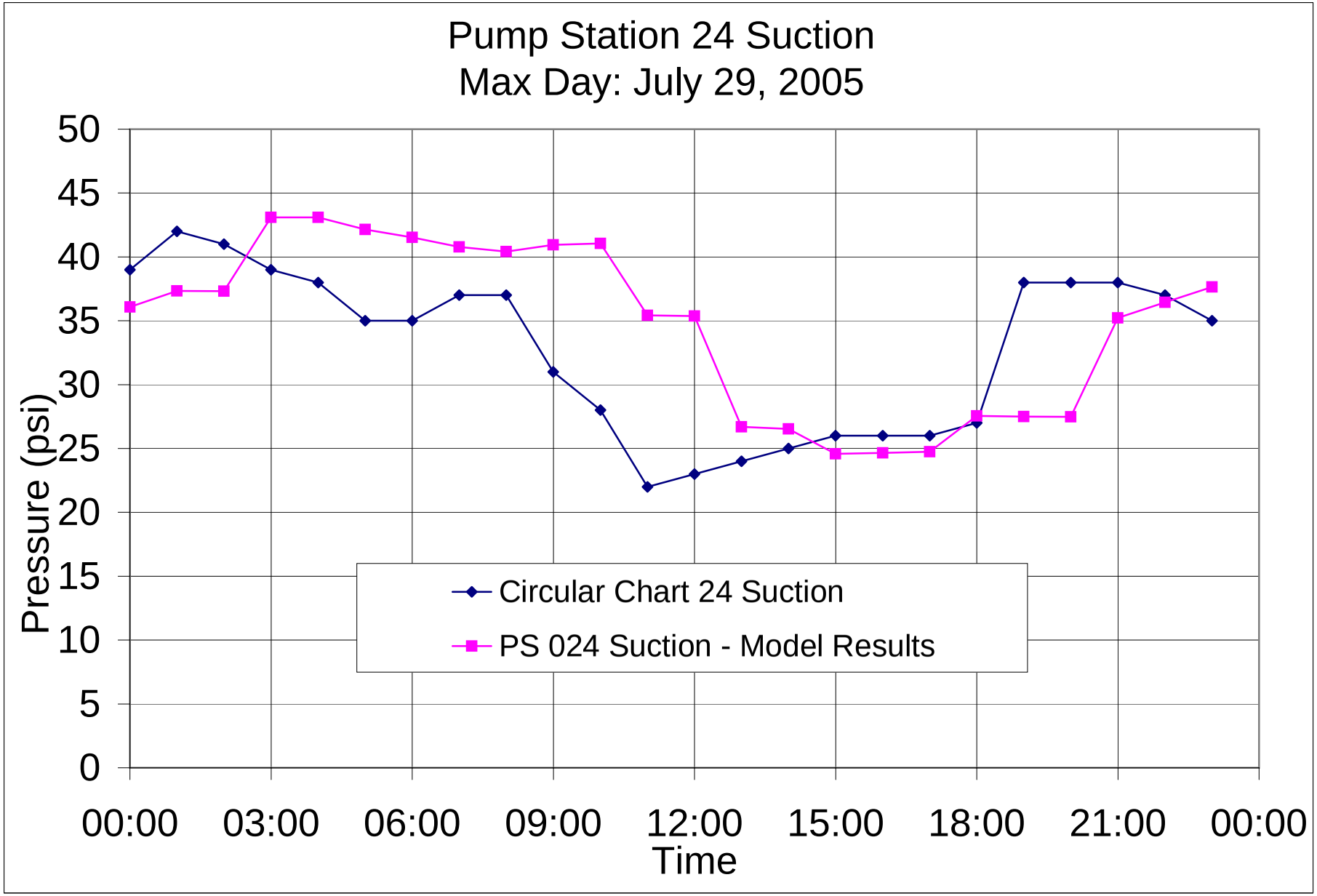

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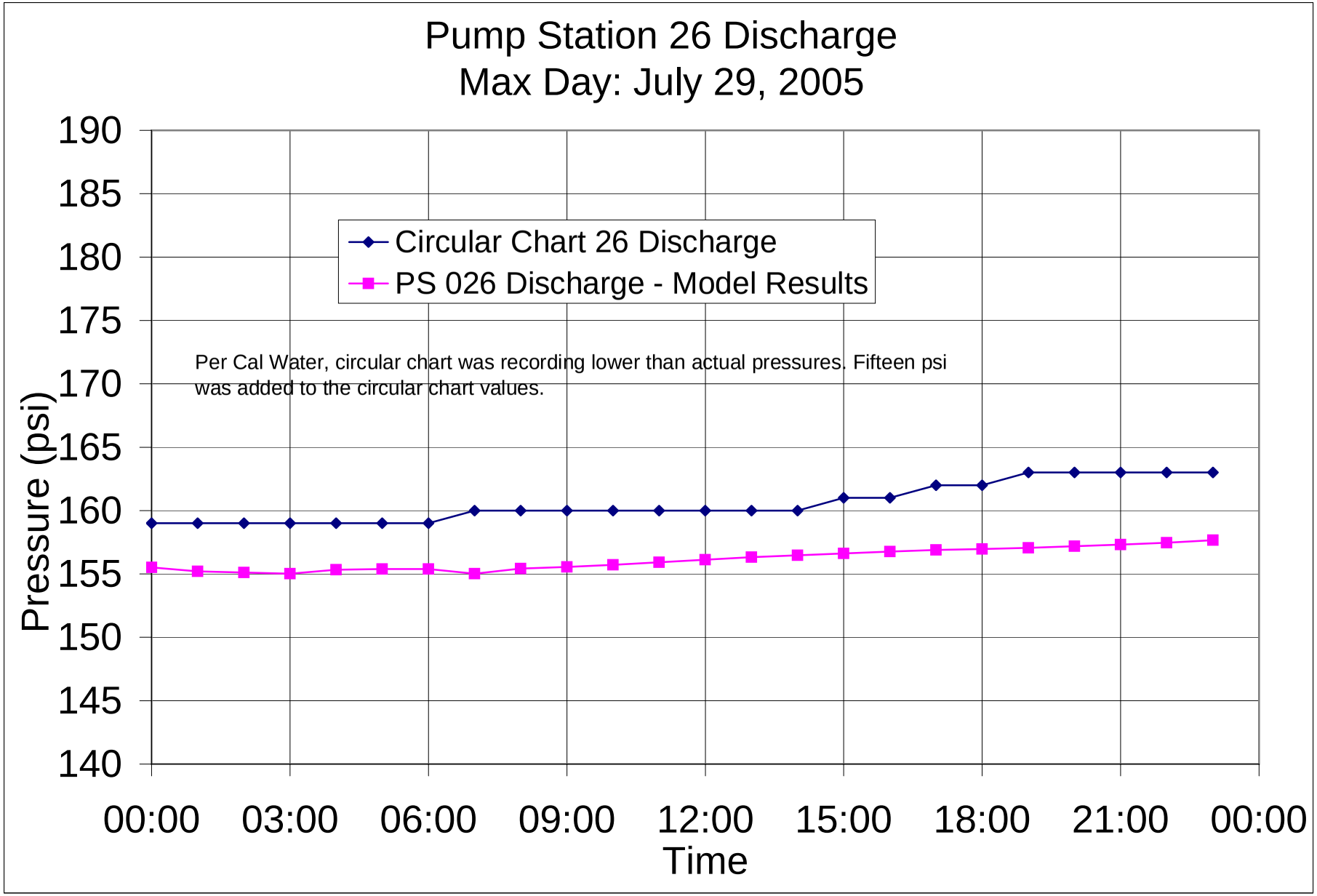

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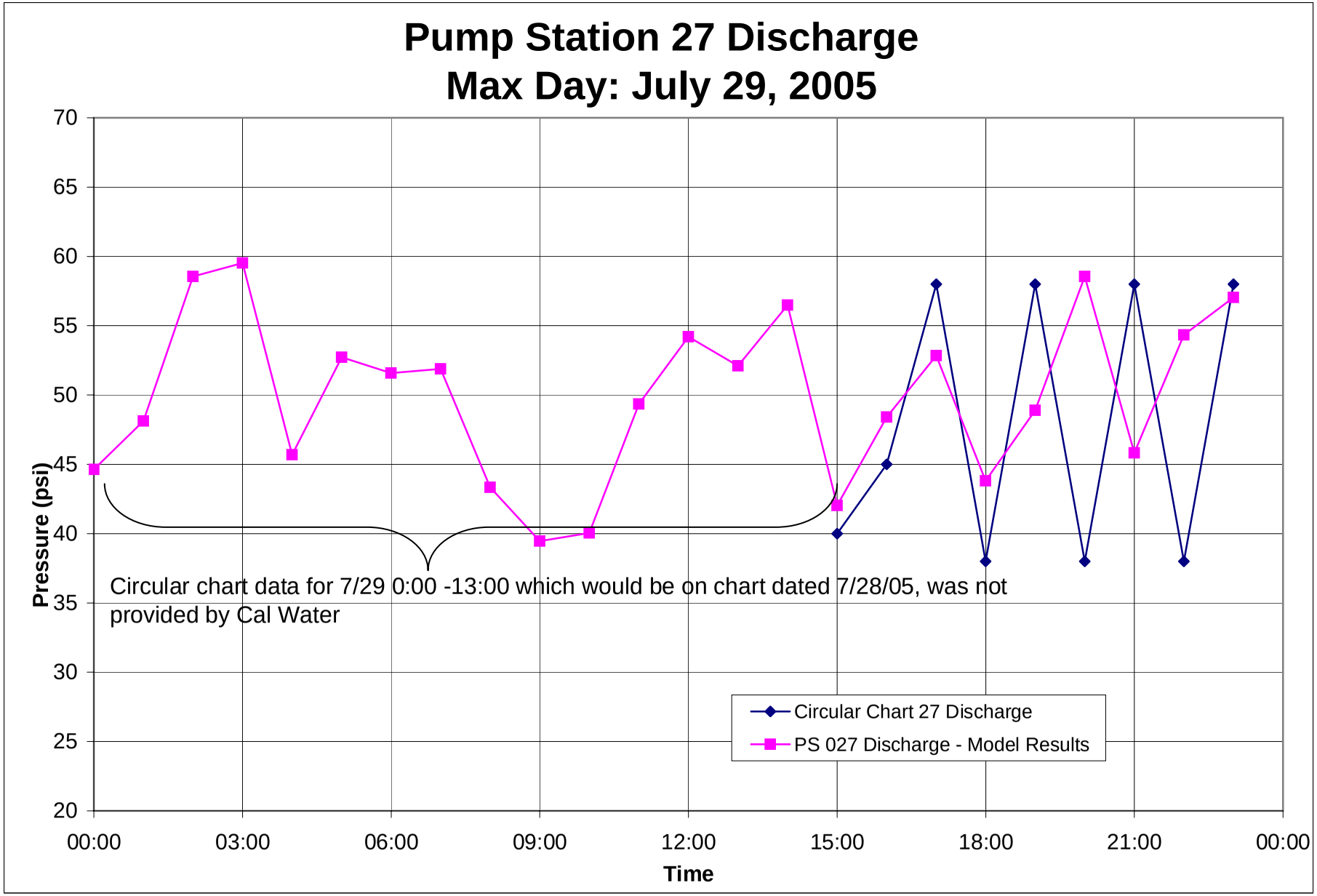

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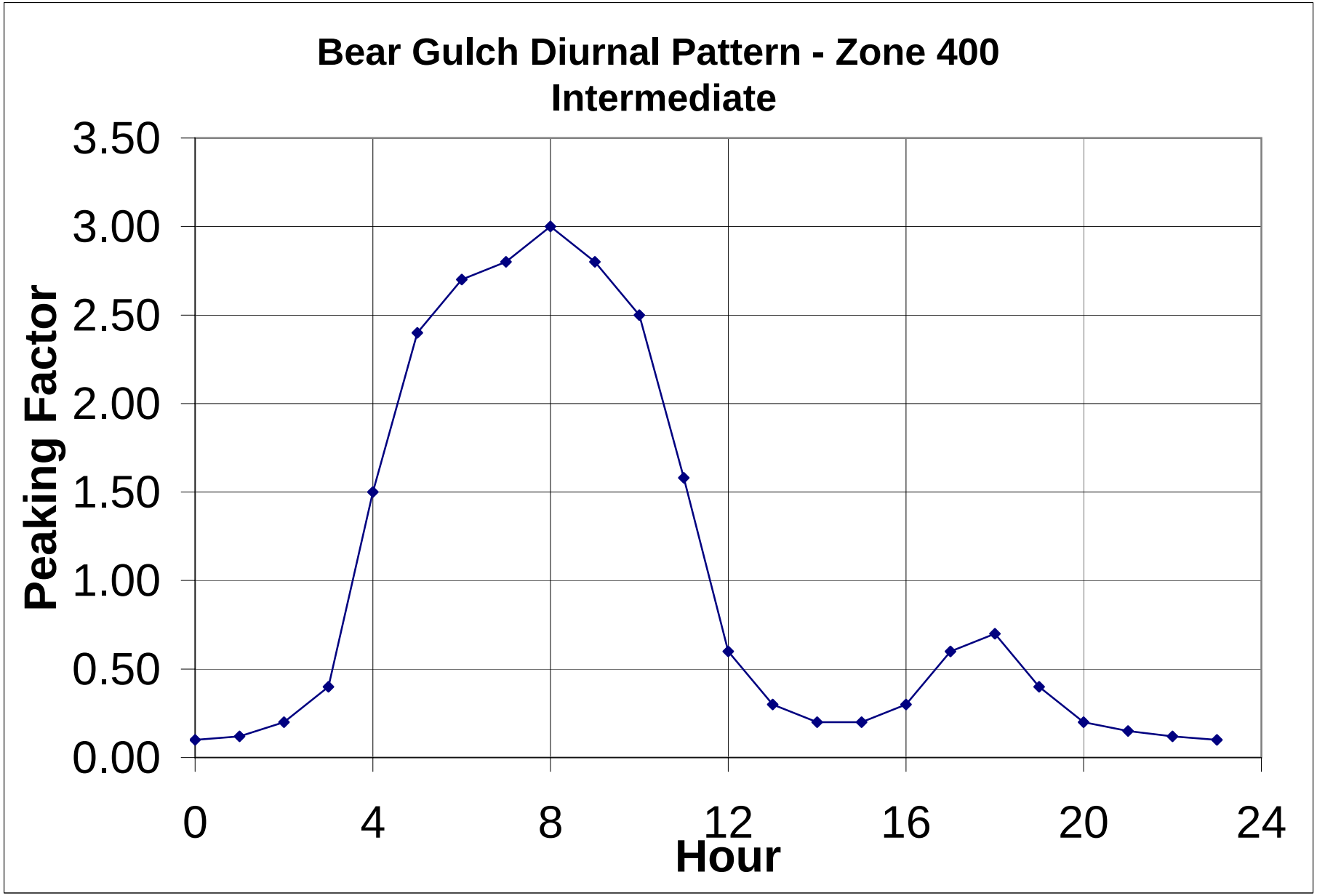

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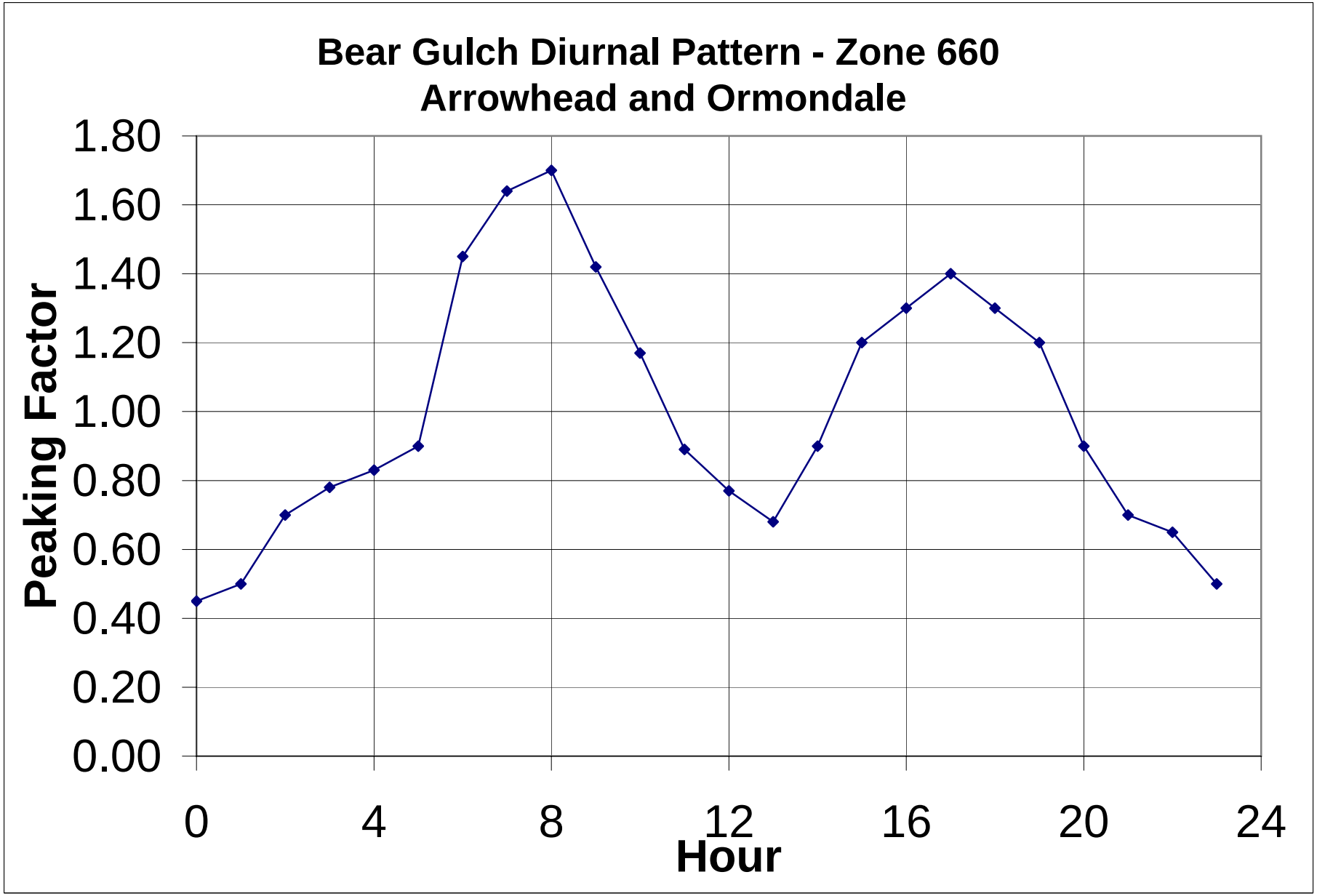

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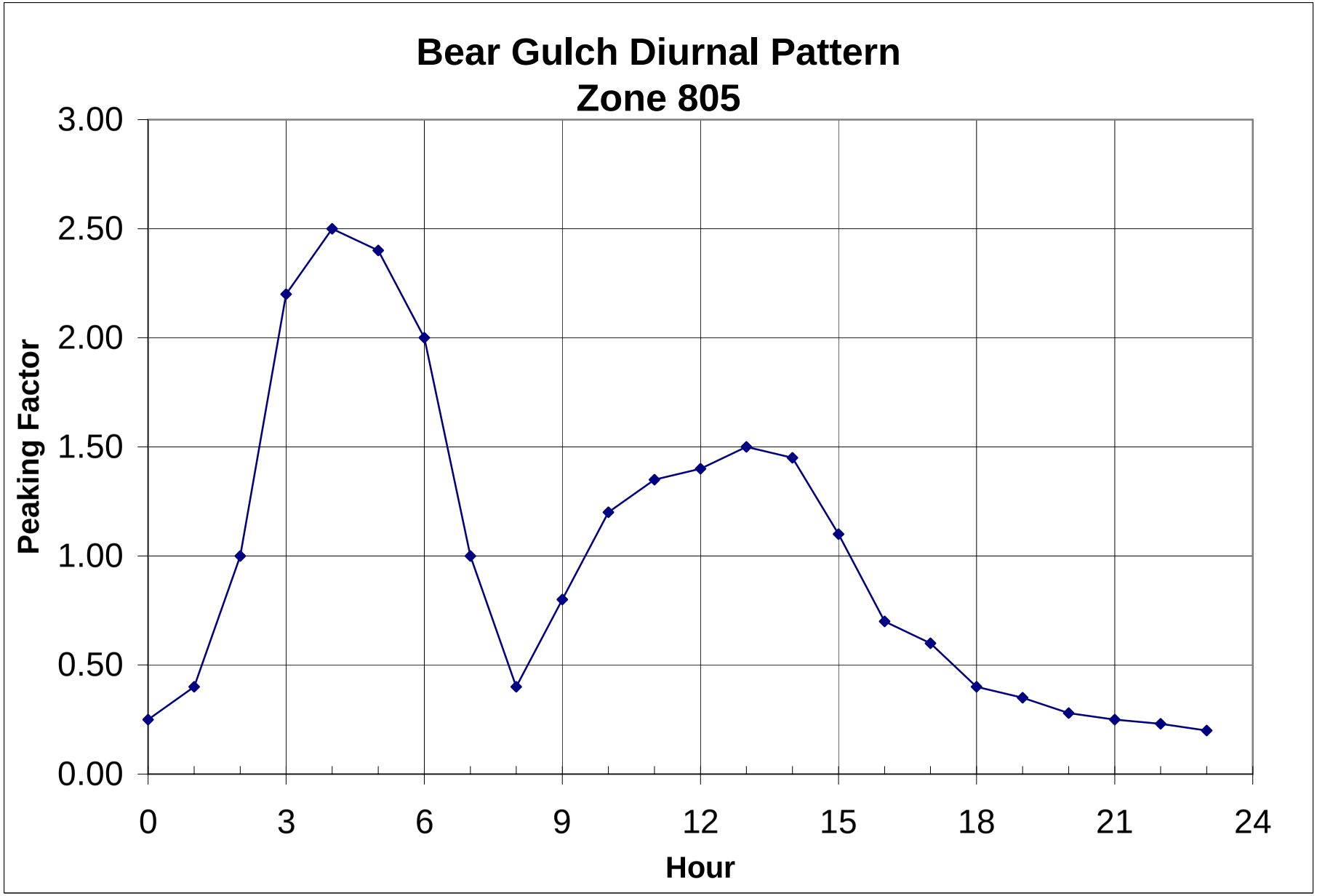

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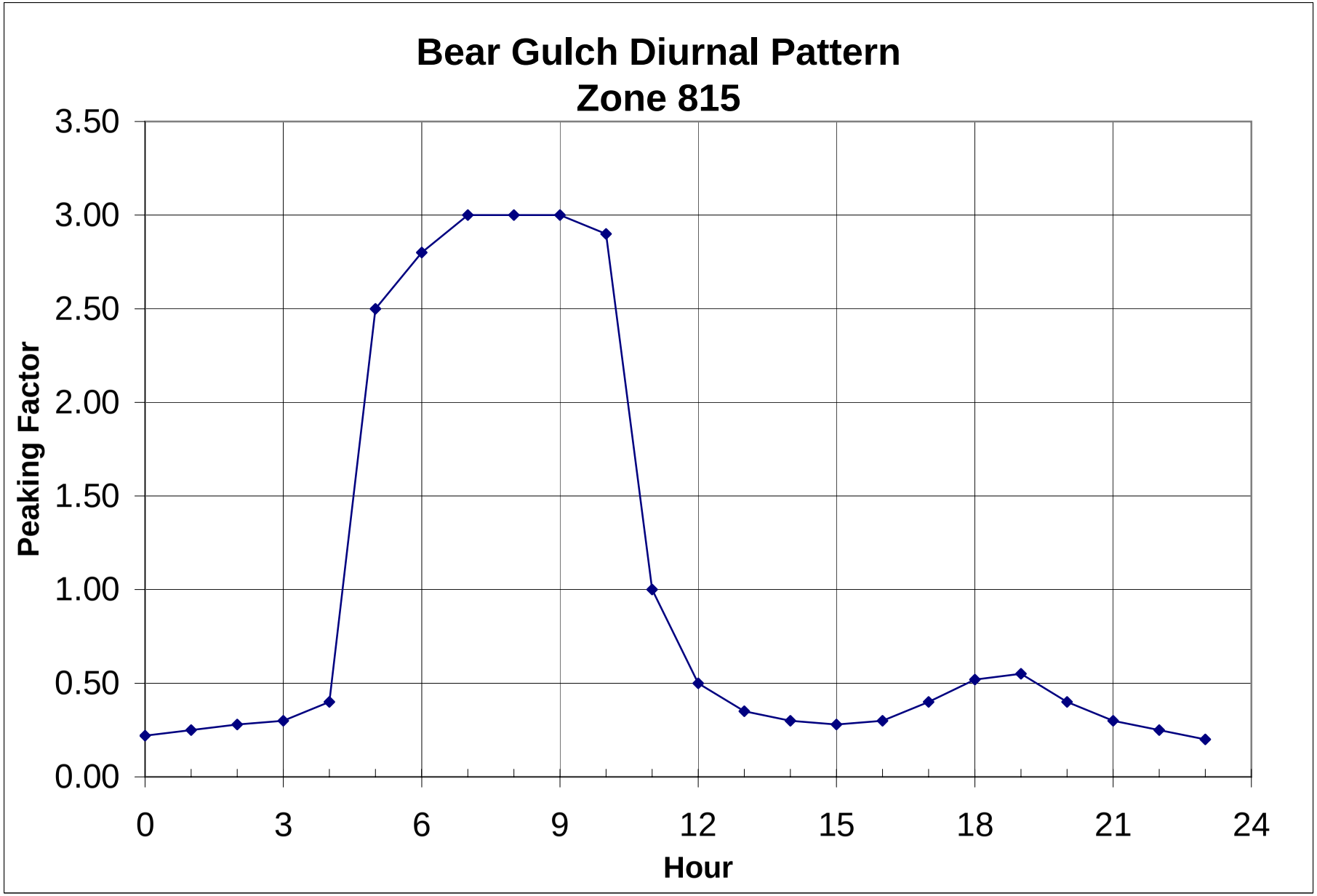

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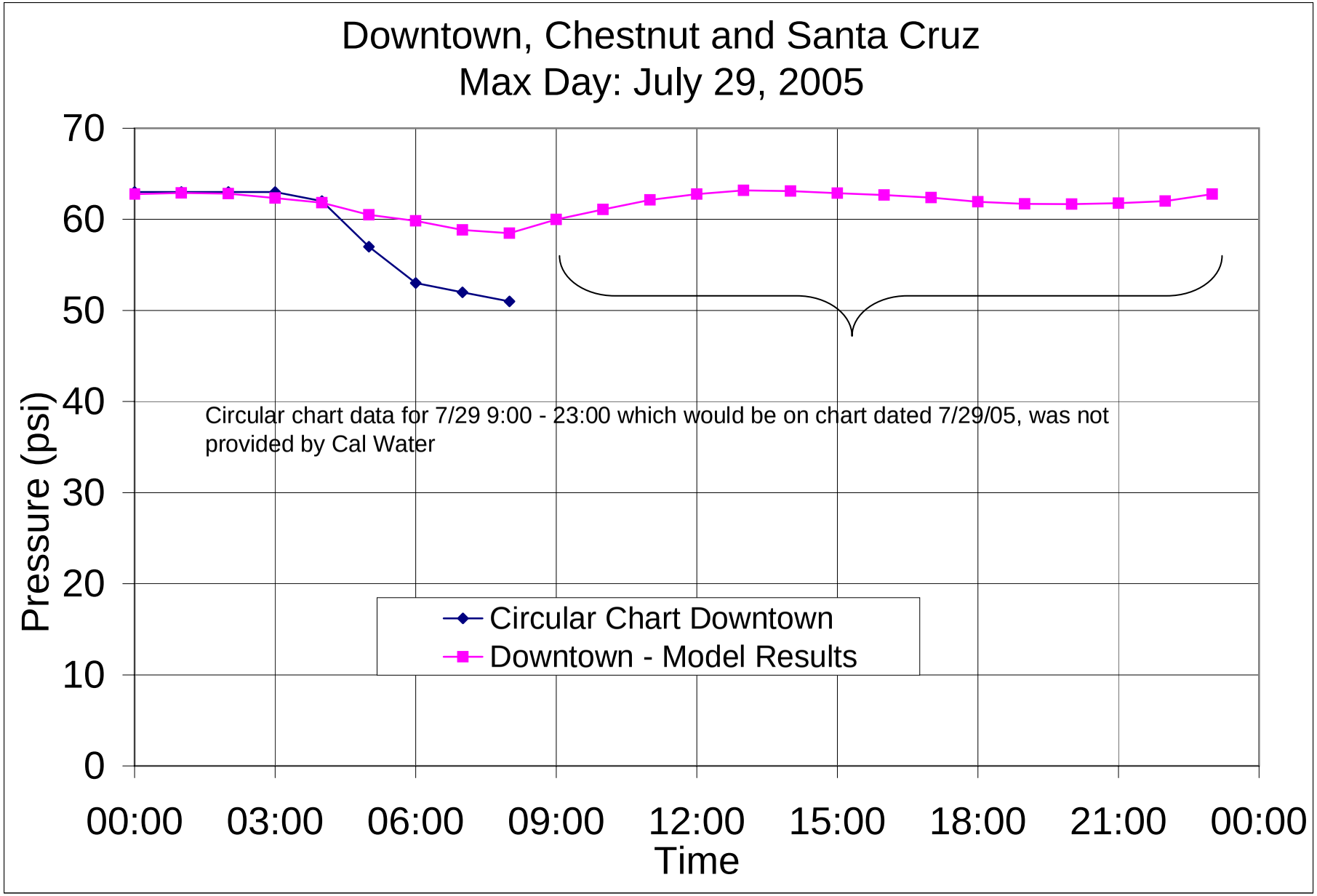

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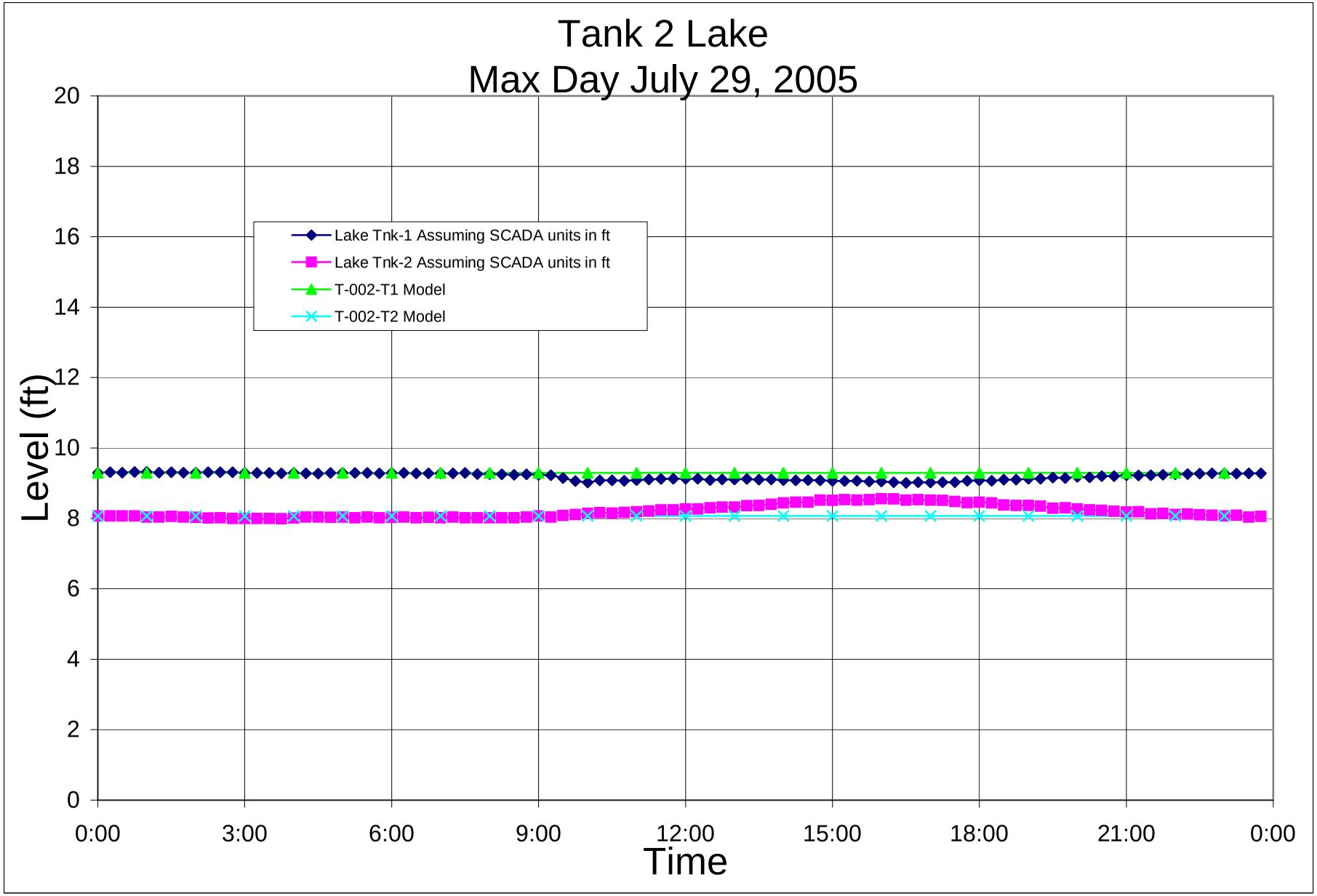

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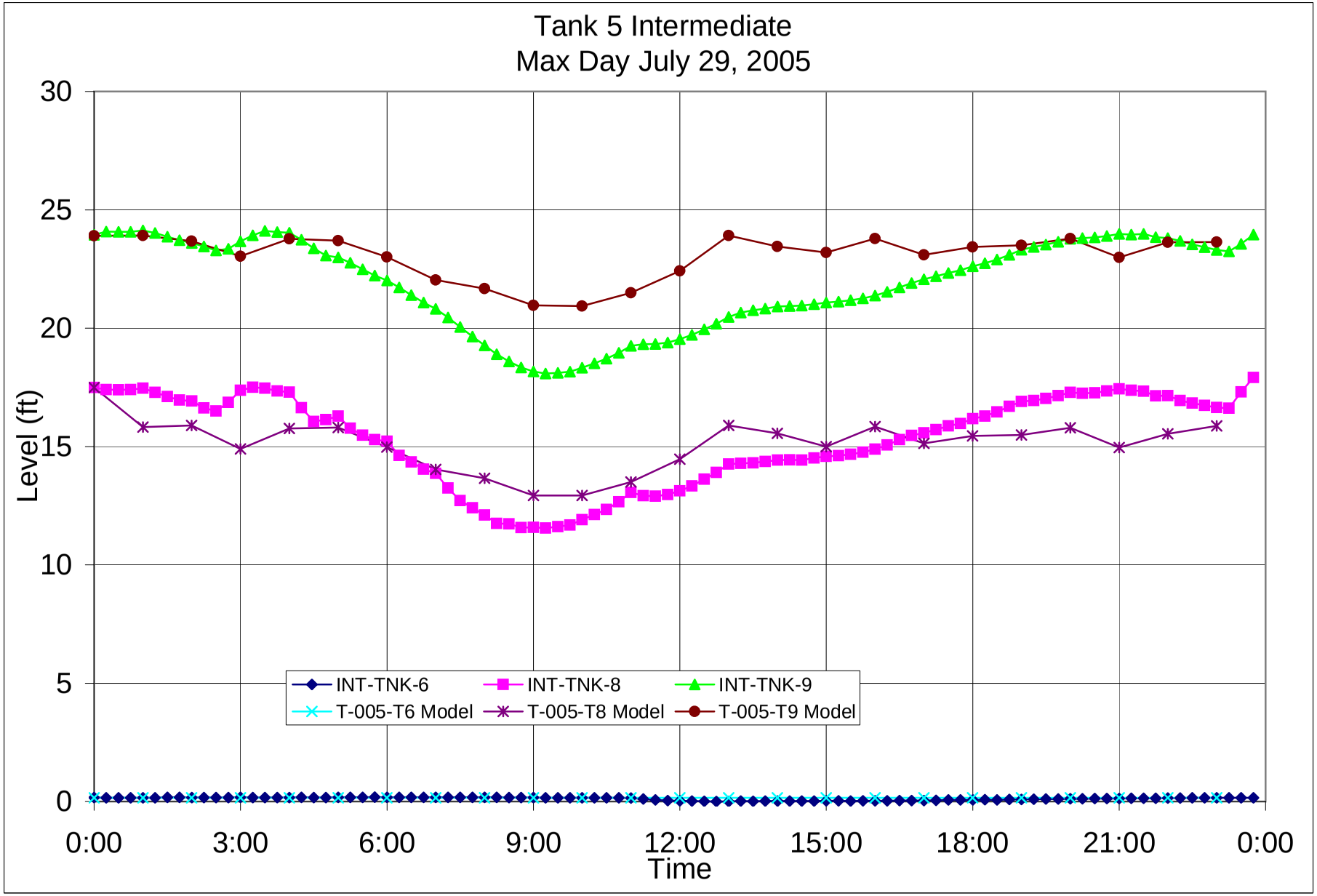

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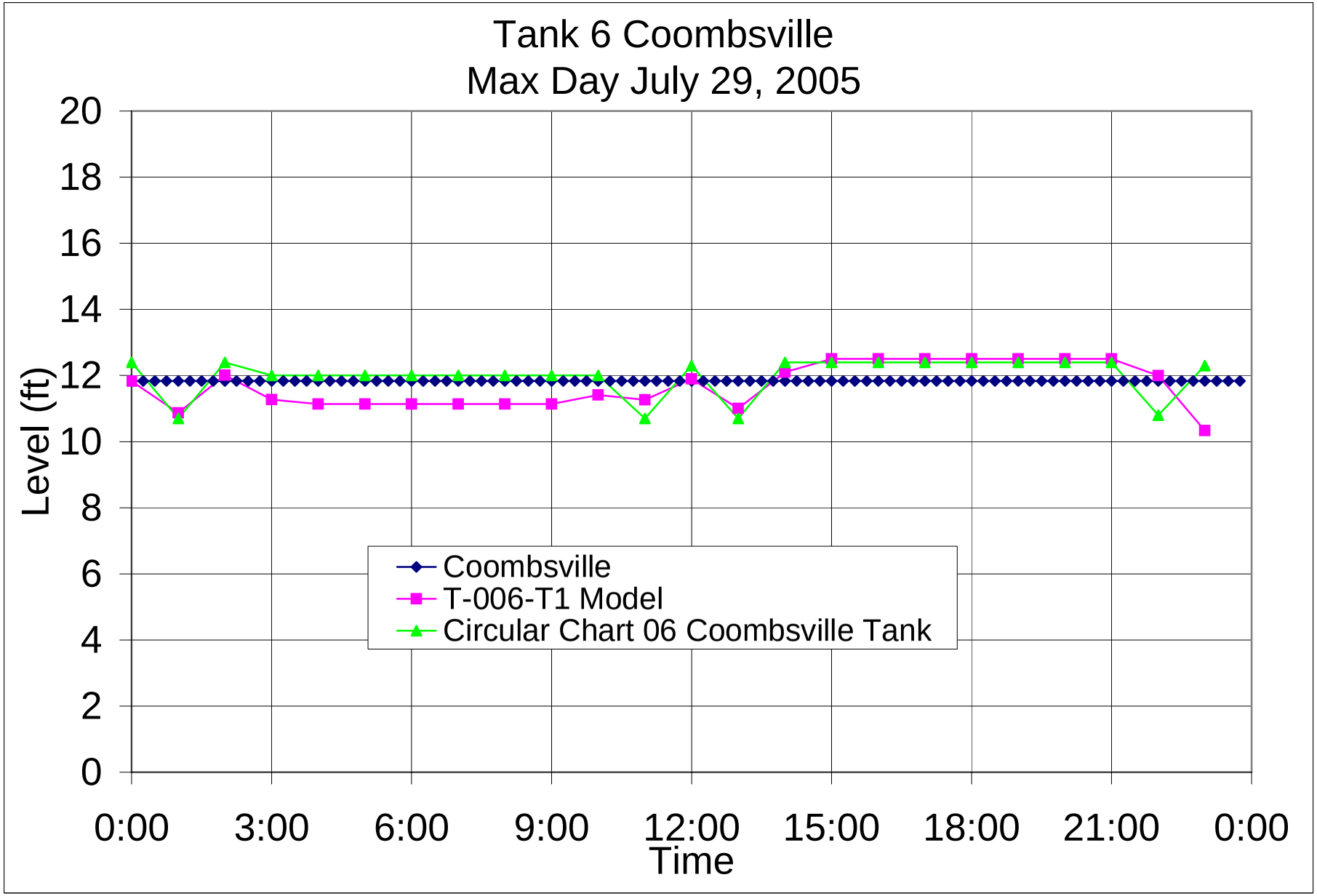

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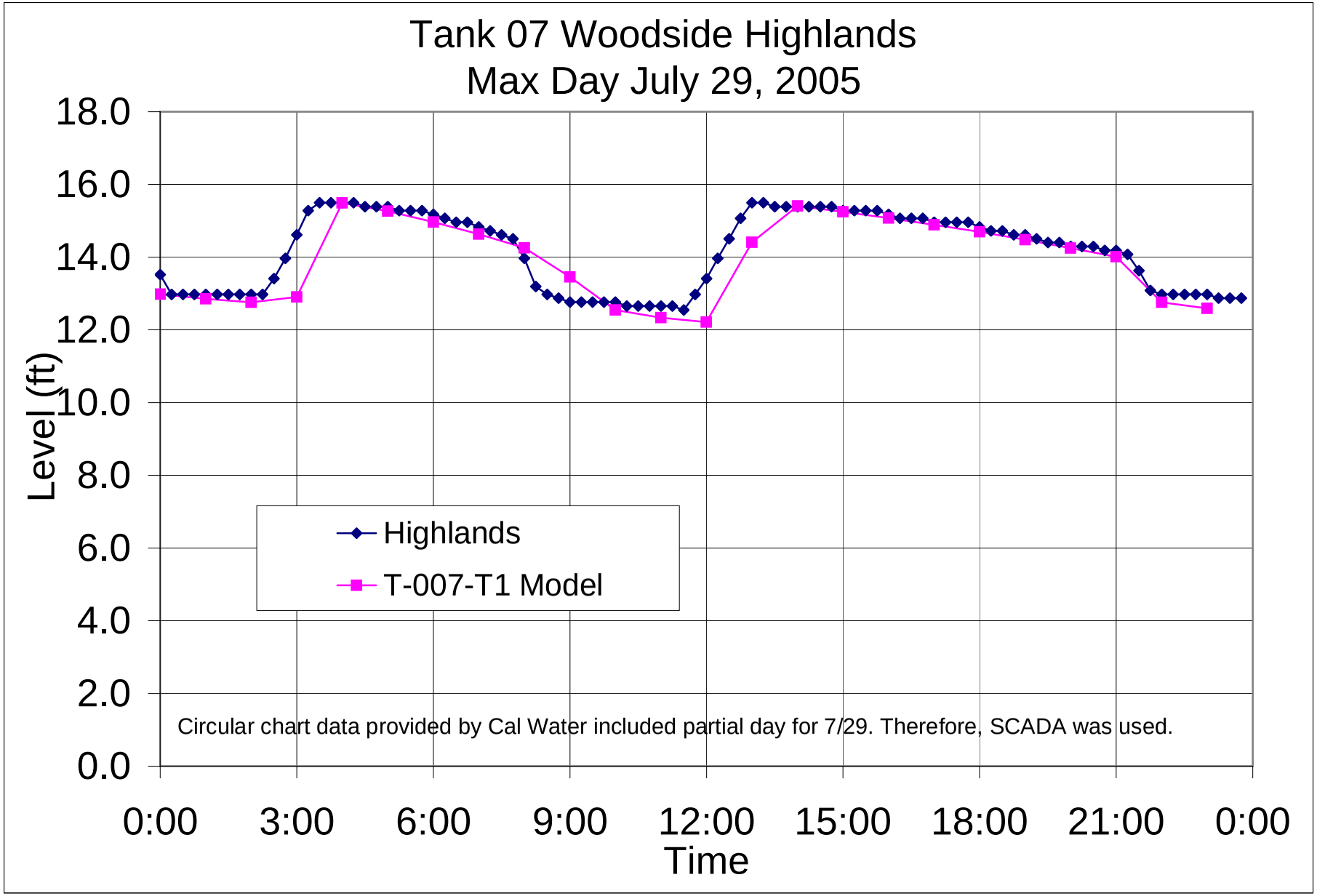

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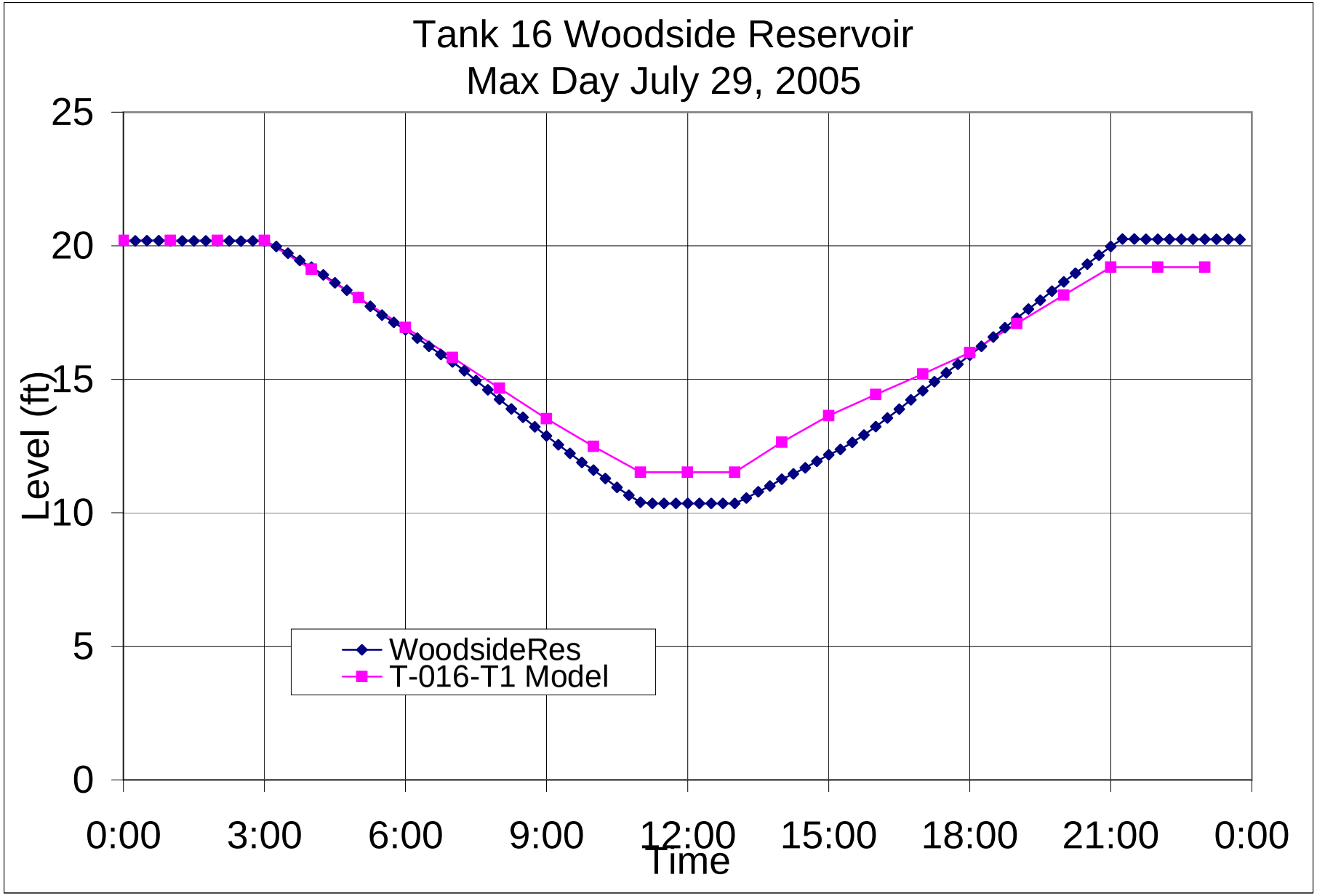

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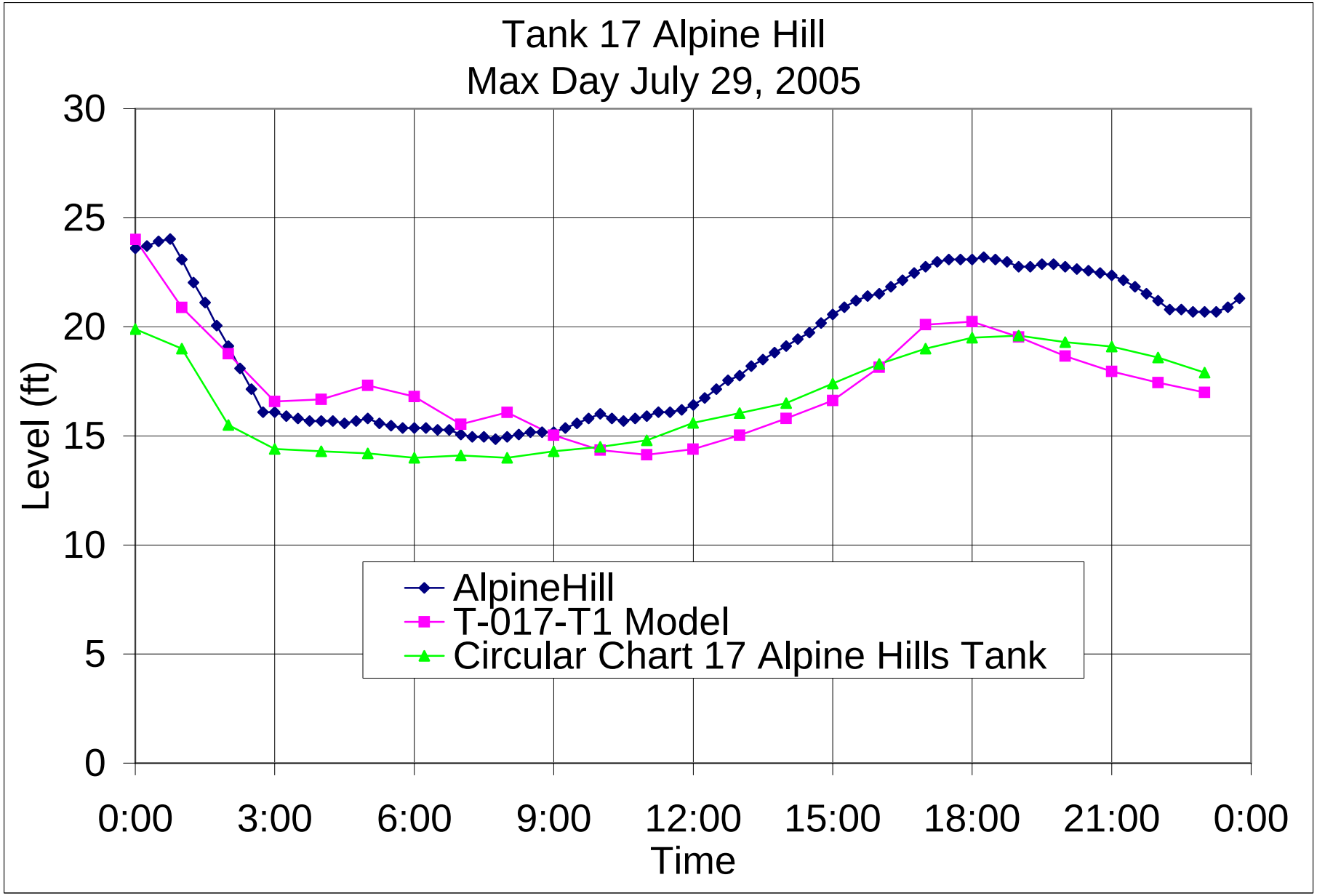

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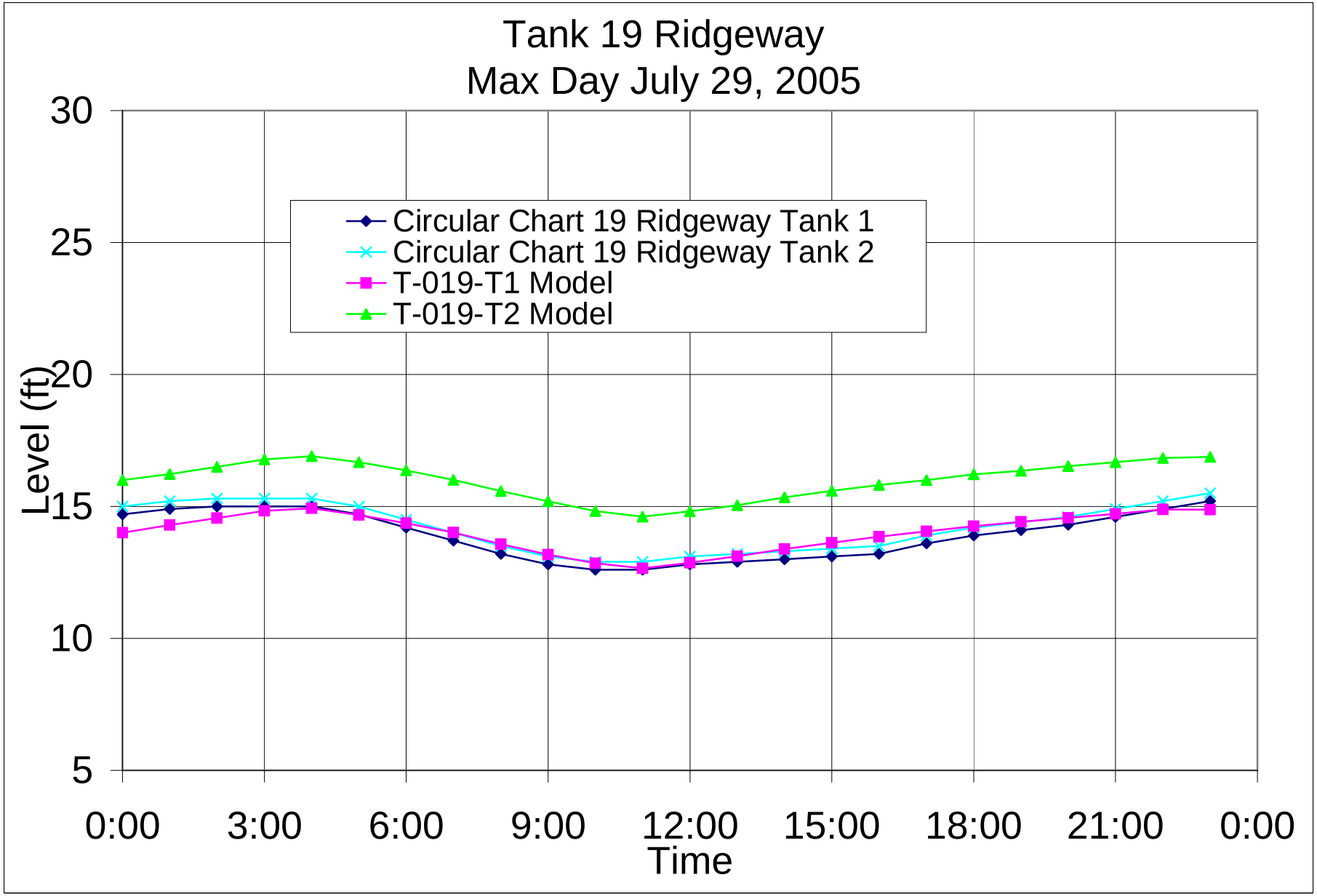

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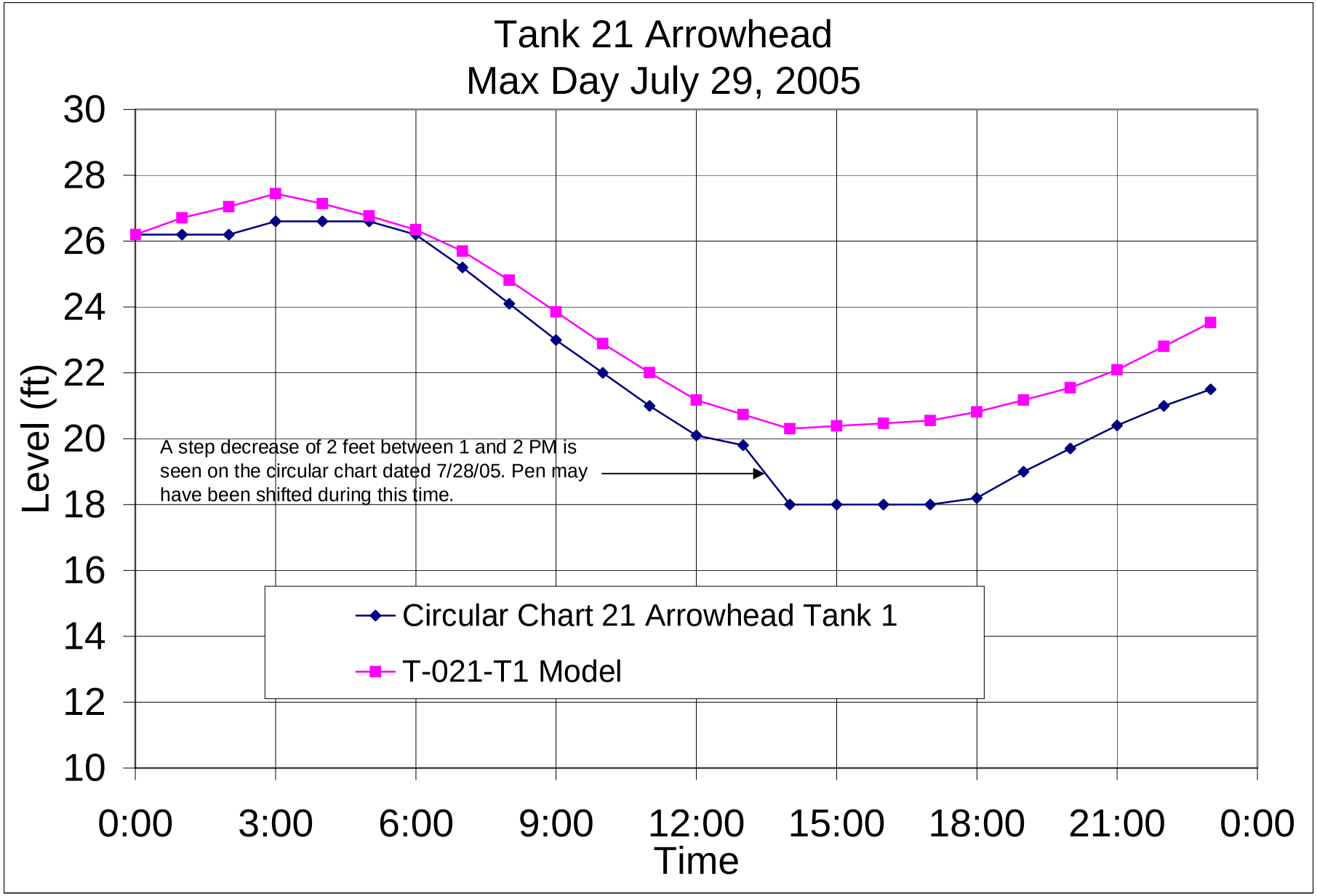

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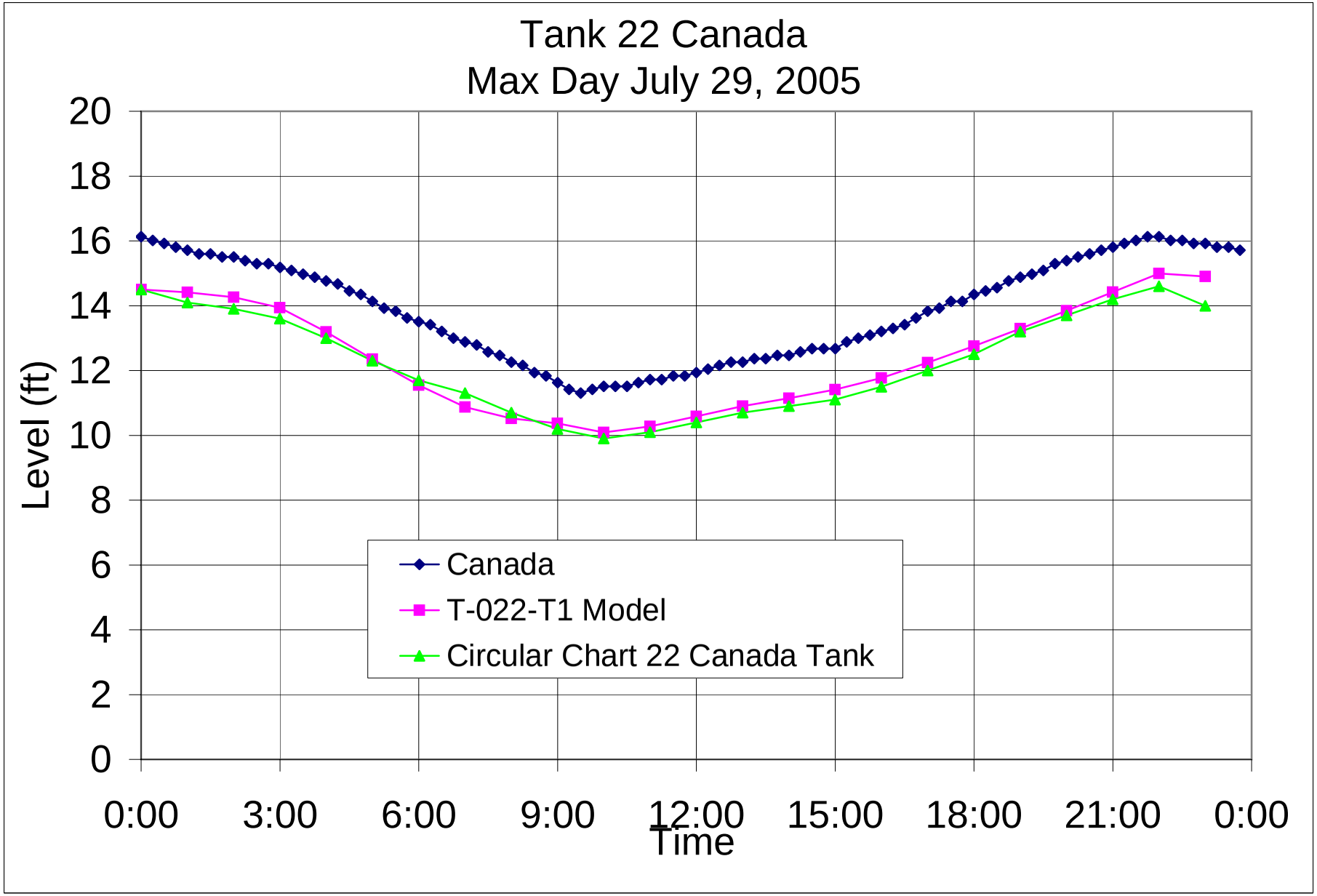

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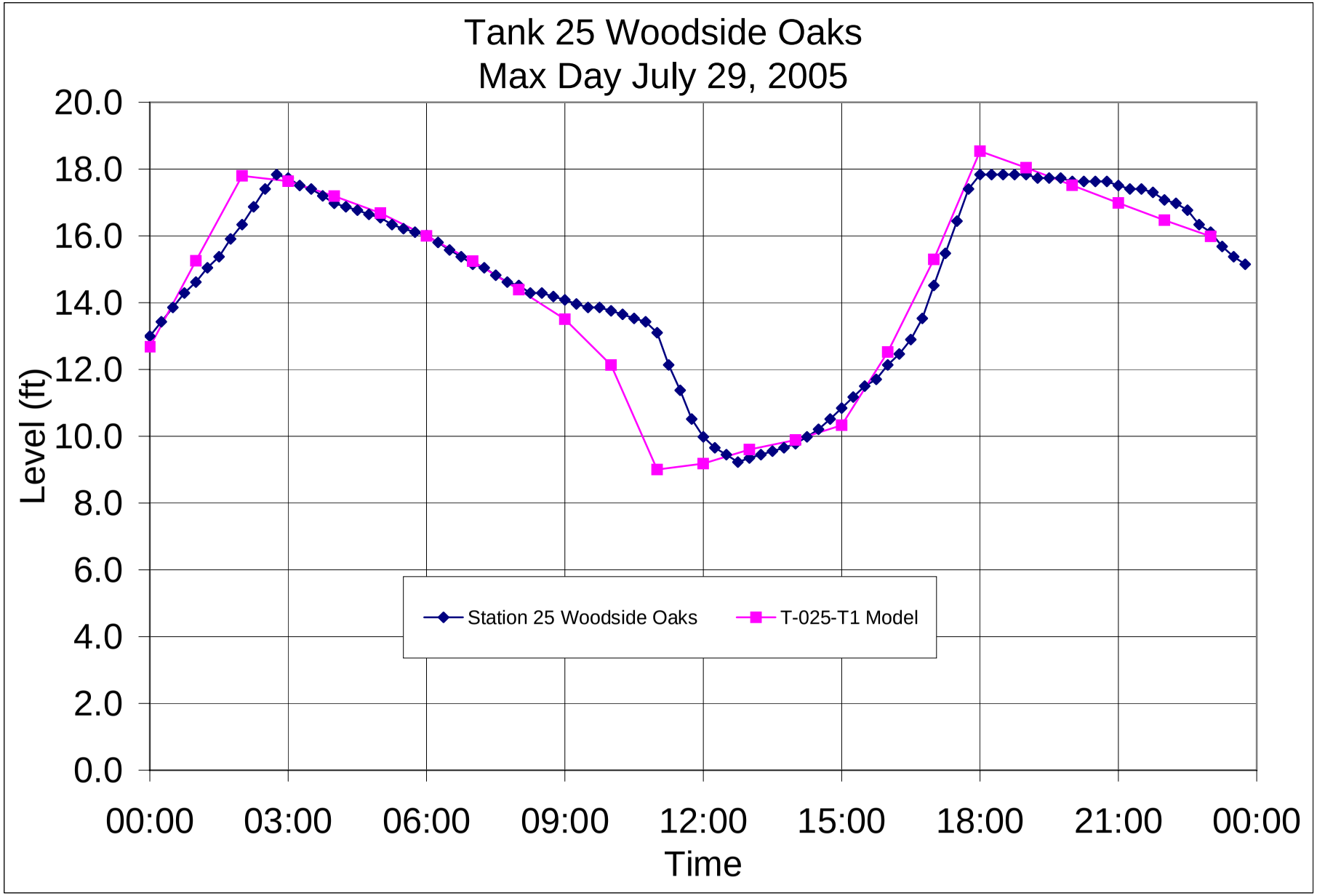

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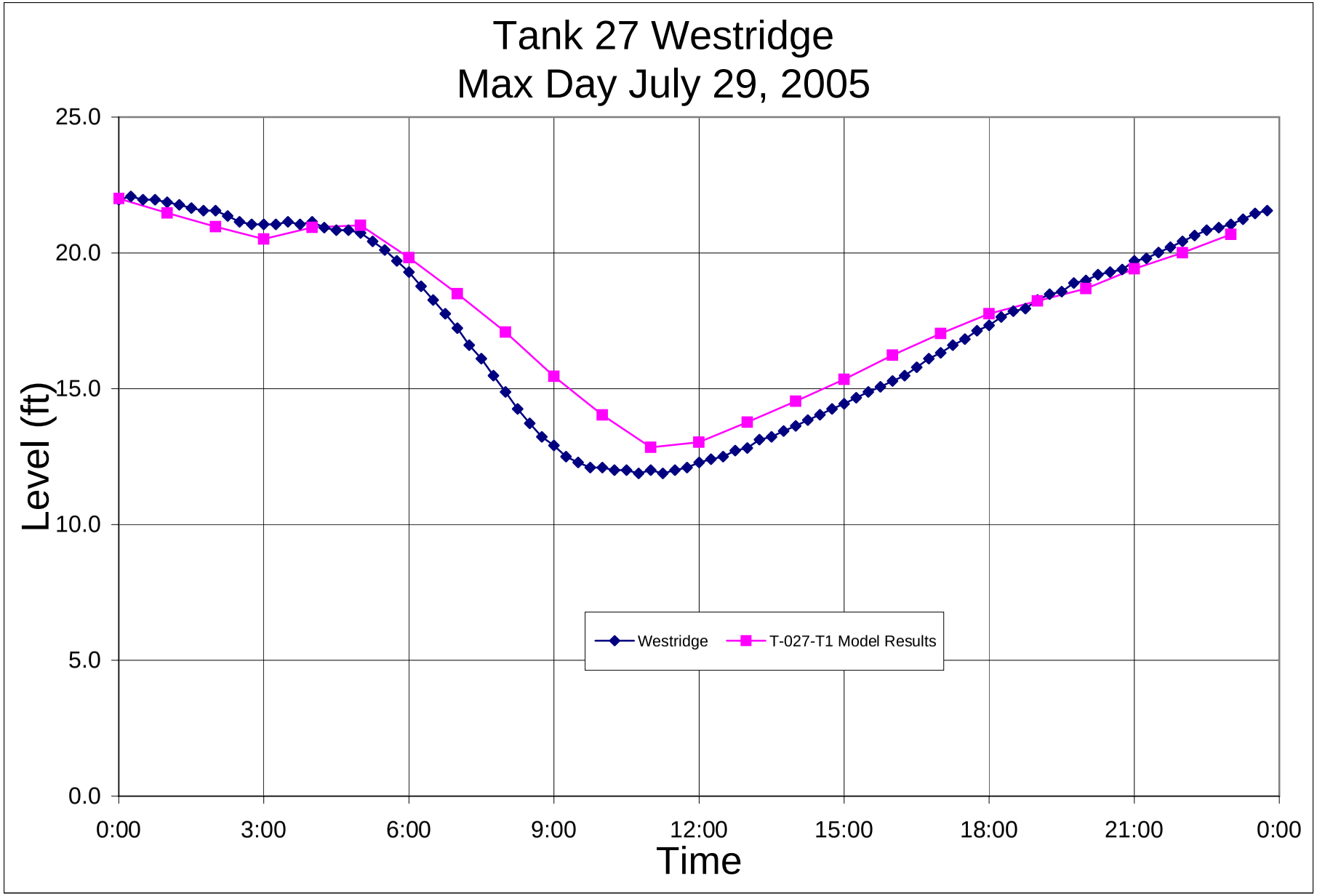

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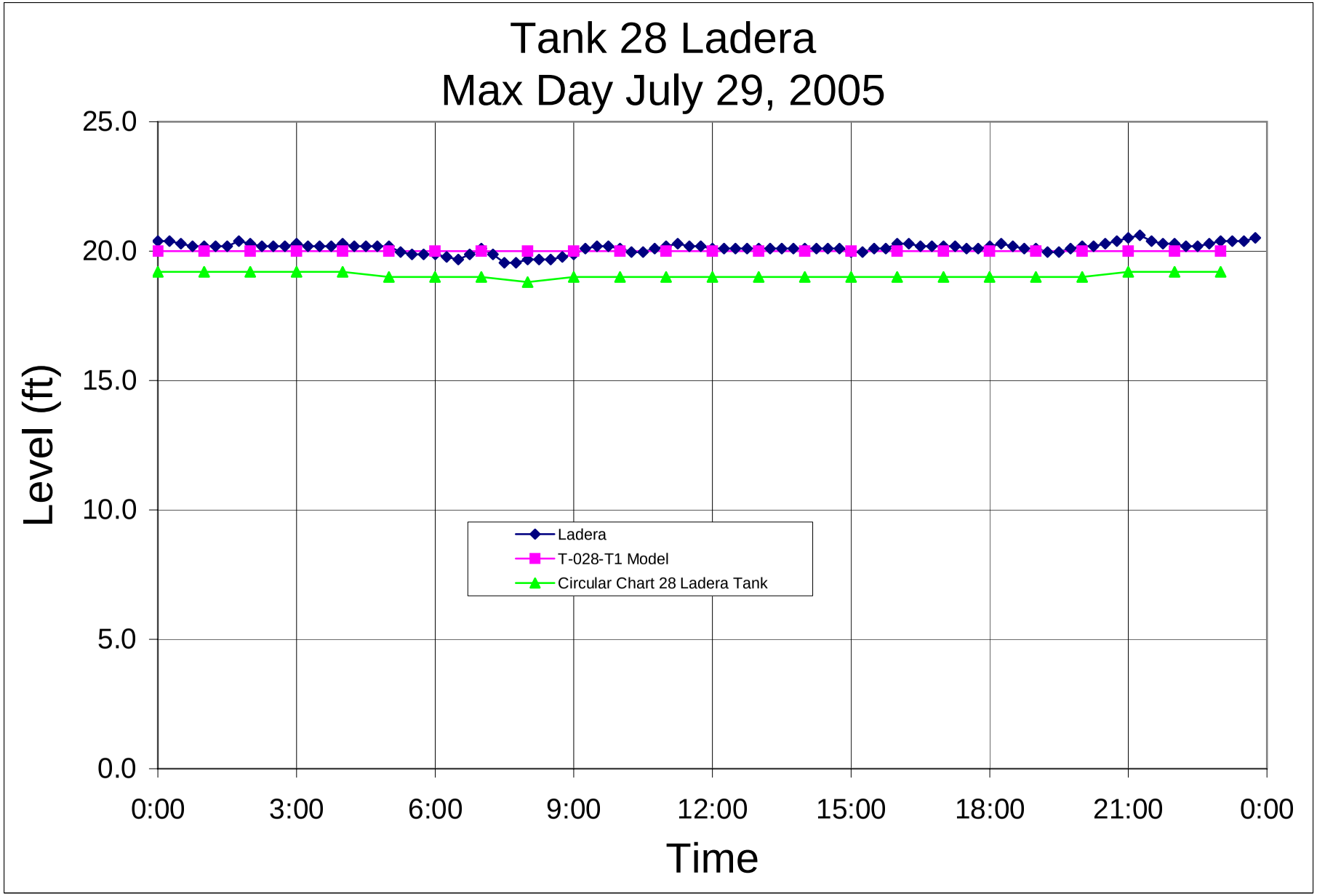

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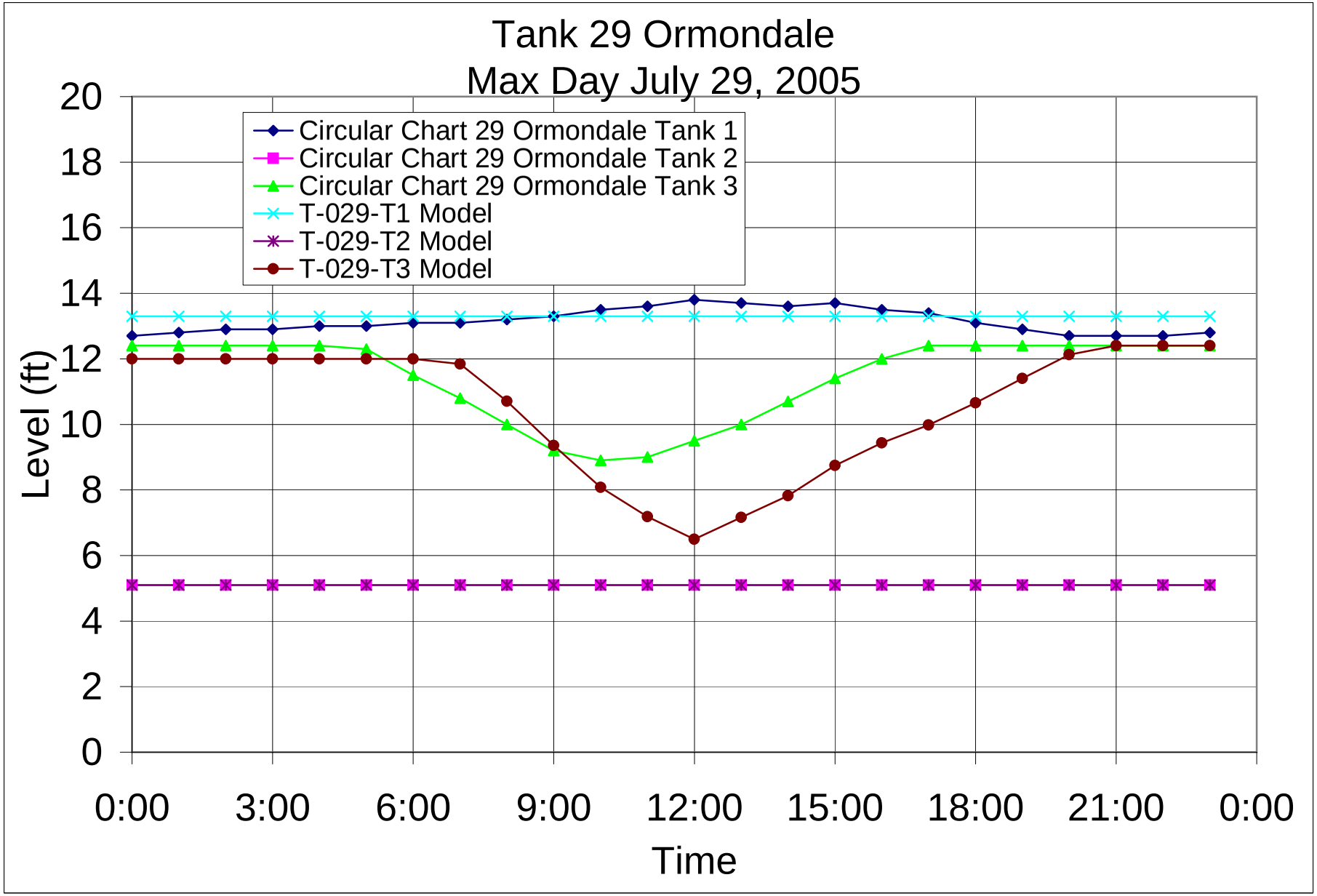

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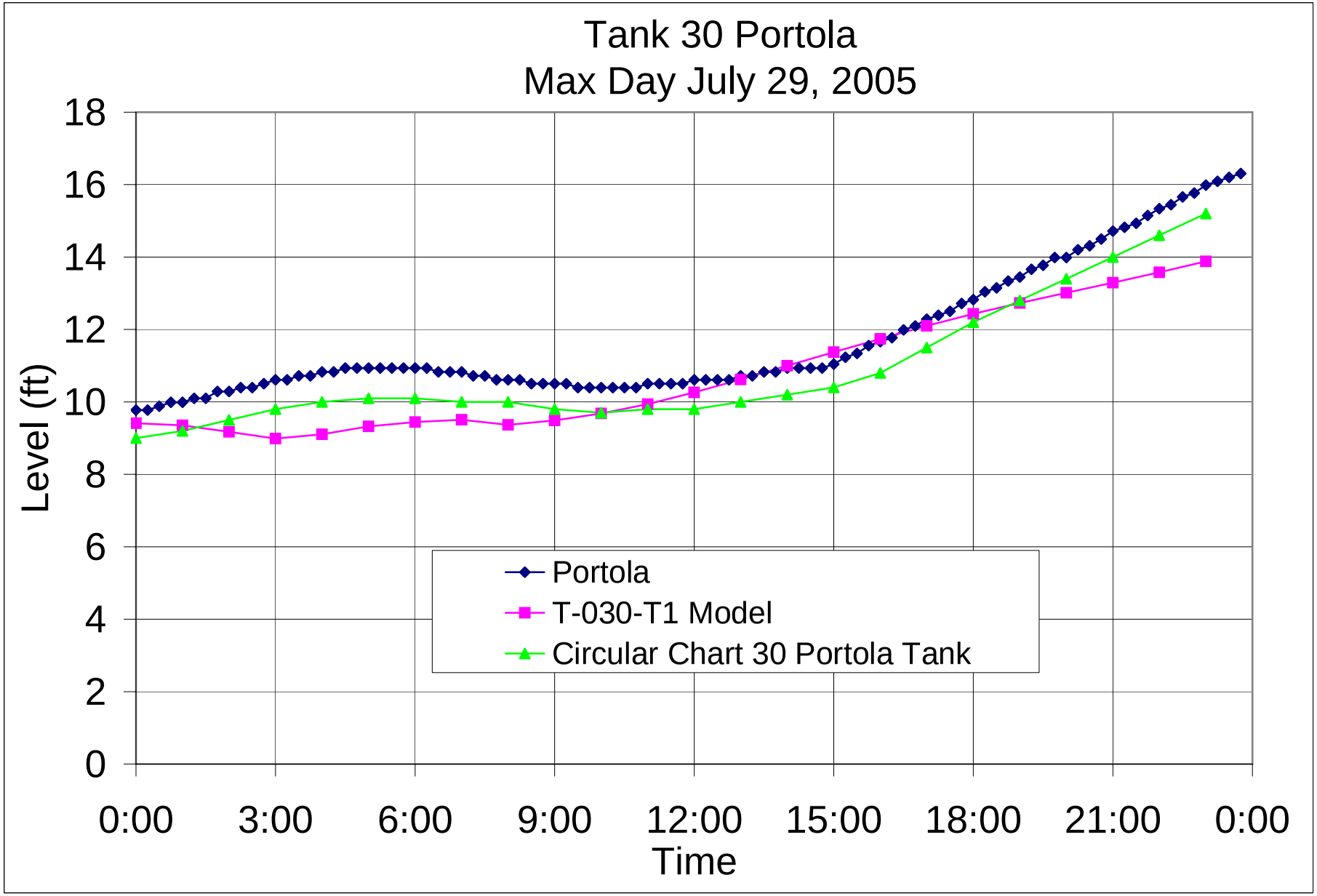

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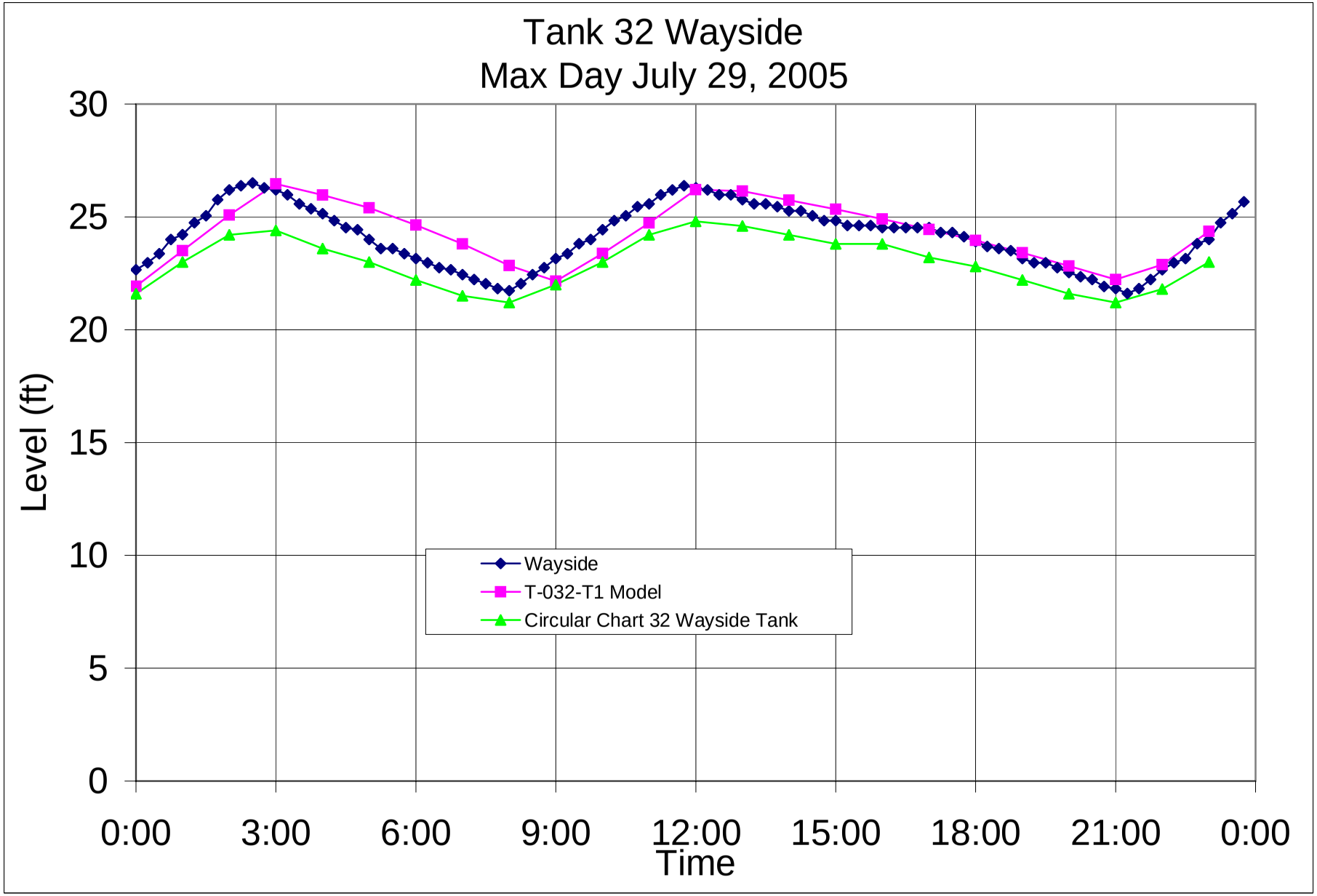

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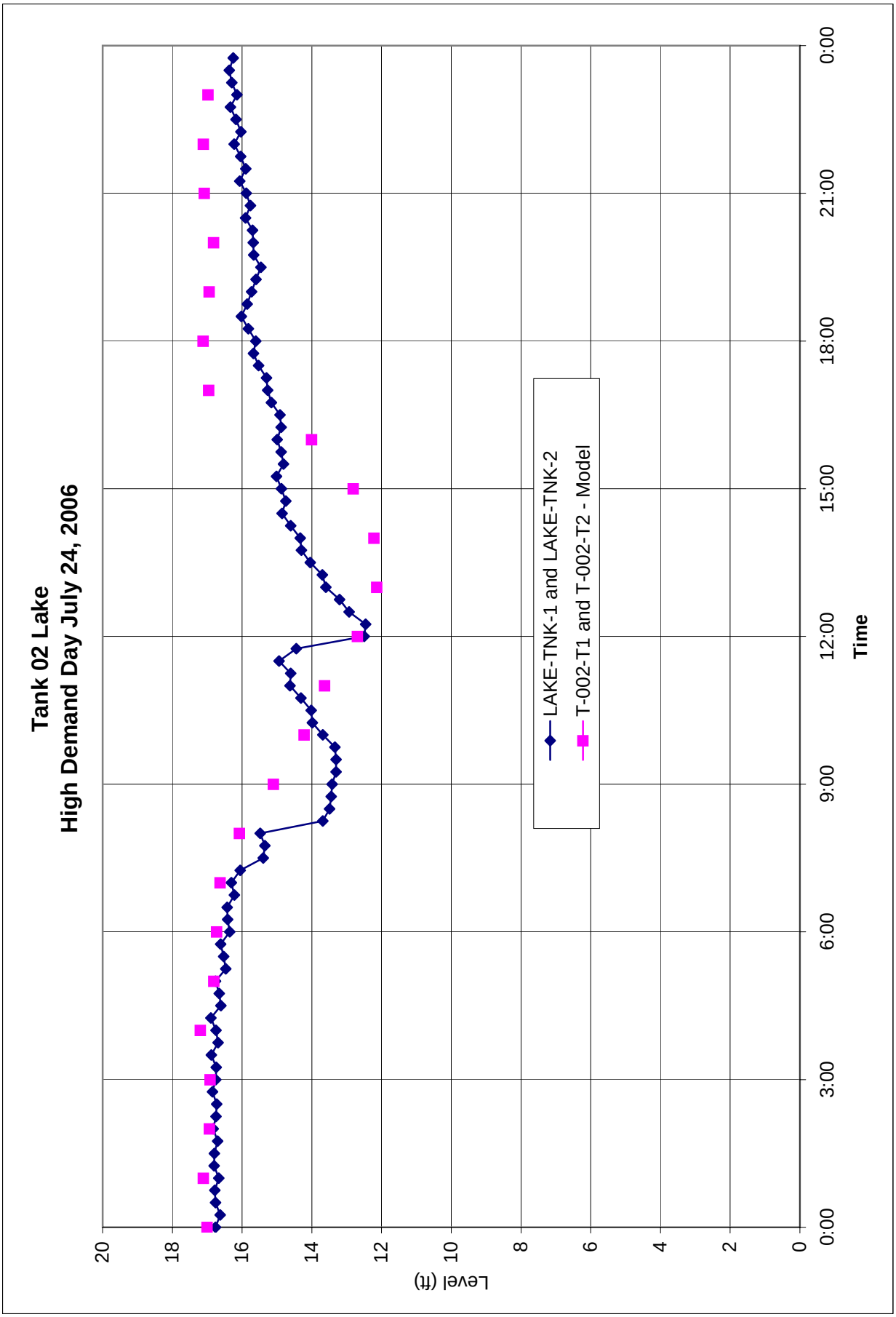
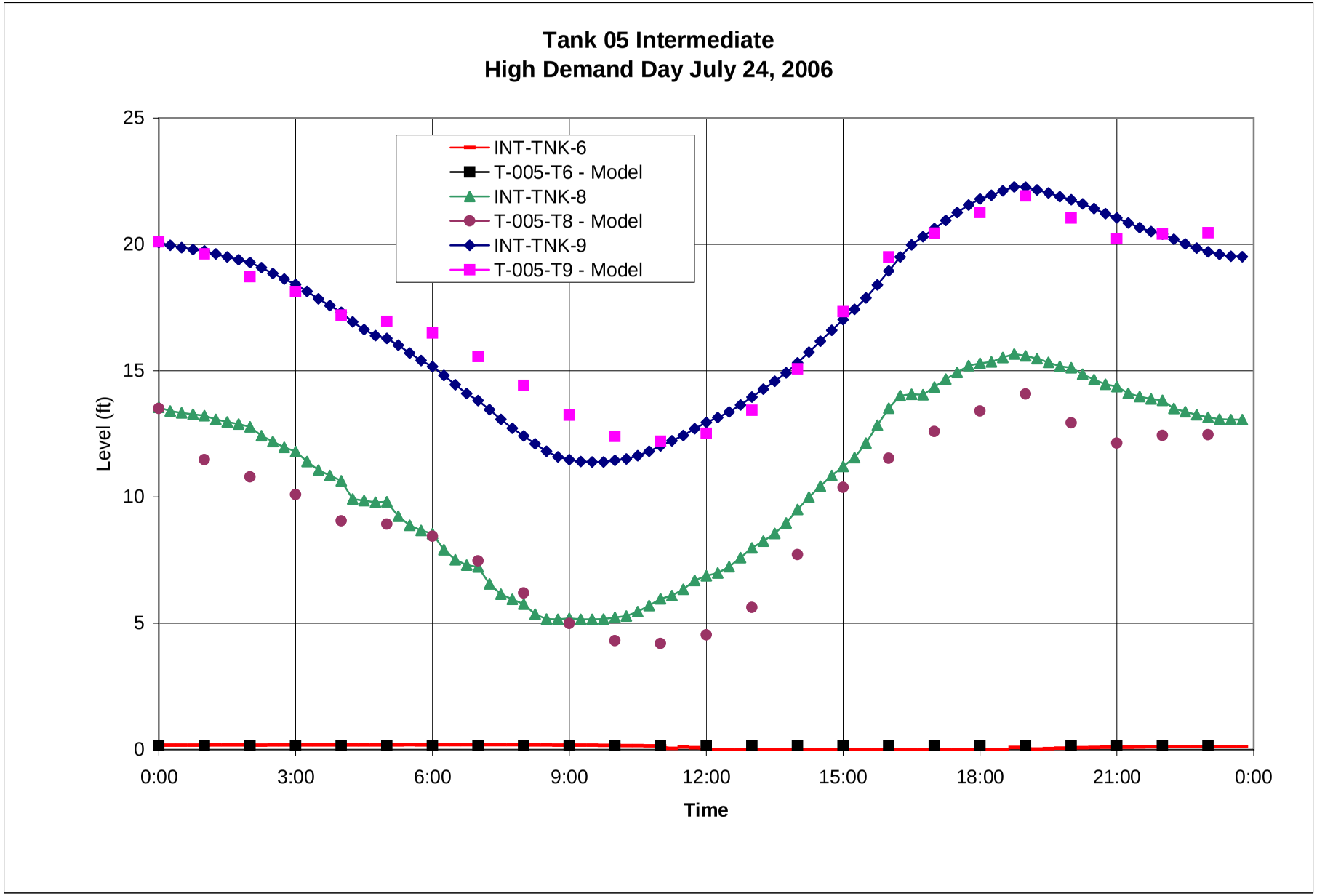
Attachment 2

High Demand Day Verification Charts


Tank 02 Lake
High Demand Day July 24, 2006
Level (ft)
20
18
16
14
12
10
8
6
4
2
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
LAKE-TNK-1 and LAKE-TNK-2
T-002-T1 and T-002-T2 - Model



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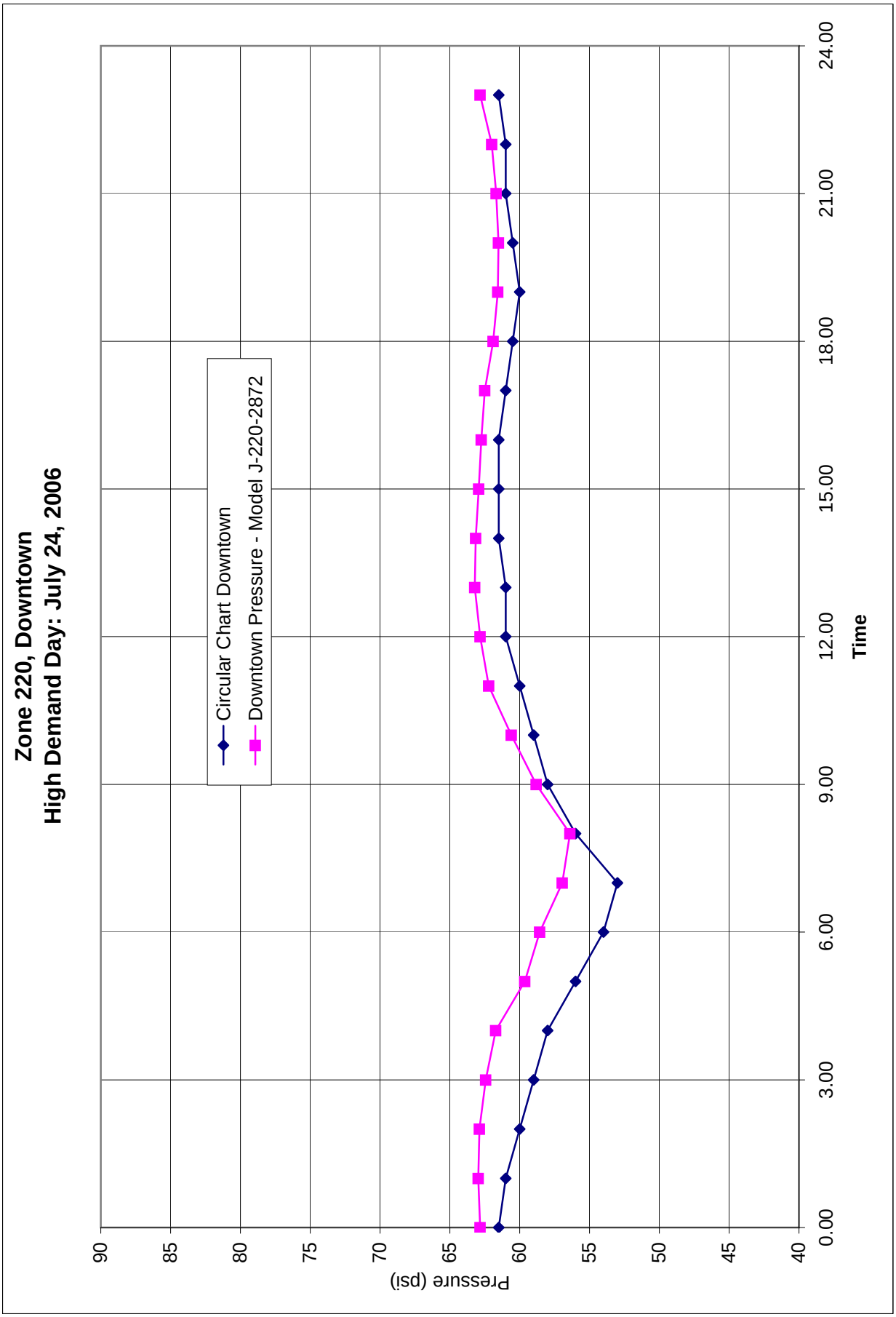
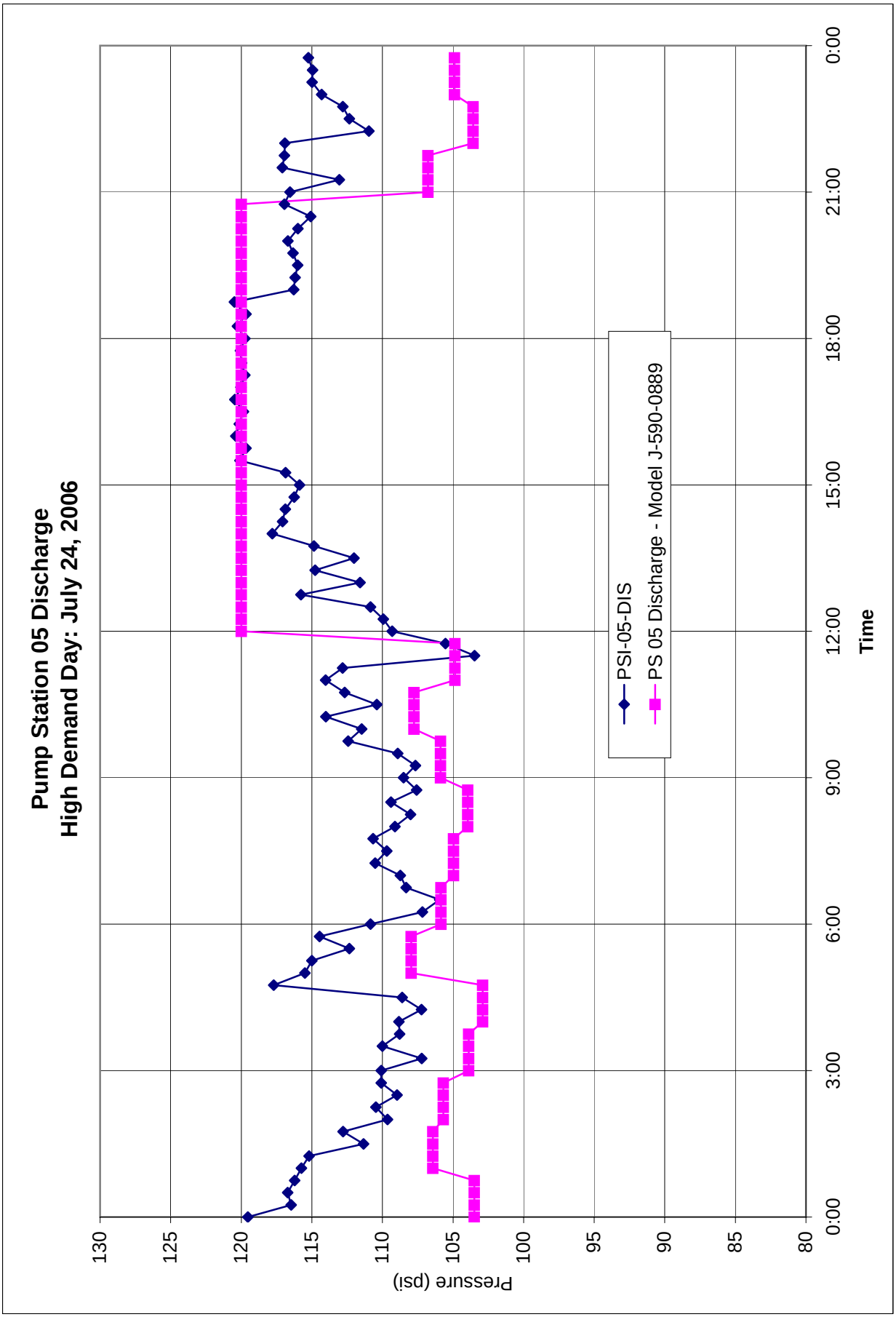

Zone 220, Downtown
High Demand Day: July 24, 2006
Circular Chart Downtown
Downtown Pressure - Model J-220-2872
Pressure (psi)
90
85
80
75
70
65
60
55
50
45
40
0.00
3.00
6.00
9.00
12.00
15.00
18.00
21.00
24.00
Time

Public Version



Appendix I
Fire Flow Analysis Results

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
Zone 220				
J-220-3210	23	0.00	74	30
J-220-3867	69	12.45	59	50
J-220-1401	42	0.00	69	55
J-220-4623	74	12.00	58	60
J-220-3717	57	0.00	65	61
J-220-2780	48	5.00	69	64
J-220-2951	48	5.65	66	66
J-220-1635	72	10.60	59	67
J-220-4748	81	2.36	56	69
J-220-4626	77	2.67	58	73
J-220-3800	82	0.00	56	73
J-220-2064	100	0.00	49	75
J-220-3799	82	0.00	56	75
J-220-0031	50	12.21	65	76
J-220-4274	71	0.00	62	78
J-220-3694	42	0.00	69	79
J-220-1969	69	0.00	61	83
J-220-2079	16	2.79	76	83
J-220-3925	101	0.00	50	84
J-220-3716	54	1.61	66	85
J-220-0108	29	9.81	74	85
J-220-3556	60	0.00	67	87
J-220-2930	63	0.00	64	88
J-220-3088	47	0.00	71	90
J-220-0872	34	0.00	74	91
J-220-4739	69	0.00	63	93
J-220-3101	48	3.29	70	93
J-220-3824	71	0.00	61	94
J-220-3983	63	0.00	65	94
J-220-3357	89	3.13	54	95
J-220-2950	48	4.50	66	96
J-220-3924	101	0.00	50	96
J-220-3827	71	0.00	61	96
J-220-0748	57	7.24	65	97
J-220-2078	17	1.08	76	98
J-220-0105	46	4.28	68	101
J-220-2406	89	0.00	53	102
J-220-3130	104	0.00	49	102
J-220-0861	27	8.27	76	104
J-220-2688	51	4.50	66	105
J-220-0095	49	8.32	67	105
J-220-1405	44	0.00	68	106
J-220-3463	57	0.00	67	107
J-220-3604	96	0.00	51	107
J-220-2147	89	0.00	53	109
J-220-2938	81	0.00	56	109
J-220-2939	80	0.00	57	109

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2937	81	0.00	56	109
J-220-2146	89	1.39	53	111
J-220-4700	81	0.00	57	112
J-220-1968	69	0.00	61	114
J-220-2940	81	6.06	56	115
J-220-3277	101	6.85	50	119
J-220-1535	43	0.00	69	129
J-220-2047	20	0.65	78	133
J-220-3560	60	0.00	67	135
J-220-4020	73	2.00	60	136
J-220-3654	59	0.00	66	139
J-220-1633	68	5.41	62	143
J-220-1634	71	1.42	60	146
J-220-2330	46	0.00	69	152
J-220-2463	89	4.02	53	153
J-220-2106	35	0.00	72	154
J-220-3465	59	8.15	66	156
J-220-1655	21	0.00	75	162
J-220-4352	68	0.00	63	167
J-220-2297	50	0.00	69	170
J-220-2046	21	1.71	78	171
J-220-3917	71	0.00	61	176
J-220-2561	30	0.63	71	188
J-220-2145	89	0.00	53	189
J-220-3918	71	0.00	61	191
J-220-3929	54	1.66	70	192
J-220-4747	79	4.45	57	193
J-220-3634	96	0.00	51	195
J-220-0839	20	0.00	75	200
J-220-1511	27	4.92	76	203
J-220-0838	20	0.00	75	207
J-220-0405	54	8.13	68	219
J-220-0871	34	0.00	74	223
J-220-3984	83	0.41	56	233
J-220-3276	100	0.00	50	236
J-220-1750	33	3.87	70	238
J-220-3462	57	0.96	67	239
J-220-0046	45	1.92	69	240
J-220-1632	71	11.95	60	249
J-220-0030	49	10.89	67	250
J-220-4354	76	4.64	59	250
J-220-0684	31	2.67	71	254
J-220-2953	48	0.00	66	254
J-220-2779	49	1.23	69	255
J-220-1852	103	10.84	48	260
J-220-0683	30	1.25	71	260
J-220-3129	104	0.00	49	274
J-220-0437	91	0.00	52	277

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2689	49	0.00	67	289
J-220-3919	71	0.00	61	300
J-220-3866	65	3.43	63	303
J-220-9986	118	6.44	42	311
J-220-2302	32	6.20	70	323
J-220-3087	49	0.00	70	324
J-220-3100	49	1.13	70	328
J-220-3356	90	0.51	54	330
J-220-0277	34	4.85	70	344
J-220-2935	60	4.76	67	357
J-220-2329	47	3.20	69	358
J-220-1379	50	9.02	66	362
J-220-4183	84	0.00	55	371
J-220-3839	75	6.62	60	373
J-220-0008	42	5.63	70	379
J-220-0038	42	2.00	70	387
J-220-1695	99	0.00	50	399
J-220-4738	69	0.00	63	404
J-220-2496	60	0.00	64	411
J-220-1592	60	0.00	67	414
J-220-0276	34	0.00	70	419
J-220-0057	32	0.00	74	420
J-220-3086	49	3.20	70	421
J-220-2494	69	28.94	61	421
J-220-2474	106	2.98	47	427
J-220-1773	55	5.36	68	427
J-220-3084	50	0.00	70	428
J-220-2476	105	1.88	47	433
J-220-2948	60	0.35	64	439
J-220-2077	20	2.14	75	443
J-220-0840	20	0.00	75	444
J-220-1374	54	0.00	64	447
J-220-3501	99	0.00	50	450
J-220-2812	104	0.00	48	450
J-220-4625	76	1.85	59	459
J-220-4314	100	0.00	50	463
J-220-3603	95	0.00	51	469
J-220-3496	96	0.00	51	469
J-220-1534	43	0.00	69	475
J-220-1469	22	0.00	76	475
J-220-2929	64	2.65	63	479
J-220-2946	63	0.00	63	486
J-220-0747	59	0.00	64	491
J-220-3832	46	0.00	67	492
J-220-3085	49	0.79	70	493
J-220-4099	85	5.67	56	493
J-220-0037	44	0.00	69	493
J-220-2535	95	3.87	51	494

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1404	44	4.28	68	499
J-220-1470	22	0.00	76	500
J-220-0887	50	2.09	67	504
J-220-3930	54	21.66	70	506
J-220-3843	75	14.03	59	515
J-220-1466	22	0.00	76	515
J-220-4699	82	6.35	56	518
J-220-2936	82	2.65	56	521
J-220-2102	31	1.20	71	524
J-220-3826	71	0.00	61	524
J-220-3823	72	0.00	61	536
J-220-1309	85	9.95	55	538
J-220-4132	100	0.00	50	538
J-220-0642	83	3.34	56	539
J-220-2338	50	0.00	68	540
J-220-0643	82	4.04	56	541
J-220-1651	55	0.00	65	542
J-220-4116	79	2.93	57	542
J-220-2337	51	0.00	67	549
J-220-4868	74	0.00	61	554
J-220-4273	70	0.00	62	557
J-220-2336	51	0.00	67	558
J-220-4059	69	0.00	62	567
J-220-1001	51	11.76	67	573
J-220-0587	34	0.00	70	574
J-220-3147	95	0.00	51	578
J-220-1650	55	13.34	65	581
J-220-4142	107	0.00	51	581
J-220-2216	55	0.00	67	589
J-220-4695	81	5.84	57	589
J-220-1253	60	0.00	66	589
J-220-4256	100	0.00	50	596
J-220-4762	79	3.17	57	599
J-220-1252	60	8.74	66	599
J-220-1400	42	0.00	69	601
J-220-3141	72	0.00	61	602
J-220-2311	78	0.00	59	605
J-220-4061	99	0.00	50	607
J-220-3170	60	9.06	64	612
J-220-1303	116	5.89	44	615
J-220-0585	99	0.00	50	618
J-220-3626	42	4.40	68	619
J-220-3744	46	0.00	67	621
J-220-4429	114	0.00	44	621
J-220-2076	20	0.00	75	622
J-220-4098	74	0.00	60	623
J-220-1471	21	0.00	77	624
J-220-0229	58	0.00	67	625

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2426	104	0.00	48	627
J-220-4761	78	0.00	58	631
J-220-1251	61	0.00	65	632
J-220-4115	78	4.66	57	632
J-220-2498	69	0.20	61	633
J-220-2626	19	6.64	80	633
J-220-1877	79	0.00	58	633
J-220-4182	85	0.00	55	635
J-220-0036	42	0.00	70	636
J-220-1250	61	4.35	65	637
J-220-2500	52	0.00	66	638
J-220-4172	95	5.82	51	641
J-220-2215	55	0.00	67	644
J-220-4097	73	17.07	60	649
J-220-3731	81	0.00	57	652
J-220-3145	127	0.00	38	653
J-220-1876	79	0.00	58	654
J-220-0376	27	3.39	76	657
J-220-1831	27	0.00	73	659
J-220-3546	69	0.00	63	659
J-220-1569	127	3.54	38	660
J-220-1832	27	1.81	73	660
J-220-1378	52	5.07	65	662
J-220-4141	107	0.00	51	664
J-220-1982	81	0.00	57	664
J-220-3258	94	0.00	52	671
J-220-3102	49	1.03	70	671
J-220-2210	55	0.00	67	673
J-220-0384	27	0.00	73	676
J-220-1981	80	0.00	58	678
J-220-4131	98	5.00	51	679
J-220-3150	80	0.00	58	680
J-220-0007	42	0.00	70	680
J-220-3545	69	23.20	63	683
J-220-3934	66	10.60	61	684
J-220-3802	83	3.46	56	685
J-220-3235	70	0.00	62	685
J-220-0034	42	29.84	70	688
J-220-3515	54	0.00	64	688
J-220-4457	59	1.37	65	688
J-220-4458	59	0.00	65	688
J-220-3151	79	0.00	58	689
J-220-4083	41	0.00	68	691
J-220-0409	53	7.65	68	691
J-220-4798	59	2.57	65	693
J-220-4160	85	14.16	55	693
J-220-3914	85	0.00	55	694
J-220-1826	30	10.89	75	697

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3730	78	0.00	59	700
J-220-3728	78	0.00	59	704
J-220-4820	68	0.43	63	704
J-220-1717	77	0.00	59	704
J-220-1718	77	0.00	59	704
J-220-1719	77	0.00	59	704
J-220-3729	76	0.00	59	704
J-220-2103	31	0.00	71	705
J-220-1976	60	19.79	62	708
J-220-3434	103	0.00	49	709
J-220-3727	77	1.97	59	710
J-220-2493	67	0.02	62	710
J-220-3582	77	0.00	59	711
J-220-3583	77	0.00	59	711
J-220-3516	54	0.00	64	711
J-220-4081	54	0.00	64	711
J-220-3588	77	0.00	59	713
J-220-4012	101	0.00	49	717
J-220-1975	61	4.21	62	717
J-220-2218	69	0.00	62	718
J-220-2296	50	0.00	69	719
J-220-3970	66	0.00	61	723
J-220-3261	93	0.00	52	723
J-220-3913	85	1.11	55	726
J-220-3724	77	2.93	59	727
J-220-3933	66	0.00	61	727
J-220-2285	61	10.53	66	731
J-220-3842	77	0.00	58	732
J-220-3439	85	0.63	55	735
J-220-4456	59	4.86	65	735
J-220-4658	77	0.00	58	738
J-220-2543	94	0.00	52	742
J-220-3858	76	0.00	59	742
J-220-3298	103	0.53	53	744
J-220-4657	77	0.00	58	749
J-220-3148	76	0.00	59	750
J-220-2425	105	2.38	47	752
J-220-4288	84	1.35	55	754
J-220-3083	50	1.76	70	755
J-220-3625	41	0.00	69	757
J-220-2840	24	0.00	74	759
J-220-4351	68	0.50	63	759
J-220-3628	37	0.00	70	760
J-220-3912	84	3.44	55	763
J-220-3045	50	6.06	66	766
J-220-2190	38	0.00	71	771
J-220-1000	47	16.54	69	772
J-220-3725	76	4.86	59	773

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2512	84	6.23	55	775
J-220-3440	84	6.47	56	783
J-220-4900	61	2.62	64	786
J-220-2117	43	0.00	72	788
J-220-4551	67	7.71	63	791
J-220-4899	61	0.77	64	794
J-220-1978	96	0.00	51	794
J-220-3149	76	0.00	59	797
J-220-2911	66	0.00	61	797
J-220-3726	76	0.58	59	797
J-220-1774	52	11.78	68	797
J-220-2162	99	2.98	48	805
J-220-9985	121	3.01	40	806
J-220-0770	26	2.24	77	808
J-220-2542	94	0.00	52	808
J-220-3041	81	0.00	58	818
J-220-3260	92	0.00	52	824
J-220-1478	30	0.00	75	824
J-220-3782	63	0.00	64	829
J-220-2513	85	5.79	55	833
J-220-4129	100	2.93	50	836
J-220-3956	103	0.00	47	838
J-220-3291	91	14.64	55	843
J-220-3955	103	0.00	47	845
J-220-3754	75	0.00	60	846
J-220-2479	55	0.00	67	848
J-220-2161	98	11.49	49	849
J-220-0686	31	0.00	71	849
J-220-3957	102	0.00	47	852
J-220-4189	78	0.00	58	852
J-220-3752	86	0.00	55	858
J-220-3019	21	0.00	77	858
J-220-4613	85	7.07	55	861
J-220-1720	75	15.32	60	861
J-220-0685	31	0.00	71	862
J-220-4843	61	0.00	64	863
J-220-1467	22	1.95	76	867
J-220-1480	28	0.00	76	867
J-220-2630	20	0.00	80	871
J-220-3931	66	0.00	61	871
J-220-4760	76	0.00	59	873
J-220-4842	61	0.00	64	880
J-220-3413	106	0.00	47	882
J-220-0488	78	6.44	58	893
J-220-2683	46	0.00	69	896
J-220-1714	81	12.91	57	897
J-220-0131	27	0.00	77	897
J-220-0896	86	0.00	55	899

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4065	63	0.00	63	899
J-220-0023	36	0.00	72	905
J-220-3408	89	0.00	53	908
J-220-3412	106	6.32	47	913
J-220-4439	87	0.00	53	914
J-220-2515	31	2.01	71	916
J-220-3259	92	0.00	52	918
J-220-2110	43	0.00	66	927
J-220-4024	82	0.00	55	929
J-220-2187	31	0.00	74	930
J-220-0035	42	8.94	70	933
J-220-2109	44	0.00	66	936
J-220-4533	64	2.38	64	938
J-220-1244	16	0.00	77	938
J-220-1243	16	0.00	77	939
J-220-0991	16	0.00	77	940
J-220-1743	42	0.00	70	940
J-220-0990	16	0.00	77	942
J-220-3407	89	7.60	53	943
J-220-0128	25	0.00	78	946
J-220-2906	64	6.60	64	947
J-220-1977	93	0.00	53	949
J-220-0436	85	17.41	55	951
J-220-0484	76	1.30	58	955
J-220-2108	43	0.00	66	955
J-220-4237	77	0.00	58	956
J-220-4325	81	4.45	56	958
J-220-3502	102	0.00	49	960
J-220-3954	99	0.00	49	960
J-220-1731	29	0.00	72	961
J-220-1938	29	2.97	72	964
J-220-1732	30	4.46	71	965
J-220-2554	32	0.92	70	967
J-220-1742	42	2.69	70	968
J-220-0485	76	0.00	58	969
J-220-0992	16	5.05	77	969
J-220-3958	99	6.23	49	971
J-220-2555	32	0.00	70	972
J-220-3464	61	8.17	66	972
J-220-1044	42	0.00	70	975
J-220-2541	82	0.00	57	976
J-220-0481	76	0.00	58	978
J-220-2549	32	1.35	70	979
J-220-2163	97	0.00	49	981
J-220-3624	41	0.00	69	981
J-220-0852	16	11.32	77	986
J-220-2164	98	6.54	49	987
J-220-2514	94	23.87	51	987

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2577	76	0.00	59	988
J-220-2645	21	0.00	80	988
J-220-3285	98	0.00	51	989
J-220-2550	32	0.00	70	990
J-220-1373	55	0.00	63	993
J-220-1553	32	0.00	70	998
J-220-0385	27	0.00	72	998
J-220-2534	93	13.34	52	999
J-220-3828	110	4.26	46	1,002
J-220-2462	89	0.82	53	1,002
J-220-0898	82	0.00	57	1,004
J-220-1554	32	0.28	70	1,008
J-220-1707	104	9.71	48	1,008
J-220-0104	31	0.00	74	1,009
J-220-3928	54	4.95	70	1,010
J-220-4018	58	0.00	68	1,015
J-220-3523	93	18.20	52	1,017
J-220-3315	71	0.00	61	1,018
J-220-3396	56	0.00	68	1,019
J-220-2477	55	0.00	68	1,020
J-220-2811	105	7.93	47	1,026
J-220-3425	78	0.00	58	1,026
J-220-2492	54	9.47	66	1,026
J-220-2049	20	0.43	75	1,030
J-220-4078	58	6.01	62	1,031
J-220-1772	56	0.00	68	1,035
J-220-0487	77	2.65	58	1,035
J-220-0486	77	0.00	58	1,039
J-220-3627	40	0.00	69	1,039
J-220-3284	99	0.00	51	1,042
J-220-4298	80	1.94	57	1,044
J-220-2996	51	0.00	72	1,044
J-220-2763	84	0.43	55	1,048
J-220-3290	107	0.00	48	1,050
J-220-1504	16	5.63	77	1,051
J-220-2762	82	0.00	56	1,057
J-220-1198	28	0.00	72	1,057
J-220-0483	77	0.00	58	1,060
J-220-2810	105	0.00	47	1,064
J-220-0482	77	0.00	58	1,066
J-220-3262	54	1.13	70	1,068
J-220-2764	87	12.26	54	1,069
J-220-2233	44	5.51	71	1,071
J-220-1741	41	4.30	71	1,073
J-220-3289	107	0.00	48	1,075
J-220-0029	32	7.77	74	1,076
J-220-4114	78	1.15	57	1,081
J-220-4025	83	0.00	55	1,083

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4011	100	4.33	50	1,083
J-220-3623	40	7.74	69	1,084
J-220-3326	75	0.00	59	1,094
J-220-4438	88	0.00	53	1,095
J-220-0860	27	15.70	76	1,096
J-220-3906	83	0.00	56	1,097
J-220-2115	41	0.00	67	1,101
J-220-3905	99	0.67	49	1,101
J-220-2442	102	2.40	49	1,103
J-220-3231	60	11.25	62	1,104
J-220-4204	69	3.51	60	1,105
J-220-2439	100	4.21	49	1,105
J-220-4239	83	6.40	55	1,105
J-220-4029	69	0.00	60	1,106
J-220-4776	65	2.67	62	1,106
J-220-1199	28	0.00	72	1,107
J-220-4028	68	0.00	60	1,108
J-220-2992	82	16.37	57	1,112
J-220-4205	68	0.00	61	1,112
J-220-2222	56	0.00	67	1,115
J-220-4016	64	7.33	65	1,117
J-220-4022	85	24.67	54	1,117
J-220-1895	51	0.00	72	1,117
J-220-4332	67	0.00	61	1,118
J-220-0028	32	10.58	74	1,119
J-220-4023	88	11.28	53	1,121
J-220-4001	111	4.95	47	1,121
J-220-4161	84	3.61	56	1,121
J-220-4428	115	0.00	43	1,123
J-220-1740	41	9.74	70	1,127
J-220-4002	111	0.75	47	1,127
J-220-4386	98	0.00	50	1,130
J-220-2114	41	5.34	67	1,131
J-220-3820	114	2.57	43	1,132
J-220-0851	20	0.00	75	1,133
J-220-3960	97	23.59	50	1,133
J-220-3343	62	0.00	65	1,134
J-220-4333	67	0.00	61	1,135
J-220-3197	55	1.49	68	1,136
J-220-3342	62	0.00	65	1,136
J-220-1368	40	9.40	69	1,138
J-220-3346	62	0.00	65	1,139
J-220-3345	62	0.00	65	1,140
J-220-4437	92	0.00	52	1,141
J-220-4248	98	3.97	51	1,145
J-220-4068	67	0.00	61	1,145
J-220-0849	20	0.00	75	1,145
J-220-4436	91	0.00	52	1,145

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0848	20	0.00	75	1,148
J-220-2323	42	0.00	70	1,148
J-220-3325	76	0.15	59	1,149
J-220-4872	91	0.00	52	1,149
J-220-4383	72	4.26	58	1,150
J-220-4238	80	8.75	56	1,151
J-220-1827	28	0.00	72	1,152
J-220-4326	91	13.90	52	1,152
J-220-4874	91	0.00	52	1,152
J-220-1304	110	0.00	47	1,153
J-220-3997	111	0.00	47	1,153
J-220-3998	111	0.00	47	1,153
J-220-0850	20	0.00	75	1,153
J-220-2165	91	3.29	52	1,155
J-220-0847	20	1.11	75	1,158
J-220-2322	42	8.30	70	1,158
J-220-3327	76	0.39	59	1,161
J-220-4067	68	0.00	61	1,161
J-220-4066	68	0.00	61	1,162
J-220-3999	111	0.00	47	1,162
J-220-4003	111	0.00	47	1,162
J-220-4203	68	0.00	61	1,164
J-220-2040	50	0.00	73	1,165
J-220-0968	38	5.77	70	1,165
J-220-1503	18	4.98	76	1,165
J-220-2232	43	4.28	71	1,167
J-220-4000	110	0.00	47	1,170
J-220-2761	70	0.00	59	1,172
J-220-4044	56	0.00	68	1,179
J-220-2441	100	1.39	50	1,181
J-220-2429	98	0.00	50	1,181
J-220-3316	71	0.00	61	1,182
J-220-0846	20	0.82	75	1,182
J-220-4202	68	0.00	61	1,183
J-220-3441	83	0.82	56	1,186
J-220-0336	23	0.00	74	1,191
J-220-1308	60	1.99	67	1,193
J-220-4339	73	3.44	59	1,193
J-220-3562	80	10.84	57	1,196
J-220-3500	91	6.30	53	1,196
J-220-2331	42	7.77	70	1,201
J-220-4117	78	18.61	57	1,203
J-220-3340	78	9.83	57	1,203
J-220-0845	20	0.00	75	1,204
J-220-4130	99	5.22	50	1,204
J-220-0072	42	0.00	70	1,205
J-220-3959	94	1.52	51	1,205
J-220-3104	67	2.48	63	1,206

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2905	65	2.60	64	1,207
J-220-2576	75	0.00	59	1,209
J-220-0071	42	0.00	70	1,210
J-220-0817	77	0.33	59	1,213
J-220-0844	20	0.00	75	1,214
J-220-1828	28	0.00	72	1,214
J-220-3339	78	4.33	57	1,215
J-220-0811	68	1.78	61	1,218
J-220-4473	71	0.00	60	1,219
J-220-0843	20	0.36	75	1,221
J-220-0068	39	3.56	71	1,222
J-220-0070	42	5.55	70	1,222
J-220-4014	99	3.13	50	1,223
J-220-2039	50	0.00	73	1,223
J-220-0083	45	0.65	68	1,227
J-220-2809	105	0.00	47	1,230
J-220-4784	58	0.00	64	1,234
J-220-0335	22	7.72	74	1,234
J-220-3961	92	0.00	52	1,236
J-220-0769	26	3.85	77	1,236
J-220-0022	36	0.00	72	1,239
J-220-2217	67	0.00	63	1,240
J-220-1878	80	0.00	58	1,241
J-220-1879	80	0.00	58	1,242
J-220-2372	23	0.00	74	1,242
J-220-2032	80	0.00	58	1,243
J-220-3830	46	0.00	67	1,244
J-220-2113	40	1.71	67	1,244
J-220-1706	109	10.89	46	1,245
J-220-3426	80	0.00	58	1,247
J-220-2112	39	0.00	68	1,247
J-220-3609	99	0.00	50	1,247
J-220-0478	73	8.49	59	1,249
J-220-1705	109	3.03	46	1,249
J-220-3427	80	0.00	58	1,250
J-220-0477	73	3.73	59	1,254
J-220-2430	83	0.00	56	1,256
J-220-4472	71	0.00	60	1,256
J-220-4323	77	0.00	58	1,259
J-220-0480	73	0.00	59	1,260
J-220-1367	43	10.00	70	1,262
J-220-4783	59	4.28	62	1,264
J-220-3282	83	4.02	58	1,265
J-220-3859	80	0.00	58	1,265
J-220-0086	46	1.47	68	1,271
J-220-3281	83	0.00	58	1,273
J-220-2111	39	8.20	68	1,274
J-220-4301	94	0.99	52	1,278

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4861	86	2.31	54	1,279
J-220-1704	109	2.00	46	1,281
J-220-4324	78	0.60	58	1,282
J-220-0479	73	0.00	59	1,286
J-220-0413	73	0.00	59	1,287
J-220-4856	85	3.80	55	1,287
J-220-0414	73	0.17	59	1,289
J-220-0925	86	0.00	55	1,289
J-220-3803	91	0.00	53	1,292
J-220-4069	64	4.78	62	1,297
J-220-2431	83	0.00	56	1,298
J-220-4179	86	2.12	55	1,299
J-220-0489	77	0.00	58	1,300
J-220-3283	83	13.66	58	1,300
J-220-0645	101	4.86	49	1,301
J-220-0347	22	3.49	74	1,301
J-220-0360	66	0.00	63	1,303
J-220-3172	73	0.00	59	1,303
J-220-0350	15	7.21	77	1,305
J-220-4471	58	4.71	64	1,306
J-220-3171	72	0.00	59	1,309
J-220-0021	44	10.87	69	1,312
J-220-2094	31	2.19	71	1,312
J-220-0490	77	0.00	58	1,313
J-220-2231	43	11.16	71	1,315
J-220-4322	77	0.00	58	1,317
J-220-1631	72	0.00	61	1,317
J-220-1516	24	4.91	74	1,318
J-220-4321	77	0.00	58	1,319
J-220-2488	105	1.97	48	1,320
J-220-4317	98	1.15	50	1,322
J-220-3450	110	2.45	45	1,323
J-220-1829	28	0.00	72	1,324
J-220-2578	77	1.61	58	1,324
J-220-4232	64	0.04	64	1,325
J-220-0815	72	0.00	60	1,326
J-220-4789	52	1.81	67	1,332
J-220-0338	15	1.01	77	1,333
J-220-0814	72	0.00	60	1,334
J-220-3469	61	4.21	66	1,336
J-220-4612	86	1.80	54	1,336
J-220-4138	102	0.00	49	1,342
J-220-0813	72	0.00	60	1,344
J-220-3688	97	0.00	51	1,344
J-220-4013	99	2.48	50	1,347
J-220-3801	81	3.46	57	1,350
J-220-0812	72	10.07	60	1,351
J-220-0200	39	8.15	70	1,351

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0862	80	0.79	57	1,352
J-220-1522	24	0.00	75	1,355
J-220-3804	91	0.00	53	1,356
J-220-3525	94	0.00	51	1,356
J-220-2440	101	5.67	50	1,357
J-220-4243	80	0.00	57	1,358
J-220-1526	24	4.71	75	1,363
J-220-4338	71	0.00	60	1,366
J-220-0177	80	0.72	57	1,367
J-220-3280	83	1.35	57	1,368
J-220-2770	109	0.00	48	1,370
J-220-4589	67	4.18	64	1,370
J-220-4803	65	0.00	63	1,371
J-220-2095	31	1.25	71	1,371
J-220-0328	14	5.53	78	1,372
J-220-2690	46	17.14	69	1,375
J-220-3415	88	1.68	54	1,376
J-220-1520	25	0.17	75	1,376
J-220-1766	38	7.96	72	1,376
J-220-4385	98	0.00	50	1,377
J-220-3904	97	9.16	50	1,377
J-220-3810	100	0.00	49	1,379
J-220-4113	76	10.43	58	1,380
J-220-3522	93	0.70	52	1,380
J-220-4588	66	6.13	65	1,381
J-220-0337	15	1.59	77	1,381
J-220-2806	104	0.00	48	1,381
J-220-2386	96	0.00	52	1,384
J-220-2583	57	7.77	63	1,385
J-220-4337	71	4.14	60	1,386
J-220-3043	57	7.00	63	1,386
J-220-3819	113	0.00	44	1,386
J-220-0161	37	4.02	72	1,390
J-220-3438	82	13.01	56	1,390
J-220-4888	54	1.03	64	1,395
J-220-2387	96	0.00	52	1,397
J-220-4064	64	0.31	62	1,398
J-220-0311	17	5.79	76	1,401
J-220-0874	39	6.51	70	1,402
J-220-4825	62	14.62	66	1,403
J-220-1502	20	3.51	75	1,403
J-220-3442	83	2.12	56	1,404
J-220-2402	91	2.07	52	1,405
J-220-3520	58	5.94	62	1,405
J-220-4758	68	2.48	61	1,405
J-220-2388	96	0.00	52	1,405
J-220-2424	104	0.00	48	1,406
J-220-3519	58	8.99	62	1,407

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1002	55	8.03	66	1,408
J-220-4618	80	3.26	57	1,408
J-220-2292	72	18.53	61	1,409
J-220-2428	101	5.00	49	1,410
J-220-0359	66	0.00	63	1,411
J-220-3443	83	0.00	56	1,411
J-220-3395	56	0.00	68	1,412
J-220-3133	56	7.98	63	1,414
J-220-2575	75	5.60	59	1,414
J-220-2389	96	1.08	51	1,417
J-220-4482	83	1.30	56	1,417
J-220-0842	20	2.48	75	1,417
J-220-4076	75	0.00	59	1,419
J-220-1004	55	15.94	66	1,421
J-220-4077	75	4.95	59	1,429
J-220-4720	54	2.96	65	1,430
J-220-4070	64	0.00	62	1,432
J-220-4540	69	0.00	61	1,436
J-220-0408	53	3.22	68	1,437
J-220-4805	70	0.36	60	1,439
J-220-3234	71	0.00	62	1,441
J-220-0999	48	2.28	68	1,442
J-220-1874	77	0.00	59	1,442
J-220-4806	70	0.39	60	1,443
J-220-2716	102	2.50	50	1,444
J-220-2572	102	3.01	50	1,444
J-220-3840	73	8.63	60	1,444
J-220-2391	100	1.01	50	1,444
J-220-4071	64	7.60	62	1,445
J-220-4886	85	3.32	55	1,445
J-220-4518	76	1.57	59	1,448
J-220-3808	83	1.71	56	1,453
J-220-0327	15	1.18	77	1,453
J-220-4122	86	1.92	55	1,454
J-220-0841	20	3.41	75	1,454
J-220-1366	43	3.13	70	1,458
J-220-4863	89	2.52	53	1,459
J-220-1003	48	9.11	68	1,459
J-220-4121	86	6.44	55	1,461
J-220-2465	90	5.43	53	1,462
J-220-2495	63	8.90	63	1,462
J-220-4328	109	0.00	48	1,463
J-220-2390	97	4.02	51	1,463
J-220-2405	90	5.24	53	1,464
J-220-2116	44	0.00	71	1,465
J-220-3324	76	0.00	59	1,465
J-220-2808	105	1.11	47	1,467
J-220-4611	86	34.36	54	1,468

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2230	44	0.00	70	1,469
J-220-4225	81	4.64	57	1,469
J-220-4496	73	0.00	60	1,470
J-220-2485	95	8.82	52	1,472
J-220-0856	44	0.00	70	1,477
J-220-1307	61	3.23	66	1,479
J-220-1214	46	0.00	68	1,481
J-220-2984	39	1.30	69	1,487
J-220-4015	66	5.55	64	1,488
J-220-0855	43	0.00	70	1,489
J-220-2423	105	0.00	47	1,489
J-220-3935	66	0.00	61	1,489
J-220-4335	67	0.75	62	1,490
J-220-3540	74	0.35	60	1,491
J-220-2361	91	4.40	53	1,492
J-220-1927	92	0.00	53	1,493
J-220-2782	58	34.72	66	1,494
J-220-0033	41	0.00	71	1,496
J-220-2910	66	11.40	61	1,500
J-220-1928	92	4.04	53	1,502
J-220-0816	77	11.25	59	1,502
J-220-3814	122	0.72	40	1,503
J-220-3446	55	0.00	63	1,504
J-220-1369	39	4.54	69	1,504
J-220-2057	27	0.00	77	1,504
J-220-3815	122	0.00	40	1,505
J-220-1738	37	0.00	72	1,506
J-220-0475	92	5.43	53	1,507
J-220-3932	66	18.35	61	1,508
J-220-2185	26	0.00	77	1,509
J-220-2719	56	19.79	63	1,509
J-220-4309	101	5.15	49	1,510
J-220-4539	69	11.40	61	1,510
J-220-3351	60	3.61	66	1,510
J-220-0970	39	0.29	69	1,513
J-220-2573	106	9.79	49	1,514
J-220-4898	39	0.00	69	1,514
J-220-4897	39	0.00	69	1,515
J-220-4896	39	0.31	69	1,518
J-220-0969	39	0.00	69	1,518
J-220-4895	39	0.00	69	1,521
J-220-2771	109	0.00	48	1,521
J-220-2180	105	10.07	48	1,521
J-220-0339	16	1.13	77	1,521
J-220-2536	79	2.77	58	1,522
J-220-2133	105	0.00	47	1,524
J-220-3816	120	0.60	41	1,524
J-220-1630	72	0.00	61	1,524

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3553	59	0.00	62	1,526
J-220-4163	75	0.68	59	1,528
J-220-1521	24	4.81	75	1,530
J-220-4039	110	7.74	45	1,531
J-220-2001	58	2.07	63	1,532
J-220-2872	75	0.00	59	1,534
J-220-1733	55	2.19	66	1,534
J-220-3901	94	3.49	51	1,535
J-220-0474	91	4.06	53	1,536
J-220-3962	88	6.61	54	1,538
J-220-1371	39	0.00	69	1,541
J-220-4853	84	4.78	55	1,543
J-220-4860	87	4.18	54	1,543
J-220-3233	71	7.12	62	1,544
J-220-0644	101	1.30	49	1,545
J-220-0303	70	0.00	62	1,546
J-220-3237	71	0.00	62	1,547
J-220-1486	14	0.00	77	1,549
J-220-2054	26	3.68	77	1,553
J-220-0519	33	4.65	70	1,553
J-220-4862	87	0.00	54	1,557
J-220-0468	87	1.61	54	1,557
J-220-4859	87	0.00	54	1,558
J-220-2691	46	4.74	69	1,559
J-220-4552	81	23.01	57	1,559
J-220-3817	118	1.15	42	1,559
J-220-1974	61	3.03	63	1,559
J-220-2965	31	0.20	71	1,560
J-220-4257	87	2.55	54	1,560
J-220-3185	56	16.18	63	1,562
J-220-0967	40	3.56	69	1,563
J-220-2579	74	8.99	60	1,563
J-220-1075	39	5.19	72	1,564
J-220-1764	40	6.66	71	1,566
J-220-4855	85	8.51	55	1,566
J-220-1073	39	0.00	72	1,567
J-220-3818	113	2.24	44	1,568
J-220-0341	16	2.26	77	1,569
J-220-4470	58	3.37	64	1,571
J-220-4541	68	6.61	61	1,573
J-220-1365	43	9.57	70	1,573
J-220-1487	14	0.19	77	1,574
J-220-4854	85	0.00	55	1,578
J-220-2760	67	3.15	61	1,578
J-220-1074	39	0.00	72	1,579
J-220-2735	60	0.00	62	1,579
J-220-4857	85	0.00	55	1,579
J-220-0469	85	2.60	55	1,579

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2954	39	0.00	69	1,581
J-220-4858	85	1.42	55	1,581
J-220-4207	80	5.55	57	1,583
J-220-2334	48	7.19	68	1,585
J-220-2472	106	3.13	47	1,586
J-220-4404	79	0.00	58	1,586
J-220-3036	107	0.00	49	1,587
J-220-1737	37	0.00	72	1,587
J-220-2189	39	0.00	71	1,590
J-220-4292	66	19.82	63	1,590
J-220-3662	108	0.00	51	1,591
J-220-3883	58	0.00	64	1,591
J-220-2665	61	13.87	62	1,592
J-220-1372	39	0.00	69	1,593
J-220-4027	67	0.00	61	1,593
J-220-2499	51	17.84	67	1,594
J-220-0101	43	5.77	69	1,597
J-220-2734	60	21.95	62	1,598
J-220-3743	46	0.00	67	1,600
J-220-0267	20	0.00	80	1,600
J-220-1890	39	6.56	72	1,601
J-220-3531	74	1.75	60	1,601
J-220-4038	110	0.00	45	1,602
J-220-1761	85	6.85	56	1,603
J-220-0434	84	0.00	55	1,604
J-220-4312	72	0.00	61	1,604
J-220-1851	100	4.38	50	1,607
J-220-0432	82	11.11	56	1,607
J-220-1510	27	2.62	76	1,607
J-220-4890	54	0.00	64	1,608
J-220-1370	39	5.39	69	1,611
J-220-4405	79	0.00	58	1,612
J-220-0809	67	0.00	61	1,612
J-220-3433	103	0.00	49	1,624
J-220-2715	89	0.70	54	1,626
J-220-3902	91	0.00	53	1,628
J-220-4127	99	1.37	50	1,631
J-220-0100	43	6.47	69	1,632
J-220-1297	46	0.00	68	1,633
J-220-3751	83	0.00	56	1,635
J-220-3642	49	1.11	66	1,635
J-220-0002	46	0.00	68	1,636
J-220-2360	89	0.00	54	1,636
J-220-3641	49	2.98	66	1,637
J-220-2359	88	0.77	54	1,642
J-220-0808	67	0.00	61	1,643
J-220-2664	62	8.39	62	1,643
J-220-2641	21	3.63	80	1,644

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0020	44	0.00	69	1,644
J-220-2969	28	0.00	72	1,644
J-220-1850	100	0.00	49	1,646
J-220-0001	46	0.00	68	1,647
J-220-4493	85	4.47	55	1,648
J-220-4802	66	1.01	62	1,648
J-220-4017	58	0.00	68	1,648
J-220-2839	24	0.00	74	1,649
J-220-0810	67	0.00	61	1,649
J-220-0431	82	9.83	56	1,651
J-220-0006	47	0.00	67	1,652
J-220-0682	30	1.16	71	1,653
J-220-4140	106	0.00	52	1,653
J-220-1508	27	0.00	76	1,653
J-220-0082	45	0.99	68	1,654
J-220-1114	65	4.70	64	1,654
J-220-4630	99	0.00	50	1,658
J-220-1509	27	3.03	76	1,658
J-220-3044	50	6.83	66	1,659
J-220-4200	78	8.70	58	1,661
J-220-1056	21	0.00	80	1,662
J-220-1519	24	4.21	76	1,663
J-220-0012	46	0.00	68	1,663
J-220-0470	93	0.00	53	1,663
J-220-4633	99	0.00	50	1,664
J-220-1213	45	0.00	68	1,665
J-220-0679	30	0.70	71	1,666
J-220-1097	27	13.39	76	1,667
J-220-0584	102	5.58	48	1,668
J-220-0236	47	6.47	67	1,668
J-220-4775	61	0.00	64	1,669
J-220-0467	85	3.37	56	1,671
J-220-0892	110	0.00	45	1,673
J-220-2241	44	10.53	70	1,674
J-220-4632	99	0.00	50	1,675
J-220-3882	58	5.72	64	1,677
J-220-4631	100	2.79	50	1,678
J-220-2928	64	16.47	63	1,679
J-220-1406	44	21.11	68	1,679
J-220-2989	78	0.00	59	1,679
J-220-1538	49	6.78	66	1,680
J-220-4542	67	5.51	62	1,682
J-220-2037	41	2.00	71	1,682
J-220-4865	110	0.00	45	1,685
J-220-1162	20	0.00	80	1,685
J-220-0578	110	0.67	45	1,686
J-220-1567	99	9.91	50	1,686
J-220-2188	39	0.00	71	1,687

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2003	59	13.42	62	1,688
J-220-4234	60	3.04	66	1,689
J-220-1514	25	0.00	75	1,689
J-220-4864	110	0.00	45	1,689
J-220-3881	58	0.00	64	1,690
J-220-4849	110	0.00	45	1,691
J-220-1385	60	0.00	66	1,692
J-220-3336	71	0.00	61	1,693
J-220-2203	100	0.00	49	1,693
J-220-3622	50	0.00	65	1,693
J-220-1319	81	2.60	58	1,695
J-220-0178	80	5.72	57	1,699
J-220-1022	60	0.00	65	1,699
J-220-4528	62	5.31	63	1,699
J-220-4251	93	7.19	52	1,700
J-220-0676	30	2.25	71	1,702
J-220-0179	80	5.48	57	1,703
J-220-4185	61	0.00	65	1,703
J-220-4848	110	0.00	45	1,703
J-220-4530	61	0.00	63	1,704
J-220-0329	16	1.44	77	1,705
J-220-2497	69	0.00	61	1,705
J-220-2952	48	0.60	66	1,705
J-220-4794	61	0.00	63	1,705
J-220-4529	61	2.60	63	1,706
J-220-1873	77	0.00	59	1,707
J-220-4801	68	0.00	62	1,708
J-220-4797	61	0.00	63	1,708
J-220-1098	32	28.88	74	1,708
J-220-1790	21	7.29	80	1,708
J-220-0404	55	0.19	68	1,710
J-220-4763	61	0.00	63	1,710
J-220-4346	58	0.00	64	1,710
J-220-0330	16	0.00	77	1,711
J-220-4800	68	0.00	62	1,711
J-220-2509	109	0.00	48	1,712
J-220-2581	72	0.00	61	1,713
J-220-1566	99	2.81	50	1,713
J-220-1628	68	0.00	62	1,714
J-220-1320	81	2.96	58	1,714
J-220-1437	48	2.40	67	1,715
J-220-0454	108	6.11	46	1,715
J-220-1313	21	0.00	74	1,715
J-220-0993	19	6.04	75	1,717
J-220-4435	93	3.87	52	1,717
J-220-3091	46	14.31	71	1,718
J-220-1627	68	0.00	62	1,718
J-220-4764	61	0.65	63	1,719

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2491	56	0.00	65	1,720
J-220-1436	48	0.22	67	1,720
J-220-4823	88	0.00	54	1,722
J-220-3608	97	3.17	50	1,724
J-220-2678	51	11.44	67	1,726
J-220-1438	48	0.00	67	1,726
J-220-4345	59	0.70	63	1,726
J-220-0332	16	0.79	77	1,726
J-220-4846	71	0.00	62	1,729
J-220-1312	21	0.00	74	1,730
J-220-3615	102	7.17	49	1,731
J-220-1299	48	2.16	67	1,731
J-220-2831	21	1.18	80	1,732
J-220-1043	37	0.00	72	1,732
J-220-3884	58	1.35	64	1,732
J-220-1082	48	0.00	67	1,733
J-220-2427	100	2.72	49	1,733
J-220-4455	59	3.73	65	1,734
J-220-4350	69	0.00	62	1,734
J-220-4477	59	8.30	63	1,735
J-220-3723	63	0.00	65	1,738
J-220-3911	92	2.69	52	1,741
J-220-0534	33	0.00	74	1,741
J-220-0948	60	0.00	65	1,741
J-220-2414	55	0.00	63	1,742
J-220-3497	84	0.00	56	1,742
J-220-2580	71	2.89	61	1,743
J-220-1265	45	0.00	68	1,743
J-220-0005	47	0.00	67	1,743
J-220-3547	72	4.18	61	1,743
J-220-2335	49	10.96	68	1,744
J-220-3499	84	2.74	55	1,745
J-220-3910	92	0.00	53	1,745
J-220-2048	21	4.35	77	1,745
J-220-4610	80	10.82	57	1,747
J-220-1021	60	0.00	65	1,748
J-220-0919	31	5.03	75	1,750
J-220-2000	58	8.01	63	1,750
J-220-3040	86	2.16	56	1,751
J-220-1830	28	0.24	72	1,751
J-220-3498	84	9.88	56	1,751
J-220-1973	62	22.00	63	1,752
J-220-1972	61	6.13	63	1,754
J-220-3968	83	3.10	56	1,754
J-220-4306	100	0.00	49	1,755
J-220-2339	57	13.51	65	1,755
J-220-2299	88	7.98	54	1,757
J-220-0004	47	0.02	67	1,759

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4852	83	1.68	56	1,759
J-220-3705	110	0.00	45	1,759
J-220-2284	60	0.00	66	1,760
J-220-3763	65	0.00	63	1,762
J-220-3985	79	7.24	58	1,763
J-220-3579	84	6.95	56	1,764
J-220-3764	65	11.54	63	1,764
J-220-3414	92	11.49	53	1,764
J-220-2704	65	0.00	62	1,765
J-220-0593	28	4.96	72	1,765
J-220-3895	93	8.68	52	1,765
J-220-0979	16	0.00	81	1,765
J-220-3942	68	3.97	60	1,766
J-220-3659	101	0.00	49	1,767
J-220-3894	92	12.74	52	1,768
J-220-1848	100	2.04	49	1,769
J-220-4707	53	1.61	67	1,769
J-220-3765	65	0.00	63	1,769
J-220-0159	37	10.17	72	1,769
J-220-2830	21	0.22	80	1,769
J-220-4334	65	0.00	63	1,771
J-220-1477	29	0.00	76	1,772
J-220-4490	84	2.00	55	1,772
J-220-3766	65	2.65	63	1,773
J-220-3658	102	0.00	49	1,776
J-220-1447	51	5.70	66	1,778
J-220-4206	81	0.00	57	1,778
J-220-3449	110	0.00	45	1,778
J-220-1095	30	2.69	75	1,778
J-220-1443	47	0.00	68	1,779
J-220-1446	51	0.00	66	1,780
J-220-4395	72	0.00	61	1,780
J-220-3967	82	0.00	57	1,780
J-220-3966	81	0.00	57	1,781
J-220-3964	82	0.07	56	1,781
J-220-1551	33	0.00	70	1,782
J-220-0579	103	0.00	48	1,782
J-220-4706	53	0.00	67	1,784
J-220-1445	51	0.00	66	1,784
J-220-2679	56	5.00	65	1,784
J-220-4486	88	1.30	54	1,787
J-220-3963	82	0.00	57	1,788
J-220-4489	83	3.13	56	1,788
J-220-4139	106	0.00	51	1,794
J-220-3965	82	0.00	57	1,795
J-220-0635	77	0.00	60	1,796
J-220-4230	63	1.64	64	1,797
J-220-2002	57	3.15	63	1,797

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0411	106	0.00	47	1,798
J-220-4300	100	3.73	49	1,798
J-220-2582	55	0.00	64	1,798
J-220-0407	52	1.22	69	1,799
J-220-2680	56	13.22	65	1,799
J-220-0410	106	0.00	47	1,799
J-220-1479	26	0.00	77	1,800
J-220-2473	106	0.00	47	1,800
J-220-0266	20	0.00	80	1,801
J-220-1853	106	0.00	47	1,802
J-220-2053	25	3.29	77	1,803
J-220-0995	19	0.24	75	1,803
J-220-4817	82	0.00	56	1,804
J-220-4705	53	0.00	67	1,805
J-220-0586	103	0.91	48	1,806
J-220-1849	100	0.39	49	1,807
J-220-4128	99	0.00	50	1,807
J-220-4303	101	2.31	49	1,809
J-220-0403	55	0.00	68	1,809
J-220-2873	73	0.42	60	1,810
J-220-2614	45	0.00	68	1,813
J-220-4357	66	0.26	61	1,814
J-220-4374	101	0.00	49	1,815
J-220-2705	65	16.89	62	1,815
J-220-4336	65	5.63	63	1,817
J-220-3198	64	0.00	64	1,817
J-220-3760	69	0.00	61	1,817
J-220-2530	100	0.00	50	1,818
J-220-4250	94	5.12	52	1,819
J-220-3761	69	0.00	61	1,819
J-220-0265	20	0.00	80	1,819
J-220-3621	50	0.00	65	1,822
J-220-4885	84	0.00	55	1,822
J-220-4373	101	0.00	49	1,823
J-220-4201	78	0.58	58	1,824
J-220-3722	62	0.00	65	1,824
J-220-2820	22	0.00	79	1,825
J-220-0412	103	7.36	48	1,825
J-220-4302	101	0.00	49	1,825
J-220-4787	53	0.00	67	1,827
J-220-4656	76	0.00	59	1,828
J-220-4304	100	0.00	50	1,828
J-220-0400	55	0.00	68	1,828
J-220-4696	83	2.67	56	1,829
J-220-4026	66	0.00	61	1,829
J-220-0647	84	14.71	55	1,830
J-220-4231	63	8.02	64	1,830
J-220-3420	99	0.96	50	1,832

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2563	21	0.00	74	1,832
J-220-3711	99	0.00	50	1,832
J-220-3657	101	0.00	49	1,833
J-220-3710	99	0.00	50	1,833
J-220-3762	69	19.48	61	1,835
J-220-2640	21	1.06	80	1,835
J-220-3607	97	0.00	50	1,836
J-220-3709	99	0.00	50	1,837
J-220-2968	30	0.48	71	1,837
J-220-4619	80	5.86	57	1,837
J-220-3432	103	0.00	49	1,838
J-220-0511	54	0.00	68	1,838
J-220-1239	28	0.00	77	1,839
J-220-3656	101	0.00	49	1,839
J-220-4210	75	0.79	59	1,839
J-220-0357	67	0.00	63	1,840
J-220-4199	78	0.70	58	1,840
J-220-2316	68	44.02	60	1,842
J-220-4126	99	0.58	50	1,842
J-220-3060	63	0.00	64	1,843
J-220-0583	103	0.00	48	1,843
J-220-4602	62	8.01	64	1,844
J-220-0356	67	2.16	63	1,845
J-220-4584	64	0.00	63	1,847
J-220-1869	74	10.51	60	1,847
J-220-0146	51	3.58	66	1,847
J-220-0067	37	8.54	72	1,847
J-220-4583	64	0.00	63	1,847
J-220-4582	64	1.13	63	1,848
J-220-4586	64	0.00	63	1,848
J-220-3445	56	0.00	63	1,848
J-220-1377	47	0.00	67	1,849
J-220-4579	64	1.18	63	1,849
J-220-4755	64	0.00	64	1,849
J-220-4756	64	0.00	63	1,850
J-220-4585	64	2.65	63	1,851
J-220-4788	53	0.77	67	1,851
J-220-0723	66	1.76	63	1,851
J-220-4198	78	1.59	58	1,854
J-220-1175	66	0.00	61	1,855
J-220-1648	22	0.00	80	1,857
J-220-0471	89	1.68	54	1,858
J-220-4580	64	7.62	64	1,858
J-220-0144	51	1.35	66	1,859
J-220-0145	52	1.11	66	1,860
J-220-0003	48	0.00	67	1,860
J-220-4305	100	0.00	49	1,861
J-220-3003	44	4.09	71	1,863

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4671	70	0.00	61	1,864
J-220-4229	63	39.08	64	1,865
J-220-1376	47	2.45	67	1,865
J-220-0994	19	5.24	75	1,866
J-220-0580	103	0.00	48	1,866
J-220-4526	100	0.00	50	1,868
J-220-3838	73	3.63	61	1,868
J-220-1854	104	0.00	48	1,869
J-220-3160	69	0.55	62	1,870
J-220-0076	40	18.59	70	1,871
J-220-4901	20	8.74	75	1,872
J-220-1284	36	6.04	72	1,872
J-220-4664	77	1.97	58	1,872
J-220-0582	103	0.00	48	1,873
J-220-0069	42	5.07	70	1,873
J-220-4672	69	0.00	62	1,873
J-220-0646	84	0.00	55	1,874
J-220-1454	48	0.00	67	1,874
J-220-3606	97	1.99	50	1,874
J-220-1855	104	0.00	48	1,875
J-220-0756	58	0.00	65	1,875
J-220-4525	100	1.27	50	1,876
J-220-3807	82	1.23	56	1,876
J-220-0066	37	12.48	72	1,877
J-220-1375	47	5.99	67	1,877
J-220-1713	60	2.69	64	1,878
J-220-0692	15	5.63	77	1,879
J-220-1071	41	4.81	72	1,880
J-220-2739	33	0.00	70	1,881
J-220-2666	109	3.94	50	1,881
J-220-2562	21	43.58	74	1,882
J-220-0581	102	0.00	48	1,883
J-220-0358	65	17.46	64	1,883
J-220-0075	40	0.00	70	1,884
J-220-1079	48	2.12	67	1,887
J-220-4884	84	1.97	55	1,887
J-220-4222	83	5.15	56	1,889
J-220-4246	100	4.81	50	1,889
J-220-4881	84	7.62	55	1,890
J-220-4883	84	0.00	55	1,891
J-220-1078	48	0.00	67	1,891
J-220-0918	30	0.00	75	1,892
J-220-2745	33	0.00	70	1,892
J-220-2169	44	3.58	71	1,894
J-220-1283	36	7.17	72	1,895
J-220-0949	65	14.07	64	1,896
J-220-1647	22	0.00	80	1,896
J-220-2819	21	0.00	80	1,898

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1442	47	0.00	68	1,899
J-220-4063	104	0.00	48	1,900
J-220-4795	60	2.69	64	1,900
J-220-2140	106	8.73	47	1,901
J-220-0435	85	3.75	55	1,901
J-220-0103	40	0.26	70	1,902
J-220-0025	40	0.00	70	1,903
J-220-0078	39	0.00	71	1,903
J-220-1729	21	0.00	75	1,904
J-220-4283	84	5.07	55	1,905
J-220-2461	89	8.03	53	1,905
J-220-0793	27	15.56	76	1,906
J-220-3612	100	2.98	49	1,906
J-220-1172	66	3.68	61	1,907
J-220-4241	66	1.68	61	1,907
J-220-0065	42	3.46	70	1,908
J-220-2186	31	0.00	74	1,909
J-220-4033	99	0.00	50	1,909
J-220-1646	22	0.29	80	1,909
J-220-0077	40	0.00	70	1,910
J-220-0079	40	1.30	70	1,910
J-220-3002	43	4.33	70	1,911
J-220-0027	40	0.00	70	1,911
J-220-0565	51	10.53	66	1,912
J-220-4284	82	6.71	56	1,914
J-220-0662	21	2.69	77	1,915
J-220-0089	48	6.95	68	1,915
J-220-0282	36	4.26	73	1,915
J-220-0026	40	1.03	70	1,917
J-220-4766	59	0.58	64	1,917
J-220-1669	28	1.73	72	1,919
J-220-0160	38	6.30	72	1,919
J-220-1402	48	3.92	66	1,919
J-220-1668	28	4.81	72	1,921
J-220-2508	108	0.00	48	1,922
J-220-2560	23	0.00	74	1,924
J-220-0661	21	0.00	77	1,925
J-220-1485	15	0.19	77	1,925
J-220-4285	82	4.71	56	1,925
J-220-2416	55	0.00	63	1,928
J-220-3159	69	0.00	62	1,928
J-220-0024	40	3.27	70	1,929
J-220-3470	61	0.00	66	1,930
J-220-2856	42	3.27	72	1,930
J-220-1077	49	2.08	67	1,930
J-220-0553	19	0.00	75	1,931
J-220-3444	56	0.00	63	1,932
J-220-1808	30	2.98	73	1,933

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4491	82	3.65	56	1,934
J-220-2310	79	0.00	59	1,939
J-220-2793	100	0.00	49	1,939
J-220-0610	25	7.48	78	1,940
J-220-0099	44	2.40	69	1,941
J-220-3745	46	0.00	67	1,941
J-220-0865	24	11.93	78	1,941
J-220-1192	58	1.77	67	1,942
J-220-1403	48	5.67	66	1,943
J-220-0466	85	1.20	56	1,943
J-220-0552	19	1.68	75	1,944
J-220-4084	50	0.00	65	1,944
J-220-0988	19	1.90	75	1,945
J-220-2144	89	18.22	53	1,946
J-220-2084	52	5.00	66	1,946
J-220-0081	46	0.00	68	1,947
J-220-4765	60	2.72	64	1,947
J-220-0345	19	6.04	75	1,951
J-220-3140	71	0.00	62	1,952
J-220-3897	94	10.19	52	1,952
J-220-2559	23	5.94	74	1,953
J-220-0010	41	1.11	70	1,954
J-220-4816	63	2.40	65	1,954
J-220-4297	80	7.38	57	1,955
J-220-1760	55	0.00	67	1,955
J-220-4247	98	14.67	51	1,956
J-220-1872	77	0.00	59	1,956
J-220-1889	40	3.15	72	1,956
J-220-0056	32	12.89	74	1,957
J-220-1335	99	5.05	50	1,958
J-220-2973	98	47.97	50	1,958
J-220-0088	49	3.37	67	1,959
J-220-4212	71	0.00	61	1,959
J-220-2805	103	1.08	48	1,960
J-220-1472	21	0.00	77	1,960
J-220-4209	71	3.85	61	1,961
J-220-4889	55	0.00	64	1,961
J-220-0473	88	0.67	55	1,962
J-220-1670	27	0.24	72	1,963
J-220-3047	51	0.00	65	1,964
J-220-1513	21	0.00	77	1,964
J-220-4810	56	0.00	63	1,964
J-220-0113	20	15.72	75	1,966
J-220-0228	61	0.00	65	1,966
J-220-4601	61	6.01	64	1,966
J-220-2151	90	7.57	53	1,967
J-220-1512	21	0.00	77	1,967
J-220-2744	33	0.00	70	1,968

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2800	27	4.06	72	1,970
J-220-0286	41	4.59	71	1,970
J-220-3611	100	0.00	49	1,972
J-220-2398	83	1.16	56	1,972
J-220-1649	55	1.71	65	1,972
J-220-3232	46	0.00	67	1,972
J-220-3039	87	0.36	56	1,973
J-220-0235	44	8.34	69	1,974
J-220-4348	59	0.00	64	1,974
J-220-1287	44	0.00	69	1,974
J-220-3879	88	0.55	55	1,975
J-220-2038	41	4.23	71	1,976
J-220-0406	52	0.00	69	1,977
J-220-3448	108	0.00	46	1,977
J-220-4347	60	6.11	64	1,977
J-220-4329	59	0.55	64	1,979
J-220-4330	59	0.00	64	1,979
J-220-4349	59	1.56	64	1,979
J-220-2088	44	0.00	69	1,980
J-220-4040	108	0.00	46	1,982
J-220-0516	44	0.00	69	1,982
J-220-0349	19	6.20	75	1,983
J-220-1555	83	3.80	56	1,983
J-220-4331	59	3.61	64	1,983
J-220-2777	58	0.00	68	1,984
J-220-3806	108	0.00	46	1,985
J-220-0455	108	1.49	46	1,985
J-220-0517	44	0.24	69	1,985
J-220-0476	15	12.36	77	1,986
J-220-0464	85	1.76	56	1,987
J-220-2333	49	1.80	68	1,988
J-220-4704	53	0.48	67	1,989
J-220-3715	108	0.00	46	1,990
J-220-0080	46	0.70	68	1,990
J-220-0226	63	2.03	64	1,991
J-220-3286	98	9.06	51	1,991
J-220-3287	100	1.90	50	1,993
J-220-3279	100	2.00	50	1,994
J-220-4082	55	0.00	64	1,994
J-220-3288	100	0.00	50	1,994
J-220-0346	19	0.00	75	1,995
J-220-0009	43	1.39	69	1,995
J-220-2397	83	1.57	56	1,996
J-220-0011	46	0.00	68	1,996
J-220-4673	69	4.30	62	1,996
J-220-3454	56	0.00	63	1,997
J-220-0344	19	2.89	75	1,998
J-220-1300	32	12.91	74	1,998

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4807	54	0.00	65	1,999
J-220-0514	44	0.00	69	2,001
J-220-0227	62	0.00	65	2,001
J-220-3903	95	4.21	51	2,001
J-220-3297	106	4.91	52	2,003
J-220-3378	62	2.01	65	2,004
J-220-0058	27	0.51	76	2,004
J-220-0501	28	4.14	77	2,005
J-220-2404	90	6.85	53	2,008
J-220-0125	28	11.47	72	2,008
J-220-0123	28	7.00	72	2,010
J-220-3706	106	1.20	47	2,010
J-220-0472	88	0.58	55	2,012
J-220-0348	19	0.67	75	2,013
J-220-0044	44	0.00	69	2,013
J-220-0210	46	0.00	67	2,013
J-220-1483	16	1.60	76	2,014
J-220-2776	58	0.00	68	2,015
J-220-4605	59	6.92	65	2,016
J-220-2642	21	2.79	80	2,016
J-220-3132	56	16.21	63	2,019
J-220-3278	100	0.00	50	2,020
J-220-1484	16	0.31	77	2,023
J-220-4674	69	1.53	62	2,023
J-220-4420	106	0.00	47	2,025
J-220-4454	59	0.00	65	2,025
J-220-2469	90	19.45	53	2,026
J-220-3986	59	0.63	65	2,026
J-220-4465	57	1.64	65	2,027
J-220-4603	63	3.92	64	2,028
J-220-2983	43	2.04	68	2,028
J-220-4744	57	9.55	66	2,030
J-220-2061	20	0.00	77	2,031
J-220-1460	20	0.00	77	2,031
J-220-1459	20	0.48	77	2,033
J-220-4682	55	0.00	64	2,033
J-220-2060	20	1.15	77	2,033
J-220-1334	63	2.19	64	2,034
J-220-2823	22	0.00	79	2,035
J-220-2824	22	0.00	79	2,035
J-220-3174	104	6.59	48	2,036
J-220-4464	57	0.00	66	2,037
J-220-0938	38	5.43	72	2,037
J-220-4463	57	1.18	66	2,038
J-220-3453	56	0.00	63	2,039
J-220-3479	72	0.00	61	2,040
J-220-2949	43	0.00	68	2,040
J-220-0940	38	2.62	72	2,041

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4782	55	0.00	64	2,041
J-220-4681	55	0.00	64	2,041
J-220-2821	22	0.00	79	2,041
J-220-3131	56	0.00	63	2,041
J-220-4684	55	0.24	64	2,041
J-220-3387	103	5.24	49	2,042
J-220-2403	91	10.56	52	2,042
J-220-1386	70	1.42	61	2,043
J-220-3738	45	0.00	68	2,043
J-220-1904	47	1.71	69	2,044
J-220-0978	16	5.91	81	2,046
J-220-0966	47	14.74	67	2,047
J-220-0209	46	0.00	67	2,048
J-220-3610	100	0.91	49	2,049
J-220-4717	66	5.91	63	2,049
J-220-2843	24	6.35	74	2,050
J-220-1441	51	3.27	66	2,050
J-220-0648	84	0.00	55	2,050
J-220-1081	48	12.98	67	2,051
J-220-0433	84	2.16	55	2,053
J-220-2132	105	0.00	47	2,054
J-220-4466	56	3.39	66	2,054
J-220-4824	62	3.75	66	2,055
J-220-3349	45	2.89	68	2,056
J-220-2774	55	0.00	64	2,057
J-220-4384	63	0.00	62	2,057
J-220-1245	21	0.00	75	2,058
J-220-2970	30	1.77	71	2,058
J-220-1409	43	0.00	68	2,059
J-220-1721	73	11.78	61	2,059
J-220-2775	55	0.00	64	2,059
J-220-4497	70	3.37	61	2,063
J-220-3614	103	1.11	48	2,064
J-220-1241	21	0.00	75	2,064
J-220-3023	30	1.38	71	2,065
J-220-1407	43	3.68	68	2,066
J-220-1722	73	2.96	61	2,066
J-220-1463	21	0.00	77	2,066
J-220-1659	63	2.40	63	2,067
J-220-3128	104	9.52	49	2,068
J-220-2529	100	0.00	50	2,068
J-220-1410	43	0.00	68	2,068
J-220-2714	105	0.94	47	2,068
J-220-2772	55	5.70	64	2,069
J-220-1242	21	3.65	74	2,070
J-220-2464	90	0.00	53	2,070
J-220-2063	21	2.09	77	2,071
J-220-1734	57	1.08	65	2,071

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0965	47	0.00	67	2,071
J-220-3640	45	4.45	68	2,071
J-220-4094	53	5.29	66	2,071
J-220-0453	108	1.39	46	2,071
J-220-4244	63	0.00	64	2,072
J-220-4211	69	1.55	62	2,073
J-220-0301	71	1.64	62	2,075
J-220-3456	56	0.00	63	2,075
J-220-3452	56	0.00	63	2,075
J-220-3134	56	0.00	63	2,075
J-220-2475	105	0.19	47	2,076
J-220-3987	57	0.00	65	2,076
J-220-4892	56	0.00	63	2,077
J-220-4891	56	0.00	63	2,078
J-220-3447	56	0.00	63	2,078
J-220-2458	84	13.06	56	2,078
J-220-1458	21	0.00	77	2,078
J-220-0059	27	12.57	76	2,078
J-220-1462	21	0.00	77	2,079
J-220-3455	56	4.91	63	2,079
J-220-2720	53	3.63	64	2,080
J-220-3135	56	5.10	63	2,080
J-220-1444	47	0.00	68	2,080
J-220-1408	43	0.00	68	2,081
J-220-4498	70	0.00	61	2,082
J-220-1987	43	0.00	68	2,082
J-220-3742	46	0.00	67	2,082
J-220-0989	24	3.08	73	2,083
J-220-4812	56	7.55	63	2,083
J-220-3833	46	0.00	67	2,084
J-220-4685	56	6.80	63	2,084
J-220-2199	105	0.00	47	2,084
J-220-4047	46	0.00	67	2,085
J-220-3831	46	0.00	67	2,086
J-220-3862	95	2.14	51	2,087
J-220-2036	44	4.18	71	2,087
J-220-4894	46	0.00	67	2,087
J-220-0452	108	8.80	46	2,087
J-220-1461	21	0.00	77	2,088
J-220-4046	46	0.00	67	2,088
J-220-2168	44	0.00	71	2,091
J-220-0429	84	0.17	55	2,091
J-220-4427	115	0.00	43	2,092
J-220-4080	55	0.00	64	2,092
J-220-4786	55	0.00	63	2,092
J-220-2958	46	0.84	67	2,092
J-220-0936	16	6.04	81	2,093
J-220-1096	31	6.23	74	2,093

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4643	73	0.00	60	2,093
J-220-2959	46	12.33	67	2,093
J-220-4079	55	0.00	64	2,093
J-220-1988	43	10.82	68	2,094
J-220-3741	46	3.73	67	2,094
J-220-4236	74	2.36	60	2,094
J-220-2198	104	0.00	48	2,094
J-220-3660	101	0.00	50	2,095
J-220-4785	55	5.24	63	2,095
J-220-0981	16	5.67	81	2,095
J-220-0289	22	0.00	74	2,096
J-220-2773	55	5.24	64	2,096
J-220-4407	75	2.69	59	2,097
J-220-4408	75	5.53	59	2,097
J-220-1546	22	3.06	74	2,097
J-220-2533	87	4.50	56	2,098
J-220-3059	63	0.00	64	2,099
J-220-3163	57	0.00	64	2,099
J-220-3164	57	1.33	64	2,099
J-220-3166	57	0.00	64	2,099
J-220-2197	104	0.00	48	2,100
J-220-1752	32	0.00	70	2,100
J-220-2672	57	0.00	64	2,100
J-220-1336	104	9.76	48	2,100
J-220-4075	70	1.25	61	2,100
J-220-4419	106	1.35	47	2,100
J-220-3042	78	0.00	59	2,100
J-220-0288	22	1.64	74	2,100
J-220-2101	65	0.00	62	2,101
J-220-0272	33	1.46	70	2,102
J-220-3613	103	6.04	48	2,102
J-220-4746	57	1.71	65	2,103
J-220-2613	45	3.61	68	2,104
J-220-2396	81	1.38	57	2,104
J-220-2807	105	3.58	47	2,106
J-220-1751	32	6.84	70	2,106
J-220-3034	92	0.00	52	2,106
J-220-0428	84	2.31	55	2,106
J-220-0950	66	0.79	63	2,106
J-220-3899	91	10.68	53	2,107
J-220-2468	90	1.39	53	2,107
J-220-2605	83	10.29	56	2,107
J-220-0170	64	7.98	64	2,108
J-220-3416	88	9.93	54	2,108
J-220-1709	28	15.17	72	2,109
J-220-0171	63	1.92	64	2,110
J-220-0957	64	2.36	62	2,110
J-220-2721	53	3.92	64	2,110

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3573	77	0.00	58	2,110
J-220-2270	75	0.00	59	2,111
J-220-2167	44	0.00	71	2,112
J-220-1076	48	4.20	67	2,112
J-220-3236	71	0.00	62	2,112
J-220-2725	47	0.00	67	2,113
J-220-0790	53	0.00	66	2,114
J-220-3435	98	6.08	51	2,114
J-220-0964	47	0.00	67	2,114
J-220-2724	47	3.37	67	2,115
J-220-0143	53	0.00	66	2,115
J-220-2467	90	0.00	53	2,115
J-220-0524	65	9.96	62	2,115
J-220-2650	63	4.89	63	2,115
J-220-3162	57	1.49	64	2,115
J-220-3161	57	0.00	64	2,115
J-220-2927	47	0.00	66	2,115
J-220-0142	53	0.00	66	2,115
J-220-2926	47	0.00	67	2,116
J-220-0140	53	0.00	66	2,116
J-220-2201	104	0.48	48	2,116
J-220-2671	57	2.12	64	2,116
J-220-0141	53	0.00	66	2,116
J-220-3030	90	0.00	53	2,118
J-220-1846	53	0.00	66	2,118
J-220-4356	69	0.92	62	2,118
J-220-2035	44	1.11	71	2,118
J-220-3165	57	2.10	64	2,120
J-220-1482	16	0.00	77	2,120
J-220-0319	20	7.62	75	2,120
J-220-4547	55	8.92	65	2,120
J-220-1930	38	0.24	69	2,122
J-220-1693	99	0.00	50	2,123
J-220-0946	63	3.58	64	2,123
J-220-0986	24	0.00	73	2,124
J-220-0951	67	0.00	63	2,125
J-220-3708	107	1.44	46	2,125
J-220-3001	44	2.50	71	2,126
J-220-3539	74	0.00	60	2,126
J-220-3193	49	0.00	66	2,127
J-220-3191	48	2.60	66	2,128
J-220-1209	28	0.00	72	2,128
J-220-3192	48	0.00	66	2,129
J-220-2271	75	0.00	59	2,130
J-220-1080	48	1.84	67	2,130
J-220-3707	107	0.00	46	2,131
J-220-1210	28	3.54	72	2,131
J-220-0451	106	5.70	47	2,131

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3457	63	0.61	63	2,131
J-220-1636	72	0.00	61	2,132
J-220-4726	77	0.39	59	2,132
J-220-3046	51	10.56	65	2,133
J-220-0340	18	5.17	76	2,133
J-220-2967	30	4.26	71	2,134
J-220-4042	49	5.77	66	2,134
J-220-3542	73	3.43	60	2,134
J-220-1629	72	0.00	61	2,134
J-220-3809	98	5.34	50	2,135
J-220-2066	99	0.79	50	2,136
J-220-4249	94	1.80	52	2,138
J-220-3774	53	4.64	64	2,139
J-220-0465	78	4.88	59	2,141
J-220-0334	18	4.26	76	2,144
J-220-2612	45	3.08	68	2,144
J-220-2421	53	5.22	64	2,144
J-220-1439	39	19.11	71	2,144
J-220-1492	37	10.39	72	2,144
J-220-2139	106	0.19	47	2,145
J-220-0074	44	0.99	69	2,146
J-220-1440	50	0.67	66	2,146
J-220-3417	87	1.13	55	2,147
J-220-2466	91	2.43	52	2,147
J-220-3908	87	1.23	55	2,149
J-220-1626	37	0.00	71	2,150
J-220-2609	38	5.77	71	2,150
J-220-1544	23	0.00	74	2,150
J-220-4683	55	5.67	65	2,152
J-220-1023	60	0.00	66	2,152
J-220-4829	55	0.00	65	2,153
J-220-3991	57	0.00	66	2,153
J-220-4867	73	0.00	61	2,153
J-220-3714	107	0.00	46	2,154
J-220-0310	18	6.64	76	2,155
J-220-4506	77	0.00	59	2,155
J-220-0929	37	4.11	71	2,155
J-220-1859	103	4.16	48	2,157
J-220-4255	90	0.00	53	2,159
J-220-2274	72	0.00	61	2,159
J-220-2275	72	0.00	61	2,159
J-220-4546	55	0.00	65	2,160
J-220-2202	103	3.20	48	2,161
J-220-1545	23	0.00	74	2,161
J-220-3173	104	0.00	48	2,161
J-220-4233	69	10.80	62	2,162
J-220-2966	31	0.00	71	2,163
J-220-3352	101	3.82	50	2,164

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2527	104	8.15	48	2,165
J-220-4221	83	0.00	56	2,165
J-220-3373	69	3.75	62	2,165
J-220-4702	79	0.00	57	2,166
J-220-2138	106	0.63	47	2,166
J-220-2082	57	5.72	64	2,167
J-220-2357	19	0.00	75	2,167
J-220-4467	57	0.00	66	2,167
J-220-1724	71	6.08	62	2,168
J-220-1723	71	4.11	62	2,168
J-220-3518	55	0.77	65	2,169
J-220-1387	69	4.83	62	2,170
J-220-2358	19	7.53	75	2,171
J-220-3775	51	2.55	67	2,171
J-220-4235	73	9.26	60	2,171
J-220-1575	66	1.73	64	2,172
J-220-3861	95	0.87	51	2,172
J-220-1072	41	2.57	72	2,174
J-220-2673	57	6.14	64	2,175
J-220-4505	77	0.00	59	2,177
J-220-3377	61	7.08	65	2,178
J-220-3740	55	0.00	63	2,178
J-220-3907	87	2.31	55	2,178
J-220-2945	62	2.95	63	2,179
J-220-3988	56	0.00	66	2,180
J-220-2415	55	0.00	63	2,180
J-220-2822	22	1.52	79	2,180
J-220-1360	23	0.00	74	2,180
J-220-4811	55	5.51	63	2,181
J-220-3922	94	3.56	52	2,182
J-220-2681	55	3.34	65	2,182
J-220-4406	77	0.00	59	2,182
J-220-2706	22	0.12	74	2,184
J-220-3989	56	0.00	66	2,184
J-220-3372	73	3.17	60	2,185
J-220-1565	103	4.62	48	2,185
J-220-1070	41	2.00	72	2,185
J-220-2200	103	0.00	48	2,185
J-220-4313	100	9.45	50	2,185
J-220-3375	66	0.57	63	2,186
J-220-4242	61	4.48	65	2,186
J-220-0073	44	6.73	69	2,186
J-220-0945	60	6.78	65	2,187
J-220-3031	87	0.00	55	2,187
J-220-2828	21	0.00	80	2,187
J-220-0085	47	0.00	68	2,187
J-220-2829	21	0.46	80	2,187
J-220-2137	106	1.39	47	2,188

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3776	51	0.00	67	2,188
J-220-0309	19	1.80	76	2,188
J-220-4893	55	4.71	63	2,188
J-220-3376	61	0.90	65	2,189
J-220-4624	76	2.33	59	2,189
J-220-3353	101	3.73	49	2,190
J-220-3663	107	1.27	46	2,190
J-220-2298	85	1.85	55	2,191
J-220-2267	62	0.81	63	2,192
J-220-3990	57	0.00	66	2,192
J-220-3664	107	0.00	46	2,192
J-220-4494	89	5.51	54	2,193
J-220-0933	25	9.64	77	2,193
J-220-2135	105	1.30	47	2,194
J-220-2827	21	0.34	80	2,194
J-220-0926	41	9.40	70	2,195
J-220-0084	47	2.84	68	2,196
J-220-0932	25	0.00	77	2,197
J-220-2478	55	4.20	68	2,197
J-220-1067	44	1.97	71	2,198
J-220-2251	18	8.42	76	2,199
J-220-0342	18	3.34	76	2,200
J-220-2142	107	1.92	46	2,200
J-220-1069	42	7.19	72	2,200
J-220-4149	105	0.00	52	2,201
J-220-0612	27	14.74	74	2,201
J-220-4051	66	6.86	63	2,201
J-220-4095	52	3.05	66	2,205
J-220-2517	32	1.70	70	2,205
J-220-0112	18	8.01	76	2,205
J-220-4741	57	0.00	66	2,207
J-220-2947	60	0.00	64	2,207
J-220-0300	69	0.66	63	2,207
J-220-3125	72	1.77	61	2,207
J-220-0971	51	26.23	65	2,208
J-220-1935	32	1.29	71	2,208
J-220-3471	73	1.03	60	2,208
J-220-2083	60	5.07	64	2,209
J-220-0930	25	3.78	77	2,211
J-220-1767	38	0.00	71	2,211
J-220-0944	60	5.00	66	2,212
J-220-0343	18	0.89	76	2,212
J-220-0248	21	4.06	80	2,212
J-220-0353	16	4.83	77	2,212
J-220-4226	66	13.25	64	2,213
J-220-4743	56	4.45	66	2,213
J-220-3300	66	0.53	64	2,214
J-220-2882	81	12.67	57	2,215

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3299	66	0.00	64	2,216
J-220-1710	60	8.63	64	2,216
J-220-1068	44	5.39	71	2,216
J-220-3158	69	0.00	62	2,217
J-220-1550	65	0.00	62	2,217
J-220-2420	53	3.78	64	2,218
J-220-2557	22	0.39	74	2,219
J-220-1493	27	14.43	76	2,220
J-220-1957	55	1.88	65	2,220
J-220-1507	27	6.11	76	2,220
J-220-0063	25	11.59	77	2,220
J-220-2408	92	0.00	52	2,220
J-220-0931	25	0.00	77	2,220
J-220-2341	35	0.00	74	2,222
J-220-2419	54	0.00	64	2,222
J-220-1020	59	5.34	66	2,224
J-220-2422	53	0.00	64	2,224
J-220-1327	61	0.00	64	2,224
J-220-3767	66	0.82	64	2,224
J-220-4495	88	0.89	54	2,226
J-220-4253	89	6.95	54	2,226
J-220-2418	54	0.00	64	2,226
J-220-4742	56	1.83	66	2,227
J-220-1525	22	5.05	76	2,227
J-220-1768	38	1.06	71	2,227
J-220-1359	65	0.00	62	2,229
J-220-2179	105	0.00	48	2,229
J-220-0572	38	15.32	71	2,229
J-220-3374	66	7.06	63	2,230
J-220-4504	77	0.00	59	2,230
J-220-2417	53	0.00	64	2,230
J-220-2065	98	4.66	50	2,231
J-220-0207	53	0.79	64	2,233
J-220-1094	30	0.00	75	2,234
J-220-3692	95	0.00	51	2,235
J-220-2558	22	0.00	74	2,236
J-220-0730	50	0.00	69	2,236
J-220-1481	16	0.00	76	2,238
J-220-0208	53	4.98	64	2,238
J-220-3969	74	0.00	60	2,239
J-220-4254	89	0.00	54	2,239
J-220-3184	54	0.41	64	2,239
J-220-4773	77	0.00	59	2,239
J-220-3105	67	1.54	63	2,240
J-220-1240	18	0.79	76	2,241
J-220-3780	52	0.79	66	2,241
J-220-4826	62	3.90	66	2,242
J-220-4310	101	1.13	49	2,242

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2136	106	3.05	47	2,244
J-220-2091	50	0.00	66	2,245
J-220-3082	50	0.96	67	2,246
J-220-3056	67	7.41	63	2,246
J-220-1323	106	0.31	47	2,246
J-220-1358	65	3.82	62	2,247
J-220-2778	51	1.66	69	2,248
J-220-4188	79	0.00	58	2,248
J-220-0013	47	3.58	68	2,251
J-220-4725	77	0.00	59	2,252
J-220-4252	89	0.00	54	2,253
J-220-4093	52	2.38	66	2,254
J-220-0114	18	0.34	76	2,254
J-220-1059	39	0.00	70	2,255
J-220-0617	25	0.68	73	2,256
J-220-3781	52	2.69	66	2,256
J-220-1060	40	1.33	69	2,258
J-220-3000	39	5.96	70	2,259
J-220-1314	22	5.70	74	2,260
J-220-3712	105	0.82	47	2,260
J-220-3693	95	1.01	51	2,261
J-220-3943	69	5.67	60	2,261
J-220-0691	16	6.06	77	2,262
J-220-2881	80	22.20	57	2,263
J-220-4120	88	0.00	54	2,264
J-220-4086	69	0.00	60	2,265
J-220-2743	33	0.00	70	2,265
J-220-2256	17	1.83	76	2,268
J-220-3689	99	0.00	50	2,271
J-220-0102	42	2.84	69	2,271
J-220-0694	16	0.00	76	2,272
J-220-3779	51	1.59	67	2,272
J-220-0570	39	0.00	71	2,274
J-220-4475	63	6.73	62	2,275
J-220-3713	105	0.00	47	2,277
J-220-2257	17	0.00	76	2,278
J-220-0304	17	1.64	76	2,280
J-220-1203	20	8.43	75	2,280
J-220-1528	22	0.00	76	2,280
J-220-3885	55	2.00	65	2,281
J-220-2674	56	1.79	65	2,282
J-220-3737	70	15.10	62	2,282
J-220-3348	55	38.30	64	2,284
J-220-4074	69	0.00	62	2,285
J-220-0352	16	3.15	77	2,287
J-220-0693	17	2.26	76	2,288
J-220-4308	101	0.79	49	2,289
J-220-4092	52	0.00	66	2,289

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4021	73	0.00	60	2,290
J-220-2090	50	15.15	66	2,290
J-220-1523	22	3.05	76	2,290
J-220-2627	19	3.39	80	2,292
J-220-3898	96	6.35	51	2,292
J-220-0213	60	9.64	66	2,292
J-220-0163	42	3.68	69	2,292
J-220-4240	64	1.52	62	2,293
J-220-0351	16	4.11	77	2,295
J-220-4085	69	0.00	60	2,295
J-220-0886	50	0.00	67	2,296
J-220-3778	51	5.19	67	2,296
J-220-2610	45	6.25	68	2,297
J-220-3886	55	0.00	65	2,298
J-220-2837	24	7.77	74	2,298
J-220-2838	24	10.27	74	2,299
J-220-0162	42	4.76	69	2,299
J-220-1030	52	3.10	66	2,301
J-220-1286	43	4.04	69	2,304
J-220-4567	69	6.88	63	2,304
J-220-4745	58	0.41	65	2,305
J-220-2814	106	2.81	47	2,306
J-220-3027	33	0.00	70	2,306
J-220-3909	87	4.81	55	2,307
J-220-1031	52	2.98	66	2,307
J-220-2669	43	6.56	70	2,307
J-220-4757	54	3.85	66	2,307
J-220-2261	17	0.00	76	2,307
J-220-2089	50	0.00	66	2,308
J-220-4282	85	0.00	55	2,308
J-220-2813	106	0.65	47	2,309
J-220-2258	17	0.02	76	2,309
J-220-1318	23	0.15	74	2,309
J-220-4041	105	0.00	47	2,312
J-220-1324	106	0.00	47	2,313
J-220-1298	45	4.78	68	2,314
J-220-2432	88	4.04	54	2,314
J-220-1093	30	2.72	75	2,315
J-220-4543	54	0.48	67	2,315
J-220-0273	33	0.61	70	2,316
J-220-3490	104	1.80	48	2,316
J-220-1173	64	6.20	62	2,316
J-220-0450	106	2.24	47	2,316
J-220-4488	89	3.80	54	2,317
J-220-3491	105	0.00	47	2,317
J-220-2033	36	1.56	70	2,317
J-220-1838	22	0.39	76	2,318
J-220-3829	106	1.06	47	2,318

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2260	17	0.00	76	2,318
J-220-3739	54	0.00	64	2,318
J-220-0127	26	0.00	77	2,319
J-220-2259	17	0.00	76	2,319
J-220-0231	45	1.20	68	2,319
J-220-2516	32	0.26	70	2,319
J-220-1962	33	0.68	70	2,320
J-220-2266	17	1.39	76	2,320
J-220-0980	16	13.85	81	2,320
J-220-1255	45	3.63	68	2,320
J-220-3492	105	0.46	47	2,320
J-220-4062	99	0.00	50	2,320
J-220-0515	43	0.00	69	2,321
J-220-3472	73	0.00	60	2,322
J-220-1449	48	9.13	67	2,322
J-220-1694	99	0.00	49	2,322
J-220-4499	69	0.00	62	2,323
J-220-2748	103	0.82	48	2,323
J-220-0569	38	3.37	71	2,323
J-220-3314	74	0.00	60	2,323
J-220-1524	22	0.00	76	2,324
J-220-1858	106	2.02	47	2,326
J-220-3982	61	1.42	66	2,326
J-220-2751	105	2.93	47	2,328
J-220-0937	20	15.84	80	2,329
J-220-2370	104	0.00	48	2,330
J-220-4281	85	0.00	55	2,331
J-220-3887	55	0.00	65	2,331
J-220-0318	20	11.51	75	2,332
J-220-3691	99	0.00	50	2,332
J-220-2050	22	1.61	76	2,332
J-220-4104	61	0.31	66	2,332
J-220-0230	45	0.00	68	2,332
J-220-1465	22	4.18	76	2,332
J-220-1527	22	0.00	76	2,332
J-220-2433	88	0.00	54	2,332
J-220-4311	101	0.00	49	2,333
J-220-0571	39	0.22	71	2,334
J-220-2749	103	1.76	48	2,335
J-220-3018	22	0.00	76	2,337
J-220-2141	106	4.95	47	2,338
J-220-1468	22	1.30	76	2,338
J-220-2155	99	2.31	49	2,340
J-220-0391	25	2.34	74	2,340
J-220-2051	22	0.00	76	2,341
J-220-4774	60	0.84	64	2,341
J-220-1498	60	0.42	66	2,341
J-220-2373	25	0.00	73	2,342

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4009	101	0.00	49	2,342
J-220-4500	54	4.16	66	2,343
J-220-0375	24	0.00	78	2,344
J-220-0130	28	0.00	76	2,344
J-220-1315	23	0.61	74	2,345
J-220-4759	70	0.00	62	2,345
J-220-1963	33	0.00	70	2,346
J-220-0166	40	4.62	70	2,348
J-220-4571	69	4.21	63	2,348
J-220-4171	92	0.99	53	2,348
J-220-1285	42	11.35	69	2,348
J-220-2511	108	0.00	48	2,349
J-220-1464	22	1.59	76	2,349
J-220-4008	101	0.00	49	2,350
J-220-4570	69	0.43	63	2,352
J-220-3721	62	0.00	65	2,352
J-220-4474	63	0.00	62	2,352
J-220-3665	104	1.30	48	2,354
J-220-2368	104	0.00	48	2,354
J-220-1674	27	4.81	72	2,355
J-220-3473	73	0.60	60	2,356
J-220-2052	22	0.84	76	2,357
J-220-4162	85	2.26	55	2,358
J-220-4010	101	0.00	49	2,358
J-220-2741	33	0.74	70	2,358
J-220-1316	23	0.00	74	2,359
J-220-2611	45	2.60	68	2,360
J-220-2262	18	0.00	76	2,363
J-220-2265	18	5.89	76	2,364
J-220-4659	78	0.00	58	2,365
J-220-1937	25	5.16	73	2,368
J-220-2369	104	1.95	48	2,368
J-220-1293	47	11.97	67	2,369
J-220-0885	49	0.00	67	2,369
J-220-0164	40	0.00	70	2,372
J-220-1317	23	0.00	74	2,372
J-220-2263	18	0.70	76	2,372
J-220-0939	38	2.93	72	2,372
J-220-0176	80	9.83	57	2,373
J-220-1518	23	2.62	76	2,373
J-220-3514	55	0.22	65	2,374
J-220-1922	54	0.51	64	2,375
J-220-2722	54	7.45	64	2,376
J-220-0064	33	0.00	73	2,376
J-220-3812	97	3.10	50	2,376
J-220-0237	50	4.26	66	2,377
J-220-1673	27	2.52	72	2,377
J-220-2443	25	1.57	73	2,377

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1264	45	4.00	68	2,378
J-220-4476	63	0.00	62	2,379
J-220-1032	54	29.04	66	2,379
J-220-3893	97	8.73	50	2,380
J-220-1533	43	6.49	69	2,381
J-220-2803	104	0.00	48	2,381
J-220-4293	61	7.97	66	2,382
J-220-1552	33	0.00	70	2,382
J-220-0987	24	1.68	74	2,383
J-220-2407	93	3.78	52	2,385
J-220-0958	59	2.77	65	2,386
J-220-1905	48	3.39	69	2,387
J-220-4701	80	6.49	57	2,387
J-220-0268	20	1.95	80	2,388
J-220-4316	99	0.00	50	2,389
J-220-3157	69	0.00	62	2,389
J-220-2675	56	8.17	65	2,389
J-220-2740	33	0.50	70	2,390
J-220-0165	40	2.16	70	2,391
J-220-4409	70	3.56	62	2,391
J-220-1448	48	0.00	67	2,391
J-220-2804	104	0.00	48	2,392
J-220-4604	60	3.56	64	2,393
J-220-4501	54	0.65	67	2,394
J-220-3077	106	5.41	52	2,394
J-220-1174	63	0.00	62	2,394
J-220-2268	62	0.61	63	2,395
J-220-3381	56	4.11	66	2,397
J-220-1857	104	0.00	48	2,397
J-220-4866	72	0.00	62	2,398
J-220-0928	37	2.09	72	2,398
J-220-4315	99	3.90	50	2,399
J-220-0203	55	14.81	64	2,399
J-220-2904	66	0.94	63	2,399
J-220-4599	62	2.00	64	2,399
J-220-4410	69	0.00	62	2,401
J-220-4073	59	4.78	65	2,401
J-220-1086	48	0.00	67	2,401
J-220-2011	23	8.87	79	2,401
J-220-2171	45	7.24	70	2,402
J-220-0794	29	2.28	75	2,402
J-220-4295	61	0.00	66	2,402
J-220-4291	70	1.90	62	2,403
J-220-1860	104	5.55	48	2,403
J-220-3347	47	39.00	68	2,404
J-220-1088	48	0.00	67	2,404
J-220-1087	48	0.00	67	2,405
J-220-1289	47	0.00	67	2,405

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1295	45	2.12	68	2,405
J-220-0773	56	0.55	65	2,405
J-220-2826	23	5.39	79	2,406
J-220-4290	70	14.95	62	2,406
J-220-4411	69	0.58	62	2,406
J-220-2574	125	5.60	42	2,406
J-220-1934	31	0.79	71	2,407
J-220-4102	61	0.00	66	2,408
J-220-3467	61	0.00	66	2,409
J-220-2092	50	0.00	66	2,410
J-220-3175	103	0.00	48	2,410
J-220-1288	47	2.84	67	2,410
J-220-0996	19	6.95	76	2,410
J-220-4417	60	4.52	64	2,412
J-220-1291	45	2.08	68	2,413
J-220-3811	98	0.00	50	2,413
J-220-1294	46	1.22	68	2,414
J-220-0390	26	7.04	73	2,414
J-220-3938	63	3.70	62	2,414
J-220-2746	103	0.00	48	2,415
J-220-0223	80	0.00	57	2,415
J-220-4103	61	0.11	66	2,416
J-220-1292	47	3.87	67	2,416
J-220-4845	72	0.00	62	2,416
J-220-0115	17	0.00	76	2,416
J-220-3380	56	0.00	66	2,417
J-220-3478	72	0.00	61	2,417
J-220-1296	45	1.79	68	2,417
J-220-1089	47	1.90	67	2,417
J-220-0269	20	0.99	80	2,418
J-220-4713	66	1.79	63	2,419
J-220-1660	66	28.27	62	2,421
J-220-4262	67	3.94	63	2,422
J-220-0959	59	0.00	65	2,422
J-220-1456	45	0.00	68	2,423
J-220-2264	17	0.00	76	2,424
J-220-0772	56	6.29	65	2,425
J-220-1856	104	10.00	48	2,425
J-220-3937	63	0.00	62	2,425
J-220-2343	29	4.23	72	2,425
J-220-4265	67	3.37	63	2,425
J-220-1290	45	1.05	68	2,425
J-220-0389	26	1.99	73	2,426
J-220-1861	104	1.01	48	2,427
J-220-4600	62	0.00	64	2,427
J-220-3506	106	0.00	52	2,428
J-220-3940	63	0.00	62	2,428
J-220-0392	26	0.00	73	2,429

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3517	55	0.87	65	2,429
J-220-1084	48	0.00	67	2,429
J-220-3813	96	1.54	51	2,430
J-220-3948	66	0.00	63	2,430
J-220-3330	74	0.00	60	2,430
J-220-0634	76	2.48	61	2,431
J-220-3594	71	2.07	62	2,431
J-220-1457	45	0.00	68	2,432
J-220-4503	54	1.20	67	2,432
J-220-1263	45	0.00	68	2,432
J-220-1354	92	0.00	53	2,433
J-220-1698	50	0.00	66	2,433
J-220-3946	66	0.51	63	2,433
J-220-3950	67	0.75	63	2,434
J-220-3949	66	3.87	63	2,434
J-220-2318	34	11.42	74	2,435
J-220-2548	20	0.00	75	2,435
J-220-1268	44	0.00	69	2,436
J-220-1453	49	0.00	67	2,437
J-220-0387	26	0.00	73	2,437
J-220-1083	48	1.68	67	2,437
J-220-4194	54	0.00	67	2,437
J-220-0263	20	0.00	75	2,437
J-220-3593	71	3.58	62	2,438
J-220-2062	22	0.55	76	2,441
J-220-1956	56	26.13	65	2,441
J-220-1262	45	6.53	68	2,441
J-220-1085	48	0.00	67	2,442
J-220-3941	63	0.00	62	2,442
J-220-0960	59	0.00	65	2,443
J-220-2067	53	0.00	68	2,443
J-220-4509	59	1.78	65	2,443
J-220-0283	34	5.70	74	2,444
J-220-3257	32	0.00	70	2,444
J-220-0116	17	3.80	76	2,445
J-220-1501	20	0.00	75	2,445
J-220-0355	18	0.00	76	2,445
J-220-4719	62	0.00	64	2,445
J-220-4544	54	0.00	67	2,446
J-220-2250	19	6.01	75	2,446
J-220-3773	55	4.18	66	2,447
J-220-2170	45	0.00	70	2,447
J-220-1517	22	2.26	76	2,447
J-220-0317	18	0.00	76	2,448
J-220-0264	20	0.00	75	2,448
J-220-4712	66	0.00	63	2,448
J-220-0952	62	1.42	63	2,449
J-220-2648	62	0.00	63	2,449

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1839	22	0.00	76	2,450
J-220-4072	59	0.00	65	2,450
J-220-4462	58	0.00	65	2,450
J-220-1455	48	1.20	67	2,451
J-220-3720	62	20.22	65	2,451
J-220-4880	20	0.00	80	2,451
J-220-0386	26	5.90	73	2,451
J-220-2374	126	0.00	42	2,451
J-220-4502	54	0.19	67	2,452
J-220-4882	20	0.00	80	2,452
J-220-3451	58	1.64	65	2,452
J-220-0660	20	19.97	75	2,452
J-220-1862	104	3.22	48	2,452
J-220-1301	37	3.51	72	2,452
J-220-4799	20	0.72	80	2,454
J-220-4193	55	0.00	66	2,454
J-220-2248	20	0.00	75	2,455
J-220-2832	20	2.36	80	2,457
J-220-2235	35	0.00	74	2,457
J-220-4581	65	5.79	63	2,458
J-220-0668	20	9.33	80	2,459
J-220-0133	58	2.09	65	2,460
J-220-4879	20	0.00	75	2,460
J-220-2747	104	0.00	48	2,461
J-220-1266	44	2.75	69	2,461
J-220-4545	53	0.00	67	2,461
J-220-2249	20	0.00	75	2,462
J-220-3513	55	1.03	65	2,462
J-220-4508	59	0.00	65	2,462
J-220-3939	63	0.00	62	2,463
J-220-3736	71	2.45	62	2,463
J-220-4844	72	0.26	62	2,464
J-220-4289	70	6.80	62	2,467
J-220-1450	49	0.00	67	2,467
J-220-0746	59	1.32	64	2,469
J-220-0513	54	0.00	67	2,469
J-220-1452	48	0.00	67	2,469
J-220-2134	104	4.47	48	2,470
J-220-4382	81	0.00	58	2,470
J-220-0954	62	3.32	63	2,470
J-220-0316	18	0.00	76	2,471
J-220-3050	72	6.47	61	2,471
J-220-2670	32	11.20	71	2,472
J-220-0060	34	7.09	73	2,473
J-220-0956	64	0.44	62	2,475
J-220-4461	58	0.00	65	2,475
J-220-1267	43	0.00	69	2,476
J-220-4835	72	1.54	62	2,476

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3772	55	14.11	66	2,477
J-220-3951	68	0.00	63	2,477
J-220-3825	71	9.39	61	2,478
J-220-0354	18	2.79	76	2,479
J-220-0745	59	0.00	64	2,479
J-220-4834	72	0.00	62	2,480
J-220-4714	66	0.00	63	2,482
J-220-3936	63	0.00	62	2,482
J-220-0729	50	0.00	69	2,482
J-220-0927	37	0.00	72	2,482
J-220-0559	40	0.87	70	2,485
J-220-4259	66	3.78	63	2,485
J-220-3436	99	5.03	50	2,485
J-220-4245	107	0.00	48	2,485
J-220-3549	68	0.00	62	2,486
J-220-0224	80	0.00	57	2,486
J-220-0062	33	12.38	74	2,487
J-220-4833	72	0.91	62	2,487
J-220-3411	93	0.00	52	2,487
J-220-0953	62	0.11	63	2,487
J-220-0717	32	9.44	70	2,487
J-220-4627	60	0.00	64	2,488
J-220-2518	32	0.35	70	2,488
J-220-4832	72	0.00	62	2,489
J-220-4261	66	0.00	63	2,490
J-220-0934	18	15.34	80	2,492
J-220-3211	21	7.96	75	2,492
J-220-3777	50	5.31	67	2,492
J-220-2375	126	0.00	42	2,494
J-220-2519	32	0.28	70	2,495
J-220-3139	71	5.77	62	2,495
J-220-1399	41	0.00	70	2,496
J-220-3944	70	0.00	61	2,497
J-220-2317	63	5.87	62	2,497
J-220-3557	55	0.00	65	2,497
J-220-1258	49	1.62	67	2,497
J-220-0518	32	4.87	70	2,497
J-220-3371	70	5.05	61	2,497
J-220-1271	44	1.32	69	2,499
J-220-3155	54	0.00	64	2,499
J-220-1065	45	2.26	70	2,499
J-220-1273	44	0.00	69	2,499
J-220-0233	44	14.11	69	2,500
J-220-2750	104	3.25	48	2,501
J-220-1451	49	11.03	67	2,501
J-220-2435	89	26.11	53	2,501
J-220-3558	47	6.01	68	2,501
J-220-0117	18	6.84	76	2,503

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0245	29	1.80	76	2,503
J-220-0061	33	0.60	74	2,503
J-220-1500	21	3.12	75	2,504
J-220-4729	77	6.47	59	2,504
J-220-2752	104	0.00	48	2,505
J-220-4469	54	0.00	67	2,507
J-220-0232	44	0.00	69	2,508
J-220-1765	40	1.25	71	2,508
J-220-1272	44	0.00	69	2,509
J-220-3183	54	3.51	64	2,509
J-220-3212	21	0.00	75	2,510
J-220-1270	44	0.00	69	2,511
J-220-0673	22	2.86	80	2,512
J-220-4418	60	1.44	64	2,512
J-220-0955	64	2.56	62	2,514
J-220-2647	62	1.77	63	2,515
J-220-3430	68	2.45	62	2,516
J-220-2221	56	0.00	67	2,516
J-220-1152	52	3.30	66	2,517
J-220-3598	72	0.65	61	2,517
J-220-0568	37	1.66	72	2,518
J-220-4165	72	0.00	61	2,518
J-220-2034	36	1.83	70	2,519
J-220-2547	20	0.00	75	2,519
J-220-4460	58	0.00	65	2,520
J-220-0631	75	0.77	61	2,520
J-220-1257	49	0.00	67	2,521
J-220-4804	64	1.80	63	2,521
J-220-3596	71	0.00	62	2,521
J-220-1092	29	0.00	75	2,521
J-220-4485	88	5.77	54	2,522
J-220-0564	52	9.77	66	2,523
J-220-0567	41	0.00	70	2,523
J-220-1352	41	0.72	70	2,523
J-220-1256	50	1.09	67	2,524
J-220-1529	44	0.00	69	2,526
J-220-3863	93	0.70	52	2,527
J-220-0595	28	12.00	73	2,528
J-220-1090	29	4.30	75	2,528
J-220-2156	58	1.44	65	2,529
J-220-2348	33	12.47	70	2,529
J-220-3428	68	0.00	62	2,530
J-220-1679	21	0.00	75	2,530
J-220-1259	50	0.00	66	2,530
J-220-0204	54	2.72	64	2,531
J-220-0566	41	6.90	70	2,531
J-220-0234	44	3.01	69	2,533
J-220-1066	45	5.31	70	2,533

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4724	74	5.77	61	2,534
J-220-3032	93	24.62	52	2,534
J-220-0560	40	1.47	70	2,535
J-220-4715	66	0.05	63	2,536
J-220-3512	55	0.79	65	2,536
J-220-3595	72	0.00	62	2,536
J-220-1678	21	0.00	75	2,537
J-220-4100	72	0.00	61	2,537
J-220-0713	26	8.80	73	2,538
J-220-0726	50	7.19	69	2,540
J-220-4718	62	0.00	64	2,540
J-220-2703	36	13.61	69	2,540
J-220-0727	50	6.61	69	2,541
J-220-3511	55	0.00	65	2,541
J-220-1202	21	14.59	75	2,544
J-220-1260	50	1.29	66	2,546
J-220-4680	55	0.00	65	2,546
J-220-4258	54	0.00	67	2,547
J-220-0302	71	8.85	62	2,547
J-220-3329	75	0.00	59	2,549
J-220-2833	20	4.09	80	2,550
J-220-4679	55	0.00	65	2,551
J-220-0097	34	4.06	73	2,551
J-220-2253	22	2.23	74	2,552
J-220-3033	93	0.17	52	2,552
J-220-3505	105	0.00	52	2,553
J-220-3081	50	0.00	67	2,555
J-220-0630	76	0.00	61	2,556
J-220-3597	72	0.00	61	2,556
J-220-4572	67	8.56	63	2,556
J-220-2907	67	0.00	62	2,557
J-220-1269	44	3.85	69	2,557
J-220-4513	76	1.62	59	2,559
J-220-4271	83	0.00	56	2,559
J-220-4716	66	0.00	63	2,560
J-220-1254	44	1.61	69	2,560
J-220-4101	72	0.00	61	2,561
J-220-3429	68	1.08	62	2,562
J-220-4769	72	1.08	62	2,563
J-220-0714	26	2.62	73	2,563
J-220-0632	77	2.57	61	2,564
J-220-2413	54	0.00	70	2,565
J-220-4414	64	3.27	63	2,565
J-220-4573	67	0.00	63	2,565
J-220-3156	54	0.00	64	2,565
J-220-1921	54	0.00	64	2,568
J-220-2964	27	3.87	73	2,568
J-220-1530	44	0.00	69	2,569

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1536	44	0.00	69	2,569
J-220-1542	31	0.00	70	2,569
J-220-4703	54	2.77	67	2,569
J-220-4790	62	1.18	64	2,570
J-220-1537	44	1.90	69	2,570
J-220-1261	50	2.67	66	2,571
J-220-1033	55	5.46	65	2,571
J-220-1531	44	0.00	69	2,571
J-220-0550	33	2.36	70	2,572
J-220-1532	44	0.00	69	2,573
J-220-2153	93	13.30	52	2,574
J-220-2301	31	1.90	71	2,575
J-220-2546	20	6.97	75	2,576
J-220-4415	62	0.00	64	2,576
J-220-4468	54	6.11	67	2,576
J-220-4507	73	0.58	62	2,577
J-220-1540	31	2.03	70	2,580
J-220-4416	62	0.00	64	2,581
J-220-4768	72	0.00	62	2,582
J-220-2668	36	0.00	69	2,582
J-220-0917	31	0.00	75	2,582
J-220-4492	80	1.03	57	2,583
J-220-0098	34	0.58	73	2,584
J-220-2294	71	0.00	61	2,584
J-220-2371	20	0.00	75	2,585
J-220-1151	52	0.00	66	2,586
J-220-2726	71	6.79	61	2,586
J-220-4263	66	1.32	64	2,586
J-220-4574	66	0.00	63	2,586
J-220-0611	29	3.05	73	2,586
J-220-4413	66	2.69	63	2,588
J-220-0588	34	1.03	70	2,588
J-220-2252	22	0.02	74	2,589
J-220-0659	20	0.00	75	2,589
J-220-4190	53	0.00	67	2,590
J-220-0657	20	0.77	75	2,591
J-220-3038	107	4.59	48	2,592
J-220-4521	73	0.00	62	2,592
J-220-4459	58	1.44	65	2,593
J-220-3771	56	2.60	66	2,593
J-220-1034	55	0.00	65	2,594
J-220-3383	56	0.31	66	2,595
J-220-0589	34	6.49	70	2,595
J-220-0299	69	12.02	62	2,595
J-220-4563	72	2.98	61	2,597
J-220-0239	44	0.00	69	2,597
J-220-1620	50	0.00	66	2,597
J-220-4796	58	2.65	65	2,601

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2962	27	0.00	73	2,601
J-220-4575	66	0.00	63	2,601
J-220-2545	20	0.00	75	2,602
J-220-1806	29	0.36	73	2,602
J-220-4780	66	0.00	64	2,603
J-220-0558	25	4.16	73	2,603
J-220-1980	90	0.00	54	2,605
J-220-1623	50	0.77	66	2,606
J-220-0658	20	0.00	75	2,609
J-220-1807	29	0.00	73	2,610
J-220-1153	52	5.51	66	2,610
J-220-0875	37	3.91	70	2,611
J-220-3900	90	0.00	53	2,611
J-220-4568	68	4.18	63	2,612
J-220-0573	44	6.06	69	2,613
J-220-0238	44	2.48	69	2,615
J-220-0512	54	1.86	67	2,615
J-220-1621	50	1.01	66	2,616
J-220-2649	62	1.07	63	2,616
J-220-0690	24	0.00	73	2,617
J-220-4511	57	1.08	65	2,619
J-220-4266	68	3.22	63	2,620
J-220-4665	66	0.07	64	2,621
J-220-0800	30	10.12	75	2,622
J-220-3458	69	0.00	61	2,626
J-220-3240	73	0.00	61	2,628
J-220-3888	56	6.73	65	2,628
J-220-2733	60	0.87	67	2,629
J-220-4576	66	0.00	63	2,630
J-220-4569	68	0.00	63	2,632
J-220-0380	27	0.00	77	2,633
J-220-4770	72	0.00	62	2,633
J-220-1906	46	2.89	69	2,637
J-220-4484	88	3.70	54	2,637
J-220-3878	113	0.00	48	2,638
J-220-0419	54	3.76	67	2,638
J-220-4260	66	0.96	64	2,639
J-220-3524	94	0.39	51	2,639
J-220-4510	58	1.03	65	2,639
J-220-2963	27	0.00	73	2,641
J-220-0320	19	3.80	75	2,642
J-220-2701	36	0.00	69	2,644
J-220-1622	51	2.80	66	2,644
J-220-2255	22	0.00	74	2,644
J-220-3947	65	2.95	64	2,644
J-220-4432	54	2.95	67	2,646
J-220-0594	28	2.16	73	2,646
J-220-4192	52	4.38	67	2,647

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4708	56	3.58	65	2,647
J-220-1061	28	0.99	73	2,648
J-220-3379	54	1.97	67	2,649
J-220-1711	60	5.03	64	2,649
J-220-3459	69	5.37	61	2,651
J-220-3770	56	0.00	65	2,653
J-220-1666	31	5.29	75	2,653
J-220-0853	31	0.00	75	2,654
J-220-4191	52	0.72	67	2,654
J-220-0418	52	7.96	67	2,655
J-220-4595	69	11.38	63	2,655
J-220-1835	21	4.52	76	2,655
J-220-4771	72	3.87	62	2,656
J-220-0147	86	3.87	55	2,656
J-220-4412	68	4.06	62	2,657
J-220-2412	53	0.99	70	2,658
J-220-3076	110	3.13	50	2,660
J-220-2510	107	0.94	48	2,662
J-220-1661	66	6.12	62	2,662
J-220-2588	24	0.00	78	2,663
J-220-3945	65	1.25	64	2,666
J-220-3382	56	0.00	66	2,668
J-220-2505	60	0.00	64	2,668
J-220-4264	68	1.11	63	2,668
J-220-0854	31	12.33	75	2,671
J-220-3923	104	2.67	48	2,672
J-220-4152	67	3.47	63	2,673
J-220-1013	50	0.00	69	2,676
J-220-0799	30	0.00	75	2,676
J-220-1739	34	3.87	74	2,676
J-220-3769	57	0.00	65	2,677
J-220-0275	33	1.46	70	2,677
J-220-0321	19	1.79	75	2,678
J-220-2254	22	0.00	74	2,678
J-220-0876	36	0.33	71	2,679
J-220-3896	89	0.89	54	2,679
J-220-2283	60	0.00	66	2,680
J-220-0687	24	4.72	73	2,680
J-220-0298	69	0.96	63	2,681
J-220-0271	33	0.61	70	2,683
J-220-2742	36	23.31	69	2,683
J-220-1433	33	3.50	70	2,683
J-220-0055	35	0.58	73	2,683
J-220-4676	56	0.00	65	2,685
J-220-3655	57	1.64	67	2,686
J-220-0590	22	0.00	74	2,686
J-220-0628	52	0.00	66	2,687
J-220-1204	22	15.42	74	2,689

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2328	53	1.61	66	2,690
J-220-4772	72	0.00	62	2,690
J-220-0274	33	0.00	70	2,690
J-220-4052	69	6.83	62	2,691
J-220-4577	66	0.15	63	2,691
J-220-0801	30	0.00	75	2,691
J-220-4053	70	1.44	61	2,691
J-220-1688	55	0.00	67	2,692
J-220-1689	55	0.00	67	2,693
J-220-2119	55	0.00	67	2,693
J-220-3252	80	2.96	57	2,694
J-220-2154	93	2.07	52	2,694
J-220-1434	33	0.00	70	2,695
J-220-4564	75	1.01	61	2,696
J-220-3920	71	0.00	61	2,698
J-220-0305	19	14.20	75	2,698
J-220-4146	105	0.58	52	2,698
J-220-0591	22	0.00	74	2,699
J-220-4677	56	0.00	65	2,699
J-220-2120	55	8.61	67	2,700
J-220-4827	84	1.06	55	2,702
J-220-0270	33	0.00	70	2,703
J-220-4851	72	1.20	61	2,703
J-220-4534	67	15.29	63	2,704
J-220-0287	40	9.79	71	2,705
J-220-4566	71	0.82	62	2,706
J-220-3239	73	17.07	61	2,706
J-220-4661	78	0.00	58	2,708
J-220-1341	98	6.71	51	2,709
J-220-4678	56	1.11	65	2,711
J-220-0924	86	0.00	55	2,712
J-220-3461	57	6.20	67	2,712
J-220-4531	67	0.48	63	2,716
J-220-0557	25	1.01	73	2,716
J-220-4675	57	0.24	65	2,717
J-220-0629	52	0.00	66	2,718
J-220-2655	101	4.35	53	2,719
J-220-0457	36	1.27	69	2,722
J-220-0284	32	1.80	75	2,724
J-220-1435	33	0.00	70	2,724
J-220-2656	101	2.50	53	2,725
J-220-3117	105	3.29	52	2,726
J-220-4850	72	0.00	61	2,726
J-220-0802	30	0.00	75	2,727
J-220-0430	77	1.11	59	2,727
J-220-0677	28	5.00	72	2,728
J-220-3889	56	3.01	65	2,728
J-220-0633	80	2.12	59	2,728

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4609	80	3.10	57	2,730
J-220-1837	22	1.54	75	2,730
J-220-4522	71	0.72	62	2,730
J-220-2166	31	0.00	73	2,730
J-220-0148	89	5.31	54	2,731
J-220-1624	51	2.75	66	2,732
J-220-1810	31	10.24	73	2,733
J-220-4532	67	1.03	63	2,733
J-220-1692	57	0.00	66	2,734
J-220-2943	68	0.00	62	2,735
J-220-2528	104	1.61	48	2,735
J-220-0456	36	0.00	69	2,736
J-220-2455	67	1.53	62	2,739
J-220-2349	34	0.00	69	2,742
J-220-0415	74	0.00	61	2,742
J-220-2836	22	4.98	75	2,743
J-220-0331	18	1.32	76	2,744
J-220-2646	29	3.17	72	2,746
J-220-2118	57	0.00	66	2,748
J-220-1979	90	17.55	54	2,749
J-220-1475	26	8.30	77	2,750
J-220-1363	57	0.00	66	2,751
J-220-3592	71	1.27	62	2,752
J-220-4537	71	0.00	61	2,753
J-220-2842	22	0.00	75	2,754
J-220-4278	80	0.00	57	2,759
J-220-3370	70	6.59	62	2,759
J-220-1063	31	0.00	73	2,760
J-220-3996	84	1.11	55	2,761
J-220-3868	71	0.00	62	2,762
J-220-3017	22	0.00	75	2,762
J-220-0458	36	0.00	69	2,764
J-220-0733	50	0.00	69	2,764
J-220-2470	93	2.86	52	2,767
J-220-2459	86	11.47	55	2,768
J-220-0126	23	5.34	75	2,769
J-220-2644	21	3.25	80	2,769
J-220-4536	72	0.00	61	2,769
J-220-3228	56	0.90	66	2,771
J-220-1834	22	0.41	75	2,776
J-220-0129	26	9.09	77	2,776
J-220-4108	61	1.75	66	2,777
J-220-1836	22	1.44	75	2,777
J-220-3699	113	0.00	49	2,778
J-220-2148	94	17.31	51	2,778
J-220-0459	36	0.00	69	2,779
J-220-0818	77	0.00	59	2,780
J-220-0262	25	4.65	73	2,781

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0315	23	0.58	74	2,781
J-220-2300	32	0.00	70	2,783
J-220-3869	71	0.00	62	2,784
J-220-1814	36	2.40	69	2,784
J-220-0261	26	1.94	73	2,786
J-220-1812	36	3.80	69	2,787
J-220-3873	115	0.00	43	2,788
J-220-2532	83	3.65	58	2,790
J-220-3227	56	0.39	66	2,790
J-220-2692	46	0.00	69	2,790
J-220-2056	30	19.69	76	2,791
J-220-4286	80	0.96	57	2,791
J-220-3229	57	0.00	66	2,792
J-220-0556	23	0.00	75	2,794
J-220-1333	64	2.95	63	2,795
J-220-0087	48	5.05	68	2,795
J-220-4224	83	2.96	56	2,797
J-220-1325	57	5.00	66	2,800
J-220-2841	22	0.00	75	2,801
J-220-1062	31	8.75	73	2,801
J-220-0053	33	12.41	74	2,803
J-220-3014	20	0.79	80	2,806
J-220-2444	25	1.79	73	2,809
J-220-2960	26	0.00	73	2,809
J-220-4109	60	0.00	67	2,810
J-220-4107	61	0.00	66	2,811
J-220-0923	86	1.03	55	2,811
J-220-2445	25	0.00	73	2,814
J-220-0735	50	1.76	69	2,817
J-220-1748	32	6.27	70	2,817
J-220-3154	45	0.36	68	2,817
J-220-2456	67	0.00	62	2,818
J-220-1326	57	0.00	66	2,818
J-220-0197	42	5.64	69	2,820
J-220-0388	26	0.00	73	2,820
J-220-3591	71	3.37	62	2,821
J-220-3756	70	0.00	61	2,822
J-220-1823	57	0.00	67	2,823
J-220-0314	22	2.50	75	2,823
J-220-2149	94	2.00	51	2,825
J-220-0333	18	2.28	76	2,825
J-220-4144	103	3.99	53	2,825
J-220-0731	50	6.64	69	2,826
J-220-1749	32	0.90	70	2,828
J-220-4145	105	2.26	52	2,829
J-220-0132	28	8.56	76	2,830
J-220-0322	18	0.89	76	2,830
J-220-4096	53	0.00	70	2,831

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1515	29	8.37	72	2,834
J-220-0695	27	2.19	77	2,835
J-220-0555	24	5.84	74	2,836
J-220-4277	80	0.00	57	2,836
J-220-0637	83	0.00	58	2,837
J-220-2961	26	0.00	73	2,837
J-220-0182	74	0.00	61	2,839
J-220-3080	112	0.00	49	2,842
J-220-2589	24	6.78	78	2,848
J-220-4125	99	0.00	50	2,849
J-220-0732	50	0.00	69	2,849
J-220-1747	31	8.17	71	2,849
J-220-4056	73	4.66	60	2,850
J-220-1057	21	5.05	80	2,852
J-220-4565	75	0.00	61	2,853
J-220-0326	18	0.00	76	2,853
J-220-4058	75	6.06	59	2,853
J-220-3410	90	4.78	53	2,855
J-220-3305	112	0.00	49	2,857
J-220-0094	50	0.00	67	2,857
J-220-0325	18	6.04	76	2,857
J-220-1201	26	2.27	73	2,861
J-220-0225	80	0.00	57	2,861
J-220-1599	84	3.92	58	2,861
J-220-4587	69	5.27	62	2,861
J-220-1476	29	5.27	76	2,862
J-220-1246	84	4.57	58	2,864
J-220-4105	61	0.00	66	2,865
J-220-0323	20	11.64	75	2,866
J-220-4294	61	8.67	66	2,867
J-220-2157	28	2.86	72	2,872
J-220-1206	31	0.00	71	2,874
J-220-1803	29	8.22	72	2,878
J-220-0151	90	1.88	53	2,878
J-220-0734	50	8.70	69	2,878
J-220-0506	55	1.18	68	2,879
J-220-3230	59	0.00	65	2,882
J-220-3409	93	8.34	52	2,884
J-220-1870	77	10.96	59	2,884
J-220-2022	30	3.10	71	2,885
J-220-1611	57	4.28	67	2,886
J-220-1600	84	0.48	58	2,890
J-220-1205	30	0.00	71	2,891
J-220-0678	28	0.00	72	2,895
J-220-2471	93	0.58	52	2,896
J-220-3307	110	0.00	50	2,896
J-220-0554	24	4.04	74	2,897
J-220-0014	48	6.08	68	2,897

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0914	32	5.03	75	2,898
J-220-1064	29	0.00	72	2,899
J-220-1822	57	0.00	67	2,899
J-220-4223	83	0.00	56	2,900
J-220-2183	24	4.21	78	2,901
J-220-3661	101	0.24	54	2,904
J-220-3794	21	3.65	80	2,906
J-220-3153	45	6.25	68	2,908
J-220-0705	30	2.43	71	2,911
J-220-1680	22	1.49	74	2,911
J-220-2667	36	0.00	69	2,914
J-220-4112	60	1.35	67	2,914
J-220-1539	30	4.74	71	2,914
J-220-4553	84	15.08	55	2,915
J-220-2184	24	9.79	78	2,915
J-220-2520	34	1.42	69	2,918
J-220-4267	79	9.45	57	2,918
J-220-3306	111	0.00	50	2,919
J-220-3503	84	0.00	58	2,920
J-220-2869	73	0.00	60	2,921
J-220-4106	61	1.94	66	2,921
J-220-4483	90	1.47	53	2,925
J-220-1362	54	0.00	67	2,926
J-220-0551	34	0.74	69	2,926
J-220-3112	105	0.65	52	2,928
J-220-3631	96	1.23	51	2,929
J-220-2633	23	9.30	78	2,930
J-220-3755	70	5.27	61	2,933
J-220-1625	52	3.02	66	2,936
J-220-0285	31	2.57	75	2,939
J-220-1328	59	0.83	65	2,939
J-220-0016	50	0.00	67	2,940
J-220-0220	53	7.52	68	2,941
J-220-0704	30	0.00	71	2,943
J-220-2150	89	5.17	53	2,944
J-220-3295	99	1.71	55	2,945
J-220-3296	100	3.75	54	2,946
J-220-0562	52	0.00	66	2,947
J-220-4137	102	10.82	49	2,947
J-220-0636	83	0.00	58	2,947
J-220-2366	102	0.00	49	2,947
J-220-2917	80	1.68	57	2,949
J-220-4287	80	0.99	57	2,955
J-220-2918	80	0.00	57	2,955
J-220-3651	69	0.00	62	2,955
J-220-4767	76	0.00	60	2,961
J-220-4150	104	5.39	52	2,964
J-220-1361	23	0.00	74	2,966

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3319	74	8.19	60	2,968
J-220-0172	79	0.31	58	2,970
J-220-3068	101	5.36	54	2,970
J-220-0169	82	0.00	59	2,971
J-220-2367	102	0.00	49	2,971
J-220-0111	24	0.00	74	2,971
J-220-3757	70	6.28	61	2,972
J-220-3079	114	0.00	48	2,973
J-220-0702	28	0.00	72	2,974
J-220-2460	84	4.95	55	2,976
J-220-0803	31	5.63	75	2,978
J-220-4143	103	0.77	53	2,981
J-220-1825	58	2.38	66	2,986
J-220-1652	22	0.15	74	2,987
J-220-0110	24	0.87	74	2,989
J-220-2344	30	4.50	71	2,990
J-220-0196	42	4.74	69	2,992
J-220-2224	56	5.51	67	2,992
J-220-4124	98	0.00	50	2,993
J-220-1159	21	1.20	80	2,993
J-220-4353	76	1.11	59	2,993
J-220-4360	103	0.00	49	2,994
J-220-2632	23	2.16	78	2,994
J-220-0961	61	1.57	64	2,995
J-220-4452	83	7.45	56	2,998
J-220-0561	52	1.09	66	2,998
J-220-2531	83	0.00	58	3,001
J-220-1247	83	0.00	58	3,002
J-220-0962	61	0.11	64	3,003
J-220-2862	36	5.51	69	3,004
J-220-2059	23	1.52	77	3,004
J-220-3589	73	12.19	60	3,005
J-220-3880	83	0.00	58	3,006
J-220-2884	83	1.56	59	3,006
J-220-4736	83	0.00	56	3,007
J-220-4727	76	0.00	60	3,008
J-220-0736	53	7.84	68	3,009
J-220-0716	29	8.87	71	3,010
J-220-2220	56	3.78	67	3,012
J-220-1160	21	0.82	80	3,013
J-220-0183	74	0.00	61	3,013
J-220-2347	30	6.40	71	3,013
J-220-0173	79	0.00	57	3,015
J-220-1112	25	6.71	73	3,015
J-220-2043	102	2.57	52	3,016
J-220-1653	22	0.00	74	3,017
J-220-4487	89	1.08	54	3,017
J-220-1947	26	0.00	77	3,017

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0598	29	5.75	72	3,018
J-220-0798	26	3.80	77	3,018
J-220-2868	74	0.00	60	3,019
J-220-2521	35	0.52	69	3,021
J-220-4340	73	8.28	60	3,021
J-220-3864	84	0.00	55	3,021
J-220-1811	34	15.36	70	3,022
J-220-0190	43	3.67	69	3,022
J-220-1543	23	0.00	74	3,025
J-220-1091	26	4.81	77	3,028
J-220-2712	25	0.55	73	3,028
J-220-0703	29	0.92	72	3,029
J-220-3695	44	1.68	68	3,030
J-220-4268	82	1.92	56	3,030
J-220-0015	50	0.00	67	3,031
J-220-0449	26	0.00	73	3,031
J-220-1115	26	0.00	73	3,031
J-220-3124	73	6.66	60	3,031
J-220-0137	25	0.11	73	3,032
J-220-3953	69	0.00	62	3,035
J-220-1330	63	0.00	64	3,035
J-220-3110	105	0.79	52	3,036
J-220-0880	26	2.27	73	3,038
J-220-0613	25	1.20	73	3,038
J-220-0614	25	0.20	73	3,038
J-220-0290	25	0.00	73	3,038
J-220-4358	104	1.06	49	3,039
J-220-0174	79	0.58	58	3,039
J-220-2942	68	0.00	62	3,039
J-220-1703	65	0.00	67	3,040
J-220-0616	25	0.00	73	3,041
J-220-0538	24	0.00	73	3,041
J-220-3559	49	5.15	68	3,043
J-220-1117	31	5.81	71	3,044
J-220-3111	105	0.00	52	3,045
J-220-0139	25	4.20	73	3,047
J-220-1840	23	0.00	77	3,047
J-220-0615	25	0.00	73	3,047
J-220-0737	53	6.01	68	3,048
J-220-4344	75	9.06	59	3,049
J-220-3269	77	4.47	59	3,050
J-220-0167	83	0.00	58	3,050
J-220-2711	25	0.00	73	3,051
J-220-4359	103	0.51	49	3,052
J-220-4219	79	0.00	57	3,054
J-220-0423	28	2.38	76	3,055
J-220-0168	83	0.00	58	3,057
J-220-3354	103	2.98	49	3,058

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2785	102	3.03	54	3,060
J-220-4030	70	0.53	61	3,062
J-220-1654	24	5.05	74	3,063
J-220-0090	49	0.00	67	3,063
J-220-3927	53	0.00	70	3,064
J-220-4453	83	0.82	56	3,065
J-220-3849	83	5.34	56	3,065
J-220-4697	83	0.00	56	3,065
J-220-1887	11	0.00	84	3,067
J-220-1109	29	1.01	71	3,067
J-220-4698	83	0.00	56	3,067
J-220-0537	25	0.50	73	3,068
J-220-2045	102	1.06	52	3,069
J-220-0138	25	0.00	73	3,069
J-220-3605	94	4.76	52	3,070
J-220-1489	55	6.01	68	3,070
J-220-0460	31	0.00	71	3,071
J-220-1865	25	0.15	73	3,071
J-220-4054	73	1.92	60	3,072
J-220-0688	25	0.00	73	3,073
J-220-0424	28	0.00	76	3,073
J-220-1103	24	0.00	73	3,075
J-220-1332	63	0.00	64	3,075
J-220-3630	96	0.00	51	3,076
J-220-0324	23	3.65	74	3,078
J-220-1824	57	1.11	67	3,079
J-220-0448	26	0.00	73	3,079
J-220-4711	66	0.00	63	3,079
J-220-1357	23	0.00	74	3,080
J-220-0882	26	0.44	73	3,081
J-220-0306	24	0.37	74	3,081
J-220-0536	25	0.00	73	3,083
J-220-0297	23	0.00	74	3,085
J-220-4215	83	1.13	56	3,085
J-220-1675	25	0.90	73	3,088
J-220-3109	105	4.21	52	3,088
J-220-0091	49	0.00	67	3,089
J-220-1817	57	0.00	67	3,091
J-220-3548	69	1.76	62	3,093
J-220-4057	75	9.11	59	3,093
J-220-1902	46	0.00	69	3,094
J-220-0656	22	0.00	74	3,094
J-220-4135	102	0.00	49	3,094
J-220-2723	59	5.65	64	3,095
J-220-0308	24	0.35	74	3,096
J-220-0563	52	1.55	66	3,096
J-220-3146	95	1.80	51	3,098
J-220-1864	25	0.00	73	3,099

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0093	49	0.00	67	3,100
J-220-1331	63	0.98	64	3,102
J-220-1730	30	0.61	71	3,103
J-220-1687	62	0.00	63	3,106
J-220-1490	55	3.99	68	3,106
J-220-1055	21	11.13	80	3,107
J-220-1667	28	3.41	76	3,108
J-220-4663	78	2.10	58	3,109
J-220-2631	21	0.00	80	3,110
J-220-1104	24	1.51	73	3,110
J-220-0908	29	0.85	71	3,110
J-220-1813	35	0.00	69	3,110
J-220-1816	57	2.60	67	3,111
J-220-2883	82	0.00	59	3,113
J-220-0397	55	0.60	68	3,115
J-220-4173	96	4.88	51	3,115
J-220-0421	28	0.00	76	3,115
J-220-0881	26	3.26	73	3,116
J-220-0689	25	2.18	73	3,116
J-220-0092	49	0.00	67	3,116
J-220-0398	55	0.00	68	3,118
J-220-1815	35	3.32	70	3,118
J-220-1329	63	7.71	64	3,118
J-220-0399	55	3.51	68	3,119
J-220-3078	114	0.91	48	3,120
J-220-1868	77	0.00	59	3,120
J-220-4214	83	0.00	56	3,121
J-220-1541	29	0.00	71	3,121
J-220-0425	28	1.66	76	3,121
J-220-2507	102	8.15	49	3,121
J-220-3526	94	0.00	52	3,121
J-220-3369	96	7.31	51	3,121
J-220-0461	31	0.00	71	3,122
J-220-1683	63	2.96	63	3,122
J-220-0019	49	0.00	67	3,122
J-220-0654	22	0.00	74	3,123
J-220-0712	25	0.00	73	3,123
J-220-0653	22	0.00	74	3,123
J-220-2058	23	9.71	77	3,123
J-220-0447	26	0.00	73	3,124
J-220-0307	24	7.30	74	3,124
J-220-1411	55	3.70	68	3,125
J-220-4123	99	0.00	50	3,125
J-220-4693	83	0.00	56	3,126
J-220-1940	23	1.44	78	3,126
J-220-4220	79	0.00	57	3,127
J-220-0152	89	0.00	54	3,127
J-220-1353	92	0.00	53	3,127

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2152	89	4.76	53	3,129
J-220-0296	23	0.00	74	3,130
J-220-3850	83	0.00	56	3,132
J-220-2591	24	5.91	78	3,133
J-220-1795	20	8.75	80	3,134
J-220-3550	69	2.50	62	3,135
J-220-2786	101	2.02	54	3,136
J-220-0295	23	0.00	74	3,137
J-220-0596	29	3.13	72	3,138
J-220-4694	83	2.02	56	3,138
J-220-0422	28	0.00	76	3,138
J-220-0652	21	0.00	75	3,140
J-220-3848	83	1.18	56	3,142
J-220-0707	29	0.00	72	3,142
J-220-0150	90	1.76	53	3,145
J-220-4299	83	0.00	56	3,145
J-220-0711	30	2.12	71	3,147
J-220-1809	36	0.87	71	3,148
J-220-1875	77	0.00	59	3,150
J-220-3359	90	2.26	53	3,150
J-220-1871	77	0.00	59	3,150
J-220-0135	26	0.00	72	3,151
J-220-1105	24	1.97	73	3,152
J-220-3696	49	3.63	68	3,154
J-220-3358	90	0.96	53	3,154
J-220-1637	78	0.00	58	3,154
J-220-0017	49	0.00	67	3,154
J-220-3700	113	0.00	49	3,155
J-220-1841	23	2.33	77	3,157
J-220-0592	22	0.00	74	3,157
J-220-1200	27	7.28	72	3,157
J-220-0718	29	9.63	71	3,159
J-220-0535	25	1.05	73	3,160
J-220-1506	24	1.54	74	3,161
J-220-4055	75	5.17	59	3,162
J-220-4148	101	1.92	53	3,165
J-220-1505	24	0.00	74	3,167
J-220-2885	82	0.00	59	3,167
J-220-1058	21	1.73	80	3,170
J-220-1746	28	3.02	72	3,173
J-220-2446	25	1.03	73	3,174
J-220-3089	49	5.70	70	3,175
J-220-1029	69	3.10	62	3,176
J-220-0420	71	3.78	62	3,178
J-220-0825	52	0.92	66	3,178
J-220-0878	28	15.21	72	3,178
J-220-3528	94	1.88	52	3,178
J-220-3249	29	0.00	71	3,179

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3851	83	0.00	56	3,179
J-220-3527	94	0.00	52	3,180
J-220-1725	62	8.42	63	3,180
J-220-0175	78	7.77	58	3,181
J-220-0463	31	0.85	71	3,183
J-220-4578	66	0.00	63	3,184
J-220-0529	31	8.85	71	3,185
J-220-0313	24	1.56	74	3,186
J-220-0312	24	0.00	74	3,186
J-220-3066	113	0.00	48	3,188
J-220-0184	74	3.61	61	3,188
J-220-4791	66	2.21	63	3,190
J-220-2044	100	2.26	54	3,191
J-220-0136	26	1.53	72	3,192
J-220-4809	66	0.00	63	3,192
J-220-0520	34	0.94	70	3,193
J-220-0706	29	3.58	72	3,193
J-220-0378	24	9.28	78	3,193
J-220-4218	82	0.00	56	3,195
J-220-0597	29	4.86	72	3,195
J-220-2783	50	20.29	69	3,195
J-220-4808	66	0.00	63	3,196
J-220-4401	97	1.08	50	3,198
J-220-1762	21	0.41	80	3,200
J-220-4709	66	0.00	63	3,200
J-220-2713	24	3.19	73	3,200
J-220-4710	66	0.22	63	3,201
J-220-4642	74	0.11	60	3,205
J-220-1027	66	2.12	63	3,205
J-220-0199	29	1.16	71	3,205
J-220-3388	97	0.00	51	3,209
J-220-0256	28	0.00	72	3,210
J-220-0180	76	0.00	60	3,210
J-220-0018	49	4.30	67	3,211
J-220-1939	23	0.00	78	3,212
J-220-3629	96	1.13	51	3,212
J-220-4307	107	0.00	46	3,214
J-220-1919	69	4.14	63	3,214
J-220-3242	29	0.00	71	3,215
J-220-0402	55	7.62	68	3,215
J-220-0377	24	0.00	78	3,216
J-220-4392	79	0.00	57	3,217
J-220-3243	29	1.35	71	3,217
J-220-0043	44	8.46	69	3,218
J-220-0280	36	0.00	73	3,220
J-220-0109	44	0.00	69	3,220
J-220-0823	52	1.53	66	3,221
J-220-0903	24	6.40	73	3,223

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1473	58	3.69	67	3,224
J-220-1676	63	1.53	63	3,224
J-220-1684	63	0.00	63	3,225
J-220-4318	97	0.00	50	3,229
J-220-2556	31	1.16	71	3,229
J-220-3822	75	3.41	59	3,229
J-220-3245	29	0.00	71	3,229
J-220-3294	113	0.00	49	3,230
J-220-0401	55	2.69	68	3,230
J-220-2522	35	0.00	69	3,231
J-220-0539	59	0.99	64	3,231
J-220-2765	89	0.00	54	3,231
J-220-3152	78	8.63	58	3,232
J-220-0768	24	0.00	78	3,235
J-220-0765	29	5.79	76	3,236
J-220-0900	26	0.00	73	3,237
J-220-0879	27	3.08	72	3,238
J-220-4217	82	1.42	56	3,239
J-220-0877	27	0.28	72	3,241
J-220-2654	95	1.27	55	3,241
J-220-3215	22	0.00	74	3,242
J-220-3204	88	0.00	55	3,243
J-220-2454	62	9.15	63	3,246
J-220-3057	69	0.79	62	3,247
J-220-1677	64	19.55	63	3,247
J-220-1028	69	0.44	62	3,248
J-220-2447	25	0.00	73	3,248
J-220-0416	76	0.00	60	3,249
J-220-2486	104	0.00	49	3,250
J-220-0655	25	0.00	73	3,250
J-220-3355	90	4.45	53	3,252
J-220-4443	72	0.00	61	3,255
J-220-2327	54	0.65	66	3,255
J-220-0935	18	20.10	80	3,257
J-220-3821	75	3.44	59	3,257
J-220-3216	22	0.00	74	3,257
J-220-3368	97	3.78	50	3,257
J-220-4372	107	2.79	46	3,258
J-220-0824	52	2.97	66	3,258
J-220-3366	97	0.00	50	3,261
J-220-3365	97	0.00	50	3,261
J-220-0963	69	0.09	62	3,263
J-220-4147	101	6.25	54	3,263
J-220-0905	28	0.00	72	3,263
J-220-2158	29	15.58	71	3,263
J-220-0947	59	1.81	66	3,264
J-220-0767	24	5.82	78	3,267
J-220-0257	22	0.00	74	3,268

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0106	44	0.00	69	3,270
J-220-2845	22	0.00	80	3,270
J-220-0107	44	12.19	69	3,270
J-220-3424	53	0.00	66	3,271
J-220-3367	97	10.46	50	3,272
J-220-3246	29	0.00	71	3,275
J-220-0096	44	3.03	69	3,276
J-220-2449	25	0.00	73	3,276
J-220-2834	23	0.00	78	3,278
J-220-3328	76	7.73	59	3,278
J-220-3241	29	0.00	71	3,278
J-220-1108	26	9.31	72	3,279
J-220-3619	90	5.12	53	3,279
J-220-3748	80	0.00	57	3,280
J-220-1949	68	2.97	62	3,280
J-220-3247	29	0.00	71	3,282
J-220-0149	90	0.00	53	3,283
J-220-1726	62	7.00	63	3,285
J-220-1557	88	6.47	54	3,285
J-220-0198	27	0.00	72	3,285
J-220-0540	59	3.65	64	3,286
J-220-2653	96	0.00	55	3,287
J-220-4270	83	2.91	56	3,287
J-220-1018	54	0.00	67	3,288
J-220-4391	79	2.80	57	3,288
J-220-0649	25	0.00	73	3,288
J-220-0201	56	5.10	65	3,290
J-220-0054	34	4.40	73	3,292
J-220-3180	106	0.00	47	3,292
J-220-1556	86	0.00	55	3,296
J-220-4019	72	0.99	61	3,296
J-220-3248	29	0.00	71	3,297
J-220-0254	28	0.00	72	3,298
J-220-2586	25	0.00	73	3,298
J-220-0181	76	0.26	60	3,299
J-220-3029	87	1.92	55	3,299
J-220-0510	54	12.37	68	3,299
J-220-0417	76	0.92	60	3,299
J-220-1686	62	0.18	63	3,300
J-220-0764	30	8.39	75	3,300
J-220-4393	79	1.03	57	3,300
J-220-0438	86	5.10	55	3,302
J-220-3058	64	5.79	64	3,302
J-220-1745	31	2.03	71	3,303
J-220-1211	25	5.91	73	3,303
J-220-2107	36	7.62	71	3,303
J-220-4134	102	0.00	49	3,305
J-220-0134	57	4.95	65	3,305

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2457	67	4.72	62	3,307
J-220-3718	64	0.00	64	3,309
J-220-1953	68	0.00	62	3,310
J-220-4781	77	0.00	60	3,310
J-220-1952	68	0.00	62	3,311
J-220-3537	74	5.22	60	3,312
J-220-4527	77	0.00	60	3,315
J-220-3008	36	0.00	71	3,316
J-220-2944	68	11.38	62	3,317
J-220-3488	64	0.00	64	3,318
J-220-1672	31	12.63	71	3,320
J-220-3643	77	3.71	60	3,322
J-220-3010	39	0.00	69	3,324
J-220-2105	36	2.07	72	3,324
J-220-4662	78	10.95	58	3,328
J-220-1107	26	1.18	73	3,329
J-220-0906	28	1.01	72	3,329
J-220-3009	36	0.79	71	3,331
J-220-3386	79	26.21	58	3,332
J-220-1111	26	3.04	73	3,336
J-220-1106	26	0.00	73	3,340
J-220-0426	25	2.55	78	3,341
J-220-3028	87	0.00	55	3,343
J-220-2709	24	1.09	73	3,343
J-220-2606	21	0.00	80	3,344
J-220-2354	40	0.00	68	3,344
J-220-3095	42	3.97	72	3,345
J-220-3007	36	0.00	71	3,348
J-220-1744	31	4.65	71	3,348
J-220-3489	64	3.82	64	3,349
J-220-2710	24	1.05	73	3,350
J-220-3323	76	0.00	59	3,351
J-220-0293	24	0.00	73	3,352
J-220-2919	79	1.13	58	3,356
J-220-1951	68	28.39	62	3,356
J-220-2207	36	0.00	69	3,356
J-220-3116	113	0.00	49	3,357
J-220-1664	68	0.90	62	3,359
J-220-0792	53	0.00	66	3,360
J-220-2364	36	0.00	71	3,361
J-220-3749	80	0.00	57	3,362
J-220-0784	53	0.00	66	3,362
J-220-2208	34	4.33	70	3,363
J-220-0763	30	7.00	75	3,363
J-220-0899	26	0.00	73	3,364
J-220-0904	24	4.04	73	3,364
J-220-1638	78	10.80	58	3,364
J-220-0902	26	0.00	73	3,364

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3067	113	2.40	49	3,365
J-220-1886	11	0.00	84	3,369
J-220-2350	26	1.11	73	3,371
J-220-1100	19	0.67	80	3,372
J-220-4641	74	7.54	60	3,372
J-220-2365	36	0.00	71	3,376
J-220-0739	41	18.66	72	3,377
J-220-0650	25	0.00	73	3,381
J-220-0864	24	10.43	78	3,382
J-220-1847	55	1.32	68	3,386
J-220-0042	44	0.00	69	3,388
J-220-0218	58	0.00	66	3,389
J-220-4213	78	0.00	58	3,389
J-220-3209	23	0.00	74	3,390
J-220-3620	87	13.15	55	3,391
J-220-0294	25	0.00	73	3,393
J-220-4660	78	16.32	58	3,393
J-220-2340	49	4.71	68	3,394
J-220-0292	25	1.56	73	3,397
J-220-4441	72	4.24	61	3,400
J-220-2104	35	0.00	69	3,401
J-220-1777	36	0.00	70	3,403
J-220-0291	25	0.00	73	3,405
J-220-0258	23	0.00	74	3,405
J-220-3208	26	0.00	73	3,406
J-220-0253	28	0.00	72	3,406
J-220-1685	44	0.00	68	3,407
J-220-2223	55	1.83	68	3,408
J-220-1248	82	0.00	59	3,409
J-220-2128	54	0.00	67	3,409
J-220-1432	37	0.00	69	3,411
J-220-0462	31	0.57	71	3,412
J-220-4175	88	8.78	54	3,412
J-220-3213	23	0.00	74	3,414
J-220-2326	54	12.31	66	3,416
J-220-1116	31	0.00	71	3,418
J-220-0910	26	0.00	73	3,419
J-220-2585	25	0.00	73	3,419
J-220-2835	23	0.00	78	3,421
J-220-3075	116	2.74	48	3,421
J-220-1429	35	1.40	70	3,421
J-220-3272	76	2.08	59	3,425
J-220-0251	28	1.92	72	3,427
J-220-2206	36	0.00	69	3,431
J-220-1110	26	2.88	73	3,434
J-220-3203	80	7.41	60	3,435
J-220-0909	26	0.00	73	3,435
J-220-3202	80	0.00	59	3,435

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0219	58	42.65	66	3,437
J-220-0804	25	1.80	78	3,437
J-220-2345	30	2.56	71	3,438
J-220-0738	40	3.46	72	3,443
J-220-1428	35	2.64	70	3,443
J-220-0619	26	0.00	73	3,446
J-220-2604	80	0.00	57	3,451
J-220-0761	24	1.59	78	3,453
J-220-3055	69	13.20	62	3,457
J-220-2247	124	14.98	39	3,462
J-220-0771	50	2.45	67	3,463
J-220-1881	33	4.81	70	3,463
J-220-1990	35	1.62	70	3,466
J-220-0901	26	0.00	73	3,466
J-220-2182	104	0.00	49	3,469
J-220-3483	115	1.23	47	3,470
J-220-0249	28	1.90	72	3,471
J-220-1735	22	6.01	79	3,471
J-220-3581	86	6.85	55	3,472
J-220-1708	32	8.43	70	3,472
J-220-1587	21	0.00	79	3,473
J-220-1426	36	0.00	70	3,473
J-220-0191	44	3.04	68	3,474
J-220-2129	54	0.00	67	3,475
J-220-2351	39	4.13	69	3,475
J-220-1903	47	0.00	69	3,476
J-220-3758	70	7.38	61	3,480
J-220-3207	26	0.00	73	3,480
J-220-3205	26	4.30	73	3,482
J-220-3251	79	3.91	58	3,483
J-220-1671	35	7.04	69	3,486
J-220-3214	23	0.00	74	3,488
J-220-4442	72	0.00	61	3,490
J-220-2652	96	0.00	55	3,491
J-220-0427	24	0.00	78	3,492
J-220-0259	23	0.00	74	3,493
J-220-1821	56	0.00	67	3,493
J-220-1863	27	0.55	72	3,495
J-220-3270	76	0.00	59	3,496
J-220-3206	26	0.00	73	3,503
J-220-4164	71	0.00	61	3,504
J-220-0493	24	3.46	79	3,507
J-220-1342	97	1.85	51	3,508
J-220-1991	35	2.62	70	3,509
J-220-2781	61	15.84	65	3,510
J-220-3250	79	7.31	58	3,511
J-220-2887	82	0.00	59	3,513
J-220-2226	55	2.00	68	3,514

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2225	55	0.00	68	3,514
J-220-0260	23	0.00	74	3,515
J-220-0492	23	1.59	79	3,515
J-220-0708	25	0.57	73	3,516
J-220-3637	99	0.00	50	3,517
J-220-2227	55	0.70	68	3,519
J-220-0250	28	0.00	72	3,521
J-220-2619	17	4.76	81	3,521
J-220-0252	28	0.77	72	3,526
J-220-0052	36	0.51	73	3,527
J-220-2787	113	0.00	49	3,527
J-220-3201	82	0.00	59	3,528
J-220-4174	88	23.85	54	3,528
J-220-4136	102	0.00	49	3,528
J-220-4034	108	22.60	46	3,529
J-220-1802	18	1.83	80	3,530
J-220-0715	29	0.83	71	3,532
J-220-3268	78	3.75	58	3,533
J-220-1423	39	0.00	69	3,533
J-220-4735	70	6.13	62	3,534
J-220-2651	65	6.88	62	3,536
J-220-1586	21	0.00	79	3,541
J-220-4159	90	0.96	53	3,542
J-220-1035	56	0.00	65	3,542
J-220-2453	65	2.36	62	3,542
J-220-1691	54	0.00	67	3,545
J-220-0762	24	4.91	78	3,548
J-220-3750	81	2.40	57	3,548
J-220-3590	72	5.94	61	3,549
J-220-2524	35	0.00	69	3,550
J-220-2075	55	0.00	68	3,552
J-220-3200	104	2.72	49	3,553
J-220-2941	67	1.68	62	3,554
J-220-0491	23	2.38	79	3,555
J-220-1141	50	0.00	67	3,558
J-220-0609	24	3.58	78	3,558
J-220-2886	82	6.69	59	3,560
J-220-0719	58	8.46	66	3,563
J-220-2437	90	1.83	53	3,565
J-220-3113	82	0.00	59	3,567
J-220-1249	82	0.00	59	3,568
J-220-3834	72	1.80	61	3,569
J-220-3054	69	0.00	62	3,570
J-220-2584	25	0.00	73	3,570
J-220-1212	59	0.00	64	3,572
J-220-3567	77	4.21	58	3,575
J-220-2659	83	9.42	59	3,577
J-220-3510	113	0.00	49	3,579

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1801	17	0.00	81	3,580
J-220-3509	116	5.70	47	3,582
J-220-1931	23	0.00	78	3,583
J-220-4343	77	2.33	59	3,585
J-220-3508	116	0.00	47	3,585
J-220-2438	90	0.65	53	3,588
J-220-4180	86	23.73	55	3,588
J-220-4655	77	3.89	58	3,589
J-220-0699	28	0.00	72	3,590
J-220-3507	116	0.67	47	3,592
J-220-3338	70	10.53	61	3,592
J-220-0663	24	7.36	78	3,594
J-220-2537	112	0.00	49	3,596
J-220-2538	112	0.00	49	3,596
J-220-0158	33	13.80	74	3,598
J-220-2352	39	0.00	69	3,600
J-220-2504	45	0.00	69	3,600
J-220-3073	116	0.00	48	3,600
J-220-2523	35	8.24	69	3,602
J-220-0651	25	0.00	73	3,606
J-220-1950	67	0.00	62	3,606
J-220-1888	11	0.00	84	3,607
J-220-0620	26	0.00	73	3,607
J-220-0911	26	0.00	73	3,609
J-220-1338	97	0.00	51	3,609
J-220-4269	82	1.49	56	3,610
J-220-2448	25	0.00	73	3,612
J-220-3759	70	0.00	61	3,612
J-220-2074	55	0.00	68	3,615
J-220-1230	19	0.58	80	3,616
J-220-2708	23	1.79	74	3,617
J-220-1424	38	0.00	69	3,618
J-220-1778	36	0.00	70	3,618
J-220-2593	17	0.00	81	3,619
J-220-1589	17	3.44	81	3,622
J-220-3485	109	0.70	50	3,623
J-220-2920	73	0.63	60	3,626
J-220-3484	109	0.00	50	3,628
J-220-2450	25	14.72	73	3,628
J-220-0669	20	4.81	80	3,629
J-220-3835	73	1.37	60	3,631
J-220-0050	36	12.77	73	3,631
J-220-2818	24	3.03	79	3,632
J-220-4216	82	2.69	56	3,636
J-220-4734	77	0.00	58	3,637
J-220-4535	72	0.00	61	3,637
J-220-3633	96	0.00	51	3,640
J-220-2921	72	2.75	61	3,643

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3020	26	0.00	73	3,646
J-220-0782	53	1.33	66	3,646
J-220-3566	76	0.00	59	3,646
J-220-1008	50	6.64	68	3,652
J-220-3053	69	2.19	62	3,652
J-220-3021	28	2.47	72	3,653
J-220-2073	55	0.00	68	3,654
J-220-1779	36	0.00	70	3,655
J-220-3244	28	0.79	72	3,658
J-220-2192	23	0.00	74	3,659
J-220-0778	53	0.00	66	3,662
J-220-1932	23	7.36	78	3,666
J-220-1118	53	0.00	66	3,667
J-220-3199	104	0.00	49	3,667
J-220-1140	50	0.00	67	3,668
J-220-0202	56	0.00	65	3,669
J-220-3860	81	0.00	57	3,670
J-220-3618	105	9.11	48	3,671
J-220-0775	53	0.00	66	3,673
J-220-3309	111	1.61	49	3,673
J-220-3563	77	0.00	58	3,673
J-220-1491	55	1.23	68	3,673
J-220-1007	49	8.90	68	3,674
J-220-3308	112	0.00	49	3,674
J-220-1413	28	4.28	72	3,674
J-220-2434	88	0.48	54	3,676
J-220-0247	24	2.86	78	3,677
J-220-0982	19	1.83	80	3,681
J-220-3074	116	0.00	47	3,682
J-220-1754	54	0.00	68	3,684
J-220-0255	26	1.01	73	3,685
J-220-3022	26	0.00	73	3,685
J-220-4440	72	0.46	61	3,690
J-220-4176	88	0.48	54	3,692
J-220-2658	96	3.61	55	3,693
J-220-2796	107	0.00	49	3,693
J-220-3004	36	0.00	69	3,696
J-220-0622	26	0.00	73	3,696
J-220-1690	54	0.00	67	3,698
J-220-3035	96	3.53	51	3,699
J-220-1019	58	7.41	66	3,699
J-220-0543	23	0.00	74	3,699
J-220-3361	92	2.21	53	3,704
J-220-1145	53	0.00	66	3,704
J-220-1042	26	0.18	73	3,704
J-220-2707	23	0.00	74	3,706
J-220-2657	96	0.00	55	3,706
J-220-1337	97	0.00	51	3,709

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1421	38	0.00	69	3,709
J-220-0664	24	0.00	78	3,711
J-220-1776	58	1.94	67	3,713
J-220-2864	76	7.54	59	3,714
J-220-2342	32	0.00	70	3,715
J-220-0913	26	0.00	73	3,717
J-220-0521	34	0.50	70	3,717
J-220-2191	23	0.00	74	3,719
J-220-2736	35	0.00	69	3,720
J-220-1161	22	5.00	79	3,720
J-220-3301	113	0.00	49	3,722
J-220-1929	38	0.00	69	3,722
J-220-3302	113	0.00	48	3,723
J-220-1207	29	0.61	71	3,724
J-220-4296	113	0.00	49	3,725
J-220-3303	113	0.00	49	3,727
J-220-0545	23	6.14	74	3,727
J-220-3304	113	0.00	49	3,728
J-220-1820	56	1.01	67	3,728
J-220-2121	53	0.00	67	3,729
J-220-1040	26	0.00	73	3,730
J-220-1819	56	1.25	67	3,730
J-220-1757	55	0.00	68	3,734
J-220-0546	23	0.00	74	3,734
J-220-0547	23	0.00	74	3,735
J-220-1756	55	10.53	67	3,735
J-220-0544	23	0.00	74	3,735
J-220-2209	35	0.00	70	3,736
J-220-0548	32	0.85	71	3,736
J-220-0907	27	0.00	72	3,736
J-220-1041	26	2.53	73	3,742
J-220-0665	23	0.00	78	3,745
J-220-1590	17	12.72	81	3,747
J-220-2122	53	0.00	67	3,749
J-220-2913	71	0.00	61	3,749
J-220-0508	55	3.98	67	3,749
J-220-0507	55	2.86	67	3,750
J-220-2603	56	4.71	66	3,750
J-220-1547	35	1.46	70	3,751
J-220-3431	104	5.89	49	3,752
J-220-0830	55	0.00	68	3,754
J-220-0666	24	0.46	78	3,754
J-220-0829	55	0.00	68	3,756
J-220-0576	20	0.36	80	3,757
J-220-2788	113	0.00	49	3,760
J-220-0786	53	57.17	66	3,760
J-220-2071	55	0.00	68	3,764
J-220-0791	53	0.00	66	3,766

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1585	21	0.00	79	3,766
J-220-0667	24	0.00	78	3,767
J-220-2661	96	0.00	55	3,767
J-220-3916	72	0.00	61	3,769
J-220-0522	34	4.20	70	3,769
J-220-0051	38	7.00	72	3,771
J-220-4394	78	2.03	58	3,772
J-220-2181	104	0.00	49	3,773
J-220-3698	108	1.09	51	3,777
J-220-0216	58	0.00	66	3,778
J-220-2072	55	0.77	68	3,779
J-220-0577	20	0.00	80	3,781
J-220-2303	26	1.40	73	3,783
J-220-1941	21	0.00	80	3,783
J-220-1758	55	0.00	68	3,784
J-220-3645	109	0.00	51	3,784
J-220-1782	34	8.24	70	3,789
J-220-2855	36	0.00	69	3,790
J-220-0124	33	9.70	70	3,792
J-220-1942	21	1.44	80	3,792
J-220-0221	58	10.79	66	3,794
J-220-2304	27	2.38	72	3,794
J-220-2660	97	1.66	55	3,794
J-220-3877	113	0.00	49	3,797
J-220-2854	45	16.95	68	3,798
J-220-0795	24	0.00	78	3,799
J-220-3701	113	1.76	49	3,800
J-220-2127	54	0.00	67	3,800
J-220-3070	113	0.00	49	3,800
J-220-3069	113	0.00	49	3,802
J-220-0621	26	2.49	73	3,805
J-220-4538	72	3.28	61	3,806
J-220-0912	26	0.00	73	3,806
J-220-1136	50	0.00	67	3,806
J-220-0040	44	2.45	69	3,808
J-220-1427	36	0.00	70	3,809
J-220-3568	72	2.07	61	3,809
J-220-0048	38	0.00	72	3,810
J-220-3108	113	0.00	49	3,811
J-220-1425	38	0.37	69	3,816
J-220-3071	114	0.00	48	3,817
J-220-2865	76	0.00	59	3,821
J-220-3636	99	2.84	50	3,821
J-220-4320	73	20.38	60	3,824
J-220-1755	55	0.00	67	3,826
J-220-0541	27	0.00	72	3,827
J-220-4554	70	0.00	62	3,828
J-220-1954	53	2.36	66	3,830

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3037	107	0.00	49	3,831
J-220-1712	60	1.81	64	3,833
J-220-2212	55	0.00	68	3,839
J-220-0549	34	2.95	71	3,840
J-220-0599	36	0.00	69	3,841
J-220-1422	38	0.00	69	3,843
J-220-4133	99	2.36	50	3,843
J-220-3480	116	0.00	47	3,844
J-220-2489	71	0.26	61	3,845
J-220-1340	97	0.00	51	3,846
J-220-4654	77	10.22	58	3,848
J-220-1612	65	1.44	64	3,849
J-220-0531	55	1.39	67	3,851
J-220-1430	36	0.00	70	3,853
J-220-2628	22	1.83	79	3,853
J-220-0681	28	0.31	72	3,855
J-220-0542	27	0.00	72	3,856
J-220-3564	77	0.00	59	3,858
J-220-0192	37	0.00	70	3,859
J-220-1016	27	0.04	72	3,859
J-220-0983	19	0.70	80	3,860
J-220-1818	56	1.25	67	3,862
J-220-3690	97	0.00	51	3,863
J-220-0509	54	5.42	68	3,864
J-220-1474	59	1.27	66	3,869
J-220-2174	104	0.00	49	3,869
J-220-2816	24	0.00	79	3,873
J-220-2853	46	0.00	68	3,873
J-220-0217	58	0.00	66	3,874
J-220-4151	66	0.00	63	3,877
J-220-0710	29	1.16	71	3,877
J-220-0618	57	5.77	65	3,880
J-220-0698	28	0.00	72	3,880
J-220-4652	75	2.77	59	3,881
J-220-3024	35	0.00	69	3,884
J-220-2863	46	0.90	68	3,885
J-220-0984	19	0.00	80	3,886
J-220-1417	30	0.00	71	3,888
J-220-3385	80	9.93	57	3,892
J-220-0195	36	3.30	70	3,893
J-220-1716	81	18.95	57	3,895
J-220-1051	22	2.43	79	3,895
J-220-3072	116	0.00	48	3,896
J-220-2125	53	2.27	67	3,897
J-220-1584	21	0.00	79	3,897
J-220-2124	53	0.00	67	3,901
J-220-2957	11	0.00	84	3,902
J-220-0504	55	6.16	68	3,902

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2177	102	9.47	49	3,905
J-220-1763	36	7.84	73	3,908
J-220-2123	53	0.00	67	3,909
J-220-0281	36	4.93	73	3,909
J-220-3644	108	0.00	51	3,910
J-220-0722	54	1.51	67	3,911
J-220-2126	54	9.46	67	3,912
J-220-0525	34	0.04	70	3,913
J-220-1604	22	0.00	80	3,916
J-220-3683	71	0.00	61	3,919
J-220-1943	22	0.00	80	3,920
J-220-0725	61	6.51	66	3,922
J-220-0781	53	0.00	66	3,924
J-220-0783	53	0.00	66	3,924
J-220-3360	92	0.00	53	3,925
J-220-2914	73	3.52	60	3,926
J-220-3679	71	0.00	61	3,927
J-220-1564	109	1.52	46	3,928
J-220-0785	53	12.56	67	3,932
J-220-2888	107	0.00	49	3,934
J-220-2214	55	1.54	68	3,934
J-220-2319	37	12.74	73	3,936
J-220-2131	58	11.25	66	3,941
J-220-2436	92	3.34	53	3,942
J-220-1488	55	0.89	68	3,943
J-220-0700	59	0.96	64	3,943
J-220-1415	29	1.22	72	3,943
J-220-2850	22	0.00	80	3,944
J-220-3569	74	1.35	60	3,945
J-220-2213	55	0.00	68	3,947
J-220-4365	104	0.00	49	3,948
J-220-0205	56	0.00	66	3,949
J-220-4376	73	0.00	60	3,951
J-220-0530	58	6.44	66	3,951
J-220-0532	55	0.00	68	3,951
J-220-2870	75	4.11	60	3,951
J-220-1759	54	3.63	68	3,952
J-220-0701	59	3.73	64	3,952
J-220-0240	24	0.00	78	3,952
J-220-4399	62	0.00	65	3,956
J-220-2309	79	0.00	59	3,956
J-220-0206	56	3.17	66	3,957
J-220-2399	78	2.07	58	3,957
J-220-2356	41	0.00	68	3,958
J-220-0777	53	0.00	66	3,959
J-220-3363	92	0.79	53	3,959
J-220-4388	79	0.00	58	3,959
J-220-2273	78	5.91	58	3,959

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1894	53	0.00	71	3,962
J-220-2663	100	3.28	54	3,964
J-220-3681	71	16.73	61	3,965
J-220-3785	73	1.33	60	3,965
J-220-1497	60	0.00	66	3,966
J-220-2355	41	5.77	68	3,967
J-220-4153	66	0.00	63	3,969
J-220-0780	53	0.00	66	3,972
J-220-0779	53	0.00	66	3,974
J-220-1237	22	0.24	79	3,974
J-220-4517	74	4.17	60	3,975
J-220-3460	57	0.00	67	3,976
J-220-3334	72	0.00	61	3,979
J-220-1047	22	0.58	79	3,980
J-220-2353	41	8.28	68	3,981
J-220-4379	75	1.76	59	3,983
J-220-1135	50	0.00	67	3,983
J-220-3064	61	0.00	66	3,983
J-220-2219	58	0.00	66	3,985
J-220-4434	74	1.33	60	3,988
J-220-0680	29	0.48	71	3,989
J-220-3466	61	0.00	66	3,991
J-220-1412	29	3.54	72	3,995
J-220-4389	79	0.00	57	3,995
J-220-3538	75	38.28	59	3,997
J-220-4819	68	0.00	64	3,998
J-220-2817	24	0.00	79	3,998
J-220-1208	29	1.03	71	3,998
J-220-3468	61	8.68	66	3,998
J-220-4380	75	0.00	59	3,999
J-220-1781	35	0.00	70	3,999
J-220-2100	30	7.43	71	3,999
J-220-2676	47	14.83	68	4,000
J-220-3646	108	0.00	51	4,004
J-220-3647	108	0.00	51	4,004
J-220-3697	108	0.00	51	4,004
J-220-3048	70	0.00	62	4,008
J-220-2346	31	0.48	71	4,010
J-220-2995	52	0.00	72	4,011
J-220-4648	75	4.21	59	4,012
J-220-2662	101	0.00	54	4,012
J-220-3543	70	7.95	62	4,013
J-220-1414	30	0.18	71	4,013
J-220-4178	86	1.35	55	4,014
J-220-1416	30	1.27	71	4,016
J-220-0600	36	1.32	69	4,017
J-220-3012	34	0.92	71	4,019
J-220-4177	86	0.00	55	4,020

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4167	79	7.45	57	4,021
J-220-0212	57	2.48	67	4,022
J-220-3107	101	0.00	54	4,023
J-220-4478	104	0.00	48	4,024
J-220-0873	36	17.53	73	4,027
J-220-1101	20	4.30	80	4,028
J-220-2211	55	0.00	68	4,032
J-220-0523	61	9.70	64	4,032
J-220-3995	71	0.00	62	4,037
J-220-2487	104	0.00	49	4,040
J-220-4728	75	5.68	59	4,041
J-220-1965	71	0.00	62	4,043
J-220-1364	54	9.96	68	4,045
J-220-1573	55	0.00	68	4,045
J-220-3051	73	6.77	60	4,046
J-220-2175	104	0.00	49	4,050
J-220-2702	34	0.26	70	4,052
J-220-1179	19	0.00	80	4,056
J-220-4390	79	0.00	57	4,062
J-220-3011	34	2.69	71	4,062
J-220-0039	45	0.00	69	4,062
J-220-3680	72	2.10	61	4,064
J-220-4830	54	1.70	68	4,064
J-220-2844	22	3.90	80	4,068
J-220-2871	74	0.04	60	4,075
J-220-0533	54	0.99	68	4,075
J-220-1049	22	4.23	79	4,076
J-220-3578	84	0.00	56	4,080
J-220-0041	45	0.91	69	4,080
J-220-4375	73	2.45	60	4,082
J-220-0222	58	2.45	66	4,084
J-220-1039	58	4.71	66	4,084
J-220-2587	37	0.00	72	4,084
J-220-4181	86	3.90	55	4,084
J-220-3565	77	3.15	58	4,085
J-220-2851	22	0.00	80	4,087
J-220-1168	46	13.03	69	4,087
J-220-0049	38	20.27	72	4,087
J-220-4089	75	0.00	59	4,089
J-220-2195	29	3.67	71	4,090
J-220-2196	29	1.22	71	4,091
J-220-0709	29	0.24	71	4,092
J-220-4196	75	2.80	59	4,093
J-220-3541	74	1.75	60	4,095
J-220-4195	75	0.00	59	4,096
J-220-4371	108	0.00	46	4,097
J-220-0244	24	24.67	78	4,099
J-220-3632	96	1.64	51	4,100

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2727	72	0.00	61	4,100
J-220-4197	76	0.59	59	4,101
J-220-0670	20	0.00	80	4,101
J-220-1310	24	0.00	79	4,101
J-220-1339	97	0.00	51	4,104
J-220-4690	79	1.49	57	4,107
J-220-3006	36	0.00	69	4,108
J-220-4831	54	0.00	68	4,108
J-220-3275	76	0.04	59	4,114
J-220-2490	71	0.00	61	4,114
J-220-0528	32	4.20	70	4,116
J-220-3005	36	0.00	69	4,117
J-220-2099	32	2.40	71	4,118
J-220-2698	36	0.94	69	4,121
J-220-2974	94	12.26	52	4,123
J-220-2643	20	3.01	80	4,124
J-220-2193	32	1.01	70	4,126
J-220-2269	75	6.42	59	4,126
J-220-0866	35	13.87	73	4,126
J-220-3025	35	0.00	69	4,127
J-220-3273	76	0.00	59	4,129
J-220-4692	79	0.00	57	4,132
J-220-2086	56	0.00	67	4,135
J-220-0241	24	0.00	79	4,135
J-220-1036	58	1.78	66	4,136
J-220-2098	32	1.90	71	4,136
J-220-1606	59	0.00	66	4,138
J-220-1038	58	3.17	66	4,138
J-220-4847	54	0.00	68	4,138
J-220-0751	35	0.00	70	4,139
J-220-3915	72	0.00	61	4,139
J-220-1549	35	0.00	69	4,141
J-220-2097	32	4.85	71	4,142
J-220-4090	75	0.74	59	4,143
J-220-4370	108	0.00	46	4,143
J-220-1037	58	0.00	66	4,143
J-220-2042	51	0.00	73	4,143
J-220-4646	78	5.46	58	4,143
J-220-0045	45	1.80	69	4,144
J-220-3364	94	9.43	52	4,149
J-220-2867	74	0.00	60	4,149
J-220-4689	79	0.00	57	4,150
J-220-4691	79	2.10	57	4,152
J-220-4688	79	0.00	57	4,152
J-220-4378	75	0.00	59	4,152
J-220-4687	79	0.83	57	4,153
J-220-3013	34	1.31	71	4,157
J-220-0883	60	1.51	64	4,159

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0246	24	3.97	78	4,166
J-220-2096	32	0.00	71	4,172
J-220-2194	31	6.53	71	4,174
J-220-1574	56	3.51	67	4,177
J-220-1139	50	0.00	67	4,180
J-220-1548	35	0.61	70	4,181
J-220-0373	31	0.00	75	4,181
J-220-0985	19	1.90	80	4,188
J-220-1727	34	0.00	70	4,188
J-220-3702	108	0.00	52	4,189
J-220-4730	94	0.00	52	4,192
J-220-1880	33	0.50	70	4,193
J-220-3481	108	0.00	52	4,193
J-220-3482	108	0.00	52	4,194
J-220-2696	34	1.22	70	4,196
J-220-3274	76	5.79	59	4,203
J-220-3392	56	9.79	68	4,204
J-220-1882	61	0.00	64	4,204
J-220-1728	34	0.00	70	4,204
J-220-4186	61	5.60	66	4,205
J-220-2503	45	0.00	69	4,212
J-220-2912	72	7.04	61	4,217
J-220-1753	54	1.47	68	4,218
J-220-1682	33	3.28	71	4,218
J-220-3106	107	0.00	52	4,221
J-220-2922	71	3.71	61	4,222
J-220-3852	76	0.00	59	4,226
J-220-3682	71	0.00	61	4,229
J-220-2362	55	1.66	68	4,230
J-220-2085	58	4.57	66	4,231
J-220-3847	74	9.24	60	4,232
J-220-0943	58	0.00	67	4,234
J-220-0214	58	1.56	67	4,235
J-220-0942	58	0.00	67	4,236
J-220-2825	20	0.77	80	4,236
J-220-3271	76	0.00	59	4,237
J-220-1936	32	1.29	71	4,239
J-220-0941	58	0.00	67	4,240
J-220-0505	55	4.44	67	4,240
J-220-4319	74	4.74	60	4,243
J-220-0211	57	2.69	67	4,243
J-220-3841	73	7.32	60	4,249
J-220-3575	61	0.00	66	4,250
J-220-1658	58	0.00	67	4,252
J-220-3406	57	0.99	67	4,254
J-220-0897	84	1.49	56	4,256
J-220-2769	32	0.00	71	4,257
J-220-1050	22	0.55	79	4,258

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1580	20	4.64	80	4,258
J-220-2087	56	0.00	67	4,264
J-220-1989	34	0.00	70	4,264
J-220-3577	61	6.49	66	4,265
J-220-1736	33	4.88	74	4,266
J-220-3391	55	0.00	68	4,268
J-220-3096	42	0.00	72	4,271
J-220-2768	32	0.00	71	4,274
J-220-3103	71	0.00	61	4,275
J-220-0215	56	4.59	67	4,277
J-220-2956	34	0.00	70	4,277
J-220-2130	54	0.00	68	4,277
J-220-1014	41	0.00	71	4,278
J-220-1933	32	0.83	71	4,279
J-220-3635	94	0.91	52	4,280
J-220-4590	66	5.00	65	4,281
J-220-1656	58	24.91	67	4,282
J-220-2173	32	0.00	71	4,282
J-220-1102	20	0.63	80	4,283
J-220-3344	61	0.00	65	4,284
J-220-1311	24	1.47	79	4,285
J-220-3853	75	3.36	59	4,290
J-220-1572	56	3.94	67	4,290
J-220-0671	20	0.00	80	4,292
J-220-0776	50	1.09	67	4,293
J-220-0118	33	0.00	70	4,294
J-220-4445	71	1.09	61	4,295
J-220-1607	59	0.00	66	4,296
J-220-2172	32	0.00	71	4,296
J-220-2178	104	0.72	49	4,304
J-220-4515	74	0.15	60	4,306
J-220-0721	54	0.87	68	4,309
J-220-1169	47	0.00	69	4,309
J-220-2325	45	6.27	70	4,311
J-220-3362	94	3.56	52	4,313
J-220-1017	54	3.69	68	4,314
J-220-0915	34	11.61	74	4,318
J-220-2697	35	3.15	69	4,318
J-220-4519	75	0.87	59	4,320
J-220-2068	55	0.00	68	4,320
J-220-3576	61	0.00	66	4,321
J-220-3580	82	1.83	57	4,322
J-220-2699	35	0.00	69	4,322
J-220-4007	108	0.00	46	4,324
J-220-4403	104	0.72	49	4,326
J-220-0750	35	0.18	70	4,328
J-220-4737	80	5.10	57	4,328
J-220-1025	68	10.29	62	4,331

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3845	74	1.79	60	4,331
J-220-4516	74	0.46	60	4,333
J-220-0527	34	0.00	70	4,339
J-220-3836	72	7.65	61	4,341
J-220-1048	22	0.99	79	4,341
J-220-3892	104	8.46	48	4,342
J-220-1794	20	7.07	80	4,342
J-220-0119	33	0.00	70	4,343
J-220-2798	34	1.38	71	4,343
J-220-2737	35	0.00	69	4,346
J-220-0867	34	0.00	74	4,346
J-220-3676	55	0.00	68	4,347
J-220-3049	71	2.03	61	4,348
J-220-2802	34	0.92	71	4,350
J-220-2700	35	7.69	69	4,351
J-220-3732	82	0.00	57	4,353
J-220-2955	34	0.00	70	4,354
J-220-2176	104	0.00	49	4,354
J-220-4091	75	1.77	59	4,358
J-220-3768	116	0.00	50	4,358
J-220-3616	105	2.28	48	4,359
J-220-0893	85	0.00	56	4,362
J-220-2981	47	0.00	69	4,364
J-220-4644	76	4.66	59	4,365
J-220-3115	116	0.00	50	4,366
J-220-3118	80	0.00	57	4,367
J-220-2971	35	0.00	69	4,367
J-220-0741	39	0.00	72	4,368
J-220-2070	55	4.76	68	4,369
J-220-0122	34	0.00	70	4,370
J-220-1171	48	0.00	69	4,370
J-220-0895	84	0.00	56	4,370
J-220-1138	50	0.00	67	4,372
J-220-4166	80	1.95	57	4,377
J-220-0894	84	0.00	56	4,377
J-220-1321	33	16.82	70	4,378
J-220-0121	34	0.00	70	4,379
J-220-1789	34	1.66	70	4,379
J-220-0831	55	0.63	68	4,380
J-220-4280	81	1.06	57	4,385
J-220-1715	81	0.00	57	4,387
J-220-0120	33	0.00	70	4,390
J-220-3561	80	16.25	57	4,392
J-220-3052	72	0.58	61	4,394
J-220-2694	35	0.00	70	4,394
J-220-1788	34	0.00	70	4,395
J-220-0789	33	0.00	70	4,396
J-220-1322	33	69.19	70	4,398

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0788	33	0.94	70	4,399
J-220-2799	34	0.00	71	4,409
J-220-0774	50	0.00	67	4,410
J-220-3504	108	0.00	46	4,411
J-220-4647	78	7.45	58	4,411
J-220-3119	80	0.00	57	4,413
J-220-4814	94	0.00	52	4,413
J-220-0526	34	0.00	70	4,414
J-220-2686	50	0.00	67	4,414
J-220-3981	69	0.57	63	4,414
J-220-2758	67	0.00	64	4,415
J-220-3120	80	0.00	57	4,418
J-220-2695	35	1.38	70	4,418
J-220-2801	34	3.36	71	4,418
J-220-3065	60	14.31	66	4,419
J-220-0601	34	0.00	70	4,421
J-220-3846	74	0.00	60	4,423
J-220-0602	34	0.00	70	4,423
J-220-3121	80	0.89	57	4,424
J-220-0787	34	6.79	70	4,426
J-220-4594	108	0.00	46	4,429
J-220-4187	61	0.00	66	4,432
J-220-0720	54	0.00	68	4,433
J-220-4520	75	0.24	59	4,435
J-220-4037	104	0.00	48	4,437
J-220-3419	104	0.00	48	4,437
J-220-4036	104	0.00	48	4,437
J-220-3586	104	0.00	48	4,437
J-220-1780	61	0.00	64	4,438
J-220-2915	72	3.50	61	4,439
J-220-3544	60	3.63	66	4,442
J-220-0916	34	0.00	74	4,442
J-220-0279	34	5.55	74	4,443
J-220-3321	72	0.00	61	4,443
J-220-2889	107	0.00	49	4,450
J-220-1180	21	1.68	79	4,450
J-220-3418	108	0.00	46	4,451
J-220-1142	50	0.00	67	4,453
J-220-1181	21	0.00	79	4,456
J-220-2069	58	8.01	66	4,457
J-220-3437	82	6.59	56	4,458
J-220-0740	39	0.00	72	4,458
J-220-2286	60	9.95	66	4,463
J-220-3844	73	0.85	60	4,463
J-220-1343	104	2.07	49	4,464
J-220-1122	64	0.00	64	4,469
J-220-1681	34	4.22	71	4,471
J-220-2006	61	4.50	65	4,477

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4433	61	0.00	66	4,481
J-220-2797	34	0.00	71	4,483
J-220-2638	21	0.67	80	4,484
J-220-1786	34	3.02	70	4,484
J-220-4088	76	0.00	59	4,487
J-220-0154	19	0.00	81	4,495
J-220-4444	71	13.15	61	4,496
J-220-1578	20	2.02	80	4,499
J-220-4555	76	3.08	59	4,507
J-220-0766	28	0.00	76	4,513
J-220-4087	76	30.63	59	4,514
J-220-1561	109	20.80	46	4,515
J-220-4377	75	0.00	59	4,520
J-220-1583	21	0.00	79	4,523
J-220-2525	35	0.61	70	4,523
J-220-4514	74	0.52	60	4,525
J-220-1170	48	4.59	69	4,528
J-220-4813	106	0.00	47	4,534
J-220-4402	104	0.00	49	4,535
J-220-1144	50	0.00	67	4,535
J-220-2639	21	0.72	80	4,540
J-220-3167	36	3.47	70	4,540
J-220-3978	65	6.16	65	4,542
J-220-2590	24	4.38	78	4,548
J-220-3532	74	0.90	60	4,548
J-220-1182	21	0.00	79	4,552
J-220-4035	105	23.03	47	4,553
J-220-0194	35	5.77	70	4,560
J-220-2982	47	0.00	69	4,562
J-220-4550	71	0.00	61	4,575
J-220-1143	50	0.00	67	4,579
J-220-4431	105	0.00	47	4,585
J-220-4731	105	0.00	48	4,587
J-220-2272	78	5.22	58	4,588
J-220-1608	60	0.55	66	4,600
J-220-1137	50	0.00	67	4,602
J-220-1845	50	4.68	67	4,603
J-220-3872	118	8.99	42	4,608
J-220-1431	35	0.00	70	4,610
J-220-1588	21	0.00	79	4,612
J-220-1610	59	0.00	66	4,612
J-220-2784	49	0.00	69	4,617
J-220-3587	103	0.00	48	4,617
J-220-1010	55	0.00	68	4,630
J-220-1024	68	0.28	62	4,630
J-220-2526	35	0.00	70	4,644
J-220-1665	68	0.00	62	4,650
J-220-1609	60	0.66	66	4,658

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4836	94	0.00	52	4,659
J-220-3123	72	2.38	61	4,664
J-220-0749	35	0.00	70	4,667
J-220-4635	117	0.00	43	4,667
J-220-3675	55	0.00	68	4,671
J-220-1663	68	0.00	62	4,671
J-220-0672	21	5.63	80	4,672
J-220-2757	67	0.00	64	4,672
J-220-0394	55	0.00	68	4,673
J-220-2245	117	0.00	42	4,678
J-220-3521	48	0.00	69	4,680
J-220-2866	75	0.07	59	4,680
J-220-3719	61	0.00	65	4,683
J-220-1419	35	0.00	70	4,683
J-220-4363	104	0.00	49	4,686
J-220-4815	94	0.00	52	4,692
J-220-2004	61	12.00	65	4,699
J-220-4818	94	0.00	52	4,699
J-220-1191	56	2.10	67	4,713
J-220-1787	34	0.00	70	4,719
J-220-4822	68	0.58	63	4,722
J-220-4650	78	0.00	58	4,737
J-220-0193	37	0.28	70	4,741
J-220-0047	46	0.82	69	4,747
J-220-1420	35	0.44	70	4,750
J-220-0868	36	3.22	73	4,757
J-220-4645	78	3.75	58	4,758
J-220-1866	21	0.00	79	4,759
J-220-4597	72	0.00	61	4,759
J-220-4651	77	0.00	59	4,763
J-220-1614	60	0.00	66	4,766
J-220-0754	36	3.06	70	4,766
J-220-1619	60	0.00	66	4,766
J-220-0381	27	12.26	77	4,767
J-220-3891	105	0.00	48	4,769
J-220-1009	55	0.00	68	4,777
J-220-1662	68	0.00	62	4,781
J-220-2506	35	2.12	70	4,785
J-220-0797	22	1.20	79	4,790
J-220-1992	68	0.00	62	4,793
J-220-1568	98	0.00	50	4,793
J-220-1418	35	0.00	70	4,797
J-220-3320	74	0.00	60	4,797
J-220-2384	35	0.22	70	4,799
J-220-3994	71	0.72	61	4,822
J-220-4279	81	0.36	57	4,825
J-220-2916	72	0.00	61	4,826
J-220-3335	72	0.00	61	4,827

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1613	60	0.00	66	4,829
J-220-4558	74	0.00	60	4,832
J-220-0870	36	0.00	73	4,836
J-220-0755	36	0.00	70	4,838
J-220-3789	106	0.00	48	4,842
J-220-3979	72	0.87	61	4,846
J-220-4169	81	1.85	57	4,847
J-220-1617	60	1.92	66	4,847
J-220-2894	107	0.00	49	4,850
J-220-1563	98	11.95	50	4,850
J-220-1562	98	2.00	50	4,854
J-220-2980	48	0.00	69	4,863
J-220-0744	35	0.00	70	4,864
J-220-1219	15	0.00	82	4,866
J-220-1615	59	0.77	66	4,866
J-220-2005	61	0.00	65	4,868
J-220-2385	35	0.00	70	4,868
J-220-3671	58	14.62	67	4,872
J-220-2622	14	0.00	83	4,875
J-220-1618	60	0.24	66	4,878
J-220-3217	35	0.00	70	4,882
J-220-1616	60	0.00	66	4,887
J-220-1218	16	0.00	82	4,889
J-220-3126	72	0.00	61	4,892
J-220-2625	12	0.00	84	4,893
J-220-0032	53	6.75	66	4,900
J-220-1157	10	0.00	85	4,901
J-220-2624	12	0.00	84	4,902
J-220-2007	61	0.00	65	4,903
J-220-2008	61	0.14	65	4,906
J-220-3254	106	0.00	48	4,909
J-220-1156	12	0.00	84	4,910
J-220-1155	12	0.00	84	4,911
J-220-4870	12	0.00	84	4,911
J-220-4869	12	0.00	84	4,911
J-220-2332	38	4.86	72	4,912
J-220-4887	12	0.00	84	4,916
J-220-1222	15	0.00	82	4,919
J-220-2909	12	0.00	84	4,920
J-220-1993	69	0.00	62	4,924
J-220-2595	15	0.00	82	4,924
J-220-3686	97	0.00	51	4,925
J-220-0757	28	4.06	76	4,926
J-220-3530	67	0.00	64	4,927
J-220-3122	80	1.47	57	4,928
J-220-3972	80	1.06	57	4,930
J-220-0884	61	5.11	64	4,932
J-220-0753	36	0.00	70	4,934

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0395	55	0.00	68	4,936
J-220-2594	15	0.00	82	4,942
J-220-1793	15	0.00	82	4,948
J-220-1166	14	0.00	83	4,952
J-220-2693	53	0.00	66	4,953
J-220-1167	14	1.03	83	4,954
J-220-1223	14	0.00	83	4,955
J-220-0379	31	11.28	75	4,957
J-220-3992	71	0.00	61	4,957
J-220-1113	66	1.03	63	4,961
J-220-2730	69	0.00	63	4,965
J-220-1792	15	0.00	82	4,971
J-220-1791	15	0.00	82	4,973
J-220-0796	22	0.00	79	4,974
J-220-0606	11	0.00	84	4,976
J-220-2608	23	4.33	79	4,979
J-220-2620	15	0.00	82	4,984
J-220-1226	14	10.71	83	4,986
J-220-0189	35	0.70	70	4,989
J-220-3333	72	0.04	61	4,991
J-220-2979	49	0.00	69	4,995
J-220-3169	37	26.63	70	4,996
J-220-0858	55	9.81	68	5,006
J-220-0374	31	0.00	75	5,007
J-220-2978	49	0.00	69	5,011
J-220-0393	55	0.00	68	5,018
J-220-1775	58	0.00	67	5,025
J-220-4168	81	0.67	57	5,026
J-220-4512	71	0.00	61	5,031
J-220-0365	31	0.00	75	5,032
J-220-1948	22	0.00	79	5,035
J-220-1187	59	1.20	66	5,036
J-220-2621	16	0.00	82	5,038
J-220-3971	79	1.08	58	5,046
J-220-3168	37	0.00	70	5,047
J-220-4381	81	0.00	58	5,051
J-220-3672	58	0.00	67	5,051
J-220-1559	105	0.00	48	5,055
J-220-1560	105	0.00	48	5,060
J-220-1220	16	0.00	82	5,061
J-220-2010	25	5.15	79	5,062
J-220-1785	35	0.00	70	5,066
J-220-0278	31	3.10	75	5,069
J-220-3993	71	0.00	61	5,069
J-220-1558	105	0.00	48	5,069
J-220-4362	104	2.52	49	5,070
J-220-2411	105	0.87	48	5,072
J-220-0752	36	1.05	70	5,076

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1221	17	0.00	82	5,077
J-220-0889	53	2.43	66	5,079
J-220-3617	105	0.58	48	5,084
J-220-4598	72	0.00	61	5,084
J-220-0888	53	0.00	66	5,089
J-220-1867	21	0.00	79	5,093
J-220-1955	53	2.09	66	5,097
J-220-3127	72	0.00	61	5,097
J-220-2409	105	0.00	48	5,097
J-220-2617	20	4.28	80	5,103
J-220-1582	21	0.00	79	5,113
J-220-3703	71	1.11	61	5,118
J-220-0806	37	0.59	70	5,121
J-220-0187	37	2.12	70	5,123
J-220-3551	71	2.07	61	5,125
J-220-3704	71	0.00	61	5,126
J-220-0396	55	0.00	68	5,129
J-220-1783	35	0.00	70	5,139
J-220-2410	104	4.18	48	5,140
J-220-0807	37	0.55	70	5,142
J-220-4557	74	0.00	60	5,145
J-220-1099	22	0.00	79	5,145
J-220-0760	24	0.87	78	5,147
J-220-1499	58	0.00	67	5,148
J-220-1657	60	0.00	66	5,158
J-220-1186	58	0.26	67	5,160
J-220-3677	71	0.00	61	5,171
J-220-1282	55	0.00	68	5,175
J-220-4821	68	0.00	63	5,176
J-220-3092	49	20.24	69	5,192
J-220-1944	22	0.00	79	5,194
J-220-1227	15	5.31	82	5,197
J-220-0869	38	0.00	72	5,203
J-220-1224	11	0.00	84	5,205
J-220-0805	37	0.00	70	5,213
J-220-4686	78	0.00	58	5,213
J-220-2229	60	0.00	66	5,221
J-220-4559	74	0.00	60	5,222
J-220-2308	79	0.00	59	5,224
J-220-1228	11	0.00	84	5,231
J-220-2615	11	1.07	84	5,232
J-220-1229	11	0.00	84	5,234
J-220-1784	35	0.00	70	5,234
J-220-2756	67	0.00	64	5,243
J-220-1189	56	0.83	67	5,247
J-220-1183	58	0.00	67	5,249
J-220-3026	36	8.61	73	5,252
J-220-1797	16	0.00	82	5,257

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3322	72	0.00	61	5,258
J-220-0859	55	0.00	68	5,261
J-220-3678	71	3.10	61	5,261
J-220-2616	19	0.00	80	5,264
J-220-0820	97	0.00	51	5,268
J-220-1945	21	0.00	79	5,269
J-220-1188	56	2.80	67	5,270
J-220-3673	59	4.54	67	5,271
J-220-1184	58	0.00	67	5,272
J-220-3674	58	1.80	67	5,274
J-220-0605	11	35.41	84	5,275
J-220-2766	35	0.00	70	5,278
J-220-1946	22	1.27	79	5,280
J-220-2228	60	0.00	66	5,281
J-220-3650	71	0.00	61	5,289
J-220-1185	58	0.00	67	5,290
J-220-1344	105	0.00	49	5,311
J-220-0821	97	1.88	51	5,316
J-220-0742	39	0.00	73	5,323
J-220-0819	97	0.00	51	5,323
J-220-2502	45	7.62	69	5,330
J-220-2896	66	0.00	63	5,334
J-220-1280	55	4.40	68	5,336
J-220-4560	74	0.00	60	5,338
J-220-3890	105	3.20	48	5,339
J-220-4387	119	0.00	41	5,341
J-220-0822	97	0.00	51	5,345
J-220-1579	21	1.59	79	5,345
J-220-4479	105	4.35	48	5,346
J-220-2767	35	0.00	70	5,348
J-220-0920	97	0.00	51	5,349
J-220-0188	35	0.00	70	5,351
J-220-0921	97	0.00	51	5,353
J-220-1278	55	0.22	68	5,353
J-220-1190	56	4.28	67	5,354
J-220-0922	97	0.00	51	5,357
J-220-2009	25	0.00	79	5,358
J-220-4170	78	6.73	58	5,359
J-220-2997	51	0.00	69	5,363
J-220-2687	50	3.87	67	5,367
J-220-1796	16	0.00	82	5,368
J-220-1577	16	0.00	82	5,371
J-220-2685	50	0.00	67	5,374
J-220-2891	107	0.00	49	5,384
J-220-0604	14	17.37	83	5,385
J-220-4341	77	3.97	58	5,388
J-220-4617	77	1.11	58	5,388
J-220-2890	107	0.00	49	5,389

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0724	60	0.00	67	5,391
J-220-1911	51	2.77	69	5,391
J-220-1215	19	0.00	81	5,396
J-220-0891	50	0.00	67	5,399
J-220-2618	19	0.00	81	5,400
J-220-0364	60	0.00	67	5,401
J-220-1154	16	21.89	82	5,402
J-220-2893	107	2.89	49	5,403
J-220-1345	105	0.00	49	5,404
J-220-0363	60	0.00	67	5,406
J-220-1576	60	0.00	66	5,416
J-220-1581	21	0.00	79	5,417
J-220-4480	105	0.34	48	5,419
J-220-3218	35	2.97	70	5,419
J-220-4481	105	0.00	48	5,422
J-220-4342	78	0.00	58	5,423
J-220-0153	20	0.00	81	5,427
J-220-0362	60	0.00	67	5,432
J-220-2596	17	2.38	82	5,434
J-220-1236	23	0.00	79	5,440
J-220-4451	69	0.00	63	5,448
J-220-2728	68	0.00	63	5,453
J-220-1348	105	0.94	49	5,455
J-220-4272	68	2.53	63	5,457
J-220-3788	106	4.16	48	5,468
J-220-3790	106	1.85	48	5,469
J-220-2280	19	0.00	81	5,477
J-220-3687	97	0.00	51	5,482
J-220-4649	77	11.11	59	5,494
J-220-2246	115	2.52	43	5,496
J-220-3572	78	0.85	58	5,504
J-220-2279	19	0.00	81	5,507
J-220-0382	36	1.80	73	5,508
J-220-4327	104	0.00	49	5,524
J-220-3571	77	0.55	58	5,525
J-220-0185	35	0.22	70	5,525
J-220-3256	106	1.52	48	5,529
J-220-3255	106	0.00	48	5,530
J-220-4361	104	0.00	49	5,531
J-220-1843	25	2.62	78	5,533
J-220-4364	104	1.32	49	5,539
J-220-1346	105	0.00	49	5,542
J-220-3574	77	7.21	58	5,543
J-220-4840	115	0.00	43	5,547
J-220-3253	106	0.00	48	5,550
J-220-4591	106	1.32	48	5,559
J-220-0641	65	0.00	66	5,566
J-220-2281	18	0.00	81	5,567

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4841	115	0.00	43	5,571
J-220-1217	18	0.00	81	5,572
J-220-1276	55	0.00	68	5,587
J-220-1277	55	0.00	68	5,587
J-220-1281	55	0.99	68	5,598
J-220-1279	55	0.00	68	5,601
J-220-2276	22	4.33	79	5,604
J-220-0639	65	0.00	66	5,608
J-220-2320	38	0.48	72	5,616
J-220-4184	119	0.00	41	5,626
J-220-1702	69	0.00	63	5,635
J-220-0638	64	0.00	66	5,636
J-220-4425	74	0.00	60	5,636
J-220-2637	15	0.00	83	5,639
J-220-1015	41	0.00	71	5,643
J-220-3784	74	0.00	60	5,647
J-220-3570	74	3.45	60	5,650
J-220-0603	15	3.54	83	5,659
J-220-4157	66	0.00	63	5,665
J-220-4355	77	0.00	59	5,676
J-220-1216	18	0.00	81	5,687
J-220-2892	107	3.75	48	5,687
J-220-3977	69	3.06	63	5,697
J-220-0383	36	0.00	73	5,703
J-220-2017	25	0.00	79	5,704
J-220-4368	115	0.00	43	5,706
J-220-3639	106	0.00	48	5,706
J-220-1347	106	3.58	48	5,712
J-220-1349	106	0.00	49	5,714
J-220-0728	48	8.58	70	5,716
J-220-3638	106	1.71	49	5,718
J-220-2908	70	0.92	62	5,720
J-220-1163	20	3.54	80	5,720
J-220-1350	105	0.00	49	5,721
J-220-1351	106	0.00	49	5,724
J-220-1164	18	0.00	81	5,730
J-220-2601	20	0.00	80	5,733
J-220-1165	18	0.00	81	5,734
J-220-3746	116	0.00	43	5,735
J-220-0836	18	0.00	81	5,738
J-220-1225	18	0.00	81	5,741
J-220-3684	96	0.00	51	5,744
J-220-3976	68	0.13	63	5,748
J-220-4621	77	1.39	59	5,749
J-220-3685	96	0.00	51	5,750
J-220-4424	76	1.70	59	5,756
J-220-0837	18	0.00	81	5,758
J-220-1892	50	5.00	69	5,764

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2623	22	0.00	79	5,765
J-220-1842	25	0.00	78	5,767
J-220-3747	115	0.00	43	5,792
J-220-2324	43	17.06	70	5,797
J-220-4369	115	0.00	43	5,798
J-220-1495	60	0.00	66	5,798
J-220-4561	115	0.00	43	5,804
J-220-4119	64	0.07	67	5,833
J-220-4839	115	0.00	43	5,835
J-220-2277	22	0.00	79	5,836
J-220-1356	93	27.46	52	5,838
J-220-2682	45	0.00	69	5,840
J-220-4620	77	0.00	59	5,841
J-220-0743	38	0.00	73	5,856
J-220-1494	60	0.00	66	5,868
J-220-4447	70	0.55	62	5,869
J-220-0697	23	0.00	79	5,872
J-220-2293	71	21.83	61	5,885
J-220-2278	22	0.00	79	5,898
J-220-4596	66	5.43	65	5,905
J-220-4653	71	8.74	61	5,910
J-220-1699	67	7.45	66	5,911
J-220-3310	74	2.32	60	5,933
J-220-0494	25	0.00	78	5,933
J-220-0997	56	6.27	67	5,936
J-220-2629	22	10.17	79	5,936
J-220-4562	72	1.35	61	5,946
J-220-0627	67	0.00	66	5,948
J-220-0575	22	0.00	79	5,959
J-220-4450	69	0.00	63	5,960
J-220-3870	119	9.14	41	5,964
J-220-3871	119	0.00	41	5,964
J-220-1964	69	0.00	63	5,966
J-220-2600	20	0.00	80	5,966
J-220-2553	71	0.68	61	5,976
J-220-2597	20	0.00	80	5,982
J-220-1798	17	0.00	82	5,984
J-220-3331	75	1.44	59	5,989
J-220-2598	20	0.00	80	5,998
J-220-1054	23	0.51	79	5,998
J-220-1238	23	0.00	79	5,999
J-220-1800	17	0.00	82	6,000
J-220-1496	60	0.00	66	6,003
J-220-2789	119	0.00	41	6,005
J-220-2501	47	0.00	68	6,007
J-220-3837	72	1.53	61	6,012
J-220-1274	55	0.00	68	6,014
J-220-4155	66	0.00	63	6,014

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1799	17	0.00	82	6,017
J-220-0574	22	0.00	79	6,018
J-220-2599	20	12.91	80	6,023
J-220-0835	22	0.00	79	6,027
J-220-1275	55	0.00	68	6,029
J-220-2790	119	0.00	41	6,035
J-220-2244	57	0.26	67	6,036
J-220-2635	17	0.00	82	6,036
J-220-2923	71	1.18	61	6,039
J-220-1355	93	0.00	52	6,061
J-220-3973	72	18.00	61	6,067
J-220-2755	67	0.00	64	6,077
J-220-2791	119	17.43	41	6,082
J-220-2684	47	2.86	68	6,108
J-220-3975	72	2.80	61	6,110
J-220-2282	22	13.68	79	6,116
J-220-3974	72	0.00	61	6,140
J-220-2897	66	0.00	63	6,152
J-220-2677	47	0.00	68	6,162
J-220-0890	47	0.77	68	6,166
J-220-3856	65	3.53	65	6,172
J-220-0500	26	1.90	78	6,175
J-220-1195	55	0.00	68	6,179
J-220-2055	25	10.19	78	6,184
J-220-1701	69	0.00	63	6,207
J-220-3332	75	0.00	59	6,214
J-220-3181	106	3.44	47	6,217
J-220-2924	71	0.00	61	6,238
J-220-3311	74	0.00	60	6,245
J-220-0640	60	0.00	68	6,248
J-220-2729	69	0.04	63	6,260
J-220-0863	60	0.00	68	6,263
J-220-1196	55	0.00	68	6,275
J-220-0361	60	0.00	68	6,284
J-220-2925	71	0.15	61	6,285
J-220-1053	23	0.00	79	6,299
J-220-4877	39	0.00	72	6,306
J-220-0186	36	0.04	71	6,307
J-220-3099	51	0.00	69	6,322
J-220-1193	55	1.18	68	6,326
J-220-2363	36	0.00	71	6,328
J-220-4426	71	1.18	61	6,337
J-220-1006	43	0.00	70	6,346
J-220-1005	41	0.00	71	6,359
J-220-2902	70	0.00	61	6,360
J-220-1197	55	0.00	68	6,362
J-220-2552	71	0.00	61	6,365
J-220-4421	75	0.00	59	6,366

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-3292	63	4.92	67	6,373
J-220-3220	57	0.00	67	6,402
J-220-1396	61	0.00	65	6,404
J-220-0674	36	0.00	71	6,407
J-220-1194	55	3.19	68	6,412
J-220-4873	60	0.00	68	6,426
J-220-4446	70	0.00	62	6,426
J-220-0675	36	0.00	71	6,431
J-220-2636	19	36.37	81	6,432
J-220-4423	75	0.00	59	6,432
J-220-4871	60	0.00	68	6,433
J-220-4878	39	0.00	72	6,440
J-220-4154	66	0.00	63	6,455
J-220-4118	64	0.00	67	6,463
J-220-1645	92	0.00	53	6,469
J-220-0834	22	0.00	79	6,485
J-220-2972	92	0.00	53	6,501
J-220-2240	39	4.45	72	6,510
J-220-2023	92	0.00	53	6,513
J-220-1644	75	0.26	59	6,520
J-220-2383	92	0.00	53	6,526
J-220-2602	20	4.39	80	6,536
J-220-4422	75	0.00	59	6,537
J-220-4228	70	0.00	62	6,544
J-220-4876	39	0.00	72	6,548
J-220-2857	42	41.98	72	6,548
J-220-3980	69	0.00	63	6,550
J-220-3477	72	0.00	61	6,556
J-220-3313	75	4.22	59	6,557
J-220-2306	71	0.00	61	6,559
J-220-1397	61	0.00	65	6,587
J-220-2381	92	0.00	53	6,596
J-220-2382	92	0.00	53	6,596
J-220-4227	70	0.00	62	6,605
J-220-2018	25	0.00	79	6,610
J-220-2380	92	0.00	53	6,613
J-220-2815	25	0.00	79	6,618
J-220-2792	119	0.00	41	6,627
J-220-4396	71	0.00	61	6,642
J-220-1700	69	0.00	63	6,656
J-220-3783	72	35.98	61	6,659
J-220-2295	61	0.00	65	6,666
J-220-2239	38	0.00	73	6,670
J-220-0626	67	0.00	66	6,685
J-220-4875	39	0.00	72	6,698
J-220-3176	118	0.00	42	6,702
J-220-3093	49	5.05	69	6,703
J-220-0495	26	0.00	78	6,704

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0832	23	1.71	79	6,705
J-220-3317	71	0.00	61	6,710
J-220-3293	63	0.00	67	6,714
J-220-1158	18	0.00	81	6,724
J-220-3179	118	10.77	42	6,725
J-220-3177	118	18.32	42	6,732
J-220-3094	48	6.88	70	6,744
J-220-3318	71	6.29	61	6,748
J-220-0833	22	0.00	79	6,767
J-220-3312	74	37.64	60	6,774
J-220-2880	71	0.92	61	6,776
J-220-4622	77	0.00	59	6,779
J-220-2901	70	0.00	62	6,786
J-220-0372	19	0.00	81	6,792
J-220-2305	71	0.00	61	6,807
J-220-0499	26	0.00	78	6,816
J-220-2991	81	15.36	58	6,826
J-220-3238	72	0.00	61	6,844
J-220-1697	70	0.00	62	6,844
J-220-1305	62	0.00	65	6,847
J-220-1234	23	0.00	79	6,907
J-220-3795	23	0.00	79	6,915
J-220-2551	71	0.00	61	6,928
J-220-1643	75	0.00	59	6,941
J-220-2287	71	10.39	61	6,959
J-220-1052	23	0.00	79	6,962
J-220-0155	20	0.00	80	6,976
J-220-4721	116	7.41	43	6,980
J-220-3495	66	0.00	63	6,987
J-220-2634	20	0.00	80	7,005
J-220-1642	78	0.00	58	7,012
J-220-1045	22	0.67	79	7,060
J-220-3187	56	3.58	68	7,072
J-220-0156	20	0.00	80	7,100
J-220-3394	56	0.00	68	7,116
J-220-1639	77	0.00	59	7,129
J-220-1640	77	0.00	59	7,138
J-220-0371	19	0.00	81	7,148
J-220-1641	77	0.00	59	7,148
J-220-2378	91	0.00	54	7,160
J-220-3186	56	1.49	68	7,161
J-220-0157	20	0.00	80	7,169
J-220-4740	69	0.00	63	7,175
J-220-4777	88	0.00	55	7,178
J-220-4156	66	0.00	63	7,179
J-220-3222	57	0.00	67	7,192
J-220-1898	51	3.70	69	7,193
J-220-0857	58	5.96	67	7,253

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2379	90	0.00	54	7,259
J-220-1381	72	0.00	61	7,260
J-220-1306	62	0.00	65	7,271
J-220-0496	26	0.00	78	7,289
J-220-2243	56	2.98	68	7,305
J-220-2376	88	0.00	55	7,308
J-220-1897	50	0.00	69	7,314
J-220-2377	88	0.00	55	7,330
J-220-2999	51	0.94	69	7,332
J-220-1891	51	1.90	69	7,336
J-220-2898	70	0.00	62	7,341
J-220-1896	51	1.16	69	7,354
J-220-3735	86	0.00	56	7,382
J-220-1995	60	0.00	68	7,382
J-220-3733	87	0.00	55	7,397
J-220-0625	66	0.00	66	7,407
J-220-2988	76	0.00	60	7,409
J-220-3734	88	0.00	55	7,414
J-220-0370	20	0.00	80	7,424
J-220-4006	88	0.00	55	7,427
J-220-2998	51	14.99	69	7,433
J-220-4005	88	0.00	55	7,438
J-220-4666	71	0.00	61	7,447
J-220-4004	88	0.00	55	7,448
J-220-0623	66	0.00	66	7,451
J-220-1605	20	0.00	80	7,456
J-220-4778	87	0.00	55	7,457
J-220-1771	39	3.39	72	7,461
J-220-2307	71	0.11	61	7,465
J-220-4779	87	0.00	55	7,471
J-220-2015	25	0.00	79	7,472
J-220-3585	87	0.91	55	7,487
J-220-2321	39	2.14	72	7,489
J-220-0368	20	0.00	80	7,537
J-220-2012	25	0.00	78	7,540
J-220-3652	73	6.23	60	7,566
J-220-3648	70	0.00	62	7,569
J-220-3952	69	3.87	62	7,579
J-220-3182	106	0.00	47	7,588
J-220-1596	65	9.64	65	7,591
J-220-3753	89	21.74	54	7,601
J-220-3649	71	0.00	61	7,605
J-220-3584	83	20.92	57	7,620
J-220-1966	70	0.00	62	7,650
J-220-3921	71	3.34	61	7,657
J-220-3653	73	0.00	60	7,659
J-220-4667	71	0.00	61	7,678
J-220-2237	38	0.00	73	7,723

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1012	37	0.00	73	7,743
J-220-3400	58	0.00	67	7,786
J-220-3791	62	0.00	65	7,829
J-220-3535	71	0.00	61	7,864
J-220-1046	22	0.00	79	7,897
J-220-2290	71	0.00	61	7,902
J-220-2291	72	0.00	61	7,952
J-220-3534	56	0.00	68	7,958
J-220-3188	56	12.60	68	7,967
J-220-1380	72	0.00	61	7,990
J-220-4397	72	0.00	61	7,990
J-220-2288	72	0.00	61	8,001
J-220-2759	67	0.00	64	8,025
J-220-3667	56	0.00	68	8,042
J-220-0828	70	0.00	62	8,074
J-220-4634	117	0.00	43	8,107
J-220-2861	37	6.11	73	8,126
J-220-1398	61	0.00	65	8,129
J-220-2482	64	0.00	67	8,134
J-220-2289	72	0.00	61	8,155
J-220-3874	72	0.00	61	8,165
J-220-0696	23	1.85	79	8,206
J-220-4616	63	0.00	64	8,219
J-220-1232	24	4.54	79	8,227
J-220-2013	25	0.00	78	8,273
J-220-3138	72	0.00	62	8,281
J-220-4448	70	0.00	62	8,283
J-220-1394	61	0.00	65	8,290
J-220-4158	66	0.59	63	8,290
J-220-3493	66	0.00	63	8,294
J-220-3389	66	0.00	63	8,296
J-220-3390	66	0.00	63	8,299
J-220-3399	56	0.00	68	8,307
J-220-2858	37	5.96	74	8,318
J-220-3494	66	45.78	63	8,328
J-220-3786	66	41.77	63	8,336
J-220-2859	36	0.00	74	8,368
J-220-0827	69	0.00	62	8,400
J-220-3393	56	0.00	68	8,407
J-220-3475	72	0.00	61	8,409
J-220-3792	62	0.00	65	8,417
J-220-2860	36	0.00	74	8,432
J-220-3178	103	35.17	49	8,442
J-220-3098	36	0.00	74	8,473
J-220-3474	72	0.00	61	8,502
J-220-3097	36	0.00	74	8,512
J-220-3221	57	0.00	67	8,513
J-220-4556	71	0.00	61	8,536

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1390	61	2.45	65	8,557
J-220-3402	58	0.00	67	8,564
J-220-3854	63	0.00	67	8,572
J-220-3476	72	0.00	61	8,575
J-220-4048	56	2.50	68	8,577
J-220-2738	36	1.80	74	8,597
J-220-3536	71	0.00	61	8,611
J-220-2879	71	0.00	61	8,644
J-220-2899	70	2.43	61	8,659
J-220-2903	71	1.84	61	8,688
J-220-2238	38	0.00	73	8,700
J-220-2900	70	62.39	62	8,709
J-220-2313	81	0.00	58	8,714
J-220-1395	61	0.00	65	8,722
J-220-4668	71	0.00	61	8,736
J-220-0998	59	2.88	66	8,743
J-220-4669	71	0.00	61	8,748
J-220-1391	61	0.35	65	8,751
J-220-1961	38	0.00	73	8,755
J-220-4670	71	0.00	61	8,756
J-220-4548	71	1.84	61	8,766
J-220-1960	38	0.00	73	8,767
J-220-2794	103	0.00	49	8,820
J-220-4549	71	0.09	61	8,842
J-220-0826	69	0.00	62	8,881
J-220-4449	71	1.62	61	8,887
J-220-4732	63	0.00	67	8,921
J-220-3533	56	0.00	68	8,957
J-220-0369	20	0.00	81	8,972
J-220-4722	116	0.00	43	8,972
J-220-2014	25	0.36	79	8,981
J-220-3350	61	2.34	65	9,030
J-220-4208	94	4.38	52	9,045
J-220-3857	63	0.00	67	9,053
J-220-3403	59	0.00	66	9,068
J-220-1393	61	0.00	65	9,070
J-220-4275	70	0.00	62	9,100
J-220-4615	62	0.00	65	9,107
J-220-1967	69	0.00	62	9,113
J-220-3224	69	0.00	62	9,153
J-220-3225	69	0.00	62	9,164
J-220-3223	70	0.90	62	9,178
J-220-4614	62	1.46	65	9,178
J-220-2019	25	0.00	79	9,212
J-220-3926	53	3.63	70	9,214
J-220-3787	62	20.86	65	9,218
J-220-3793	62	0.00	65	9,226
J-220-3865	62	0.00	65	9,231

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-0498	26	0.00	78	9,255
J-220-2795	103	0.00	48	9,268
J-220-3267	58	0.00	68	9,271
J-220-3855	63	4.20	67	9,275
J-220-4733	64	0.00	67	9,288
J-220-2852	21	0.00	80	9,310
J-220-3405	59	0.00	66	9,315
J-220-0624	65	0.00	67	9,316
J-220-1302	37	1.20	73	9,317
J-220-3226	70	0.00	62	9,359
J-220-3487	61	0.00	65	9,362
J-220-3486	61	0.00	65	9,366
J-220-4276	70	14.68	62	9,387
J-220-2849	21	2.56	80	9,423
J-220-3061	61	0.22	65	9,431
J-220-2878	60	0.00	66	9,434
J-220-2877	60	0.00	66	9,437
J-220-1392	61	11.10	65	9,456
J-220-2753	70	16.19	62	9,458
J-220-2754	69	2.27	63	9,499
J-220-3529	67	0.52	64	9,556
J-220-2731	67	7.62	64	9,569
J-220-2848	21	0.00	80	9,573
J-220-4050	56	3.63	68	9,583
J-220-2876	59	0.46	66	9,587
J-220-3404	59	45.59	66	9,642
J-220-4430	94	7.24	52	9,649
J-220-0607	21	0.00	80	9,657
J-220-4592	94	0.00	52	9,670
J-220-4398	56	0.00	68	9,685
J-220-4593	94	0.00	52	9,702
J-220-1983	94	4.50	52	9,707
J-220-1994	65	0.00	67	9,724
J-220-4366	103	2.14	48	9,731
J-220-3401	58	5.99	67	9,737
J-220-0608	21	0.00	80	9,761
J-220-1026	65	0.00	67	9,766
J-220-1125	65	0.00	67	9,797
J-220-3397	57	0.00	67	9,992
J-220-2242	56	7.24	68	9,993
J-220-3016	21	0.00	80	10,022
J-220-1382	57	0.00	67	10,023
J-220-1383	57	0.20	67	10,027
J-220-1384	57	0.00	67	10,030
J-220-3195	57	0.00	67	10,037
J-220-3196	57	0.00	67	10,041
J-220-3219	57	0.00	67	10,071
J-220-1997	64	0.00	67	10,083

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1388	56	0.00	67	10,127
J-220-1389	56	0.00	68	10,155
J-220-3398	56	0.00	68	10,164
J-220-3194	56	0.00	67	10,167
J-220-2312	81	0.00	58	10,181
J-220-2400	21	0.00	80	10,213
J-220-2016	25	0.00	79	10,267
J-220-4400	56	0.00	68	10,333
J-220-1598	67	2.31	64	10,336
J-220-3062	56	0.00	68	10,362
J-220-3190	56	0.72	68	10,409
J-220-4111	64	0.00	66	10,434
J-220-3875	74	0.00	61	10,440
J-220-1593	62	0.00	66	10,462
J-220-2732	64	0.94	66	10,469
J-220-3602	103	0.00	49	10,474
J-220-1128	64	0.00	67	10,544
J-220-3189	56	2.21	68	10,579
J-220-2483	64	0.00	67	10,613
J-220-1011	37	8.78	73	10,618
J-220-4110	64	0.00	67	10,628
J-220-2977	66	8.03	64	10,666
J-220-2481	64	0.00	67	10,691
J-220-3015	21	0.00	80	10,702
J-220-1996	64	0.00	67	10,703
J-220-1998	64	0.00	67	10,717
J-220-3063	56	0.00	68	10,742
J-220-3876	74	0.00	61	10,780
J-220-4753	119	0.00	42	10,858
J-220-3599	103	0.00	49	10,895
J-220-1912	53	2.48	69	10,953
J-220-1984	88	10.56	55	10,964
J-220-1985	88	3.10	55	10,973
J-220-4749	118	0.00	42	10,974
J-220-2026	88	0.00	55	10,978
J-220-2024	88	0.00	55	10,982
J-220-2025	88	0.00	55	10,998
J-220-2027	88	0.00	55	11,002
J-220-2029	88	0.00	55	11,002
J-220-3136	89	0.00	55	11,003
J-220-2031	89	0.00	54	11,003
J-220-2994	88	0.00	55	11,003
J-220-3600	103	0.00	49	11,003
J-220-2993	88	4.42	55	11,004
J-220-2028	88	0.00	55	11,010
J-220-4750	118	0.00	42	11,022
J-220-1986	88	0.00	55	11,025
J-220-2030	94	0.00	52	11,034

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-4751	117	0.00	43	11,067
J-220-4792	117	0.00	43	11,076
J-220-4754	117	0.00	43	11,109
J-220-2539	87	40.42	55	11,141
J-220-3601	103	0.00	49	11,176
J-220-4723	115	0.00	43	11,177
J-220-4049	56	0.99	68	11,182
J-220-4793	103	0.00	49	11,188
J-220-0497	26	0.00	78	11,230
J-220-4032	72	0.00	62	11,300
J-220-2847	21	0.00	80	11,338
J-220-4367	106	0.00	47	11,348
J-220-2990	81	3.37	58	11,368
J-220-2540	81	16.81	58	11,447
J-220-2401	21	0.36	80	11,493
J-220-2314	79	26.38	59	11,553
J-220-2987	76	0.00	60	11,582
J-220-2315	74	20.80	61	11,725
J-220-2985	74	0.00	61	11,743
J-220-3341	74	0.00	61	11,752
J-220-2986	74	0.00	61	11,763
J-220-2020	25	0.00	79	11,796
J-220-4043	56	0.58	68	11,821
J-220-3337	74	1.13	61	11,834
J-220-4031	72	14.64	62	11,890
J-220-2021	25	0.00	79	11,892
J-220-3137	72	4.45	62	11,986
J-220-4045	55	1.68	68	11,994
J-220-3555	70	17.72	63	11,998
J-220-1925	69	0.00	63	12,067
J-220-1926	69	0.00	63	12,068
J-220-1924	69	6.71	63	12,073
J-220-3668	69	1.92	63	12,077
J-220-3554	69	13.10	63	12,094
J-220-0444	26	5.37	78	12,255
J-220-1920	69	0.00	63	12,269
J-220-1918	69	0.00	63	12,279
J-220-2975	69	0.00	63	12,323
J-220-1597	67	2.52	64	12,384
J-220-1770	38	0.00	73	12,403
J-220-0758	22	0.00	80	12,422
J-220-2976	66	16.16	64	12,453
J-220-4837	38	0.00	73	12,488
J-220-0242	25	1.64	79	12,552
J-220-1595	65	32.00	65	12,663
J-220-1910	53	0.00	69	12,695
J-220-0759	22	4.71	80	12,752
J-220-4838	38	0.00	73	12,766

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-1594	62	9.09	66	12,816
J-220-2934	61	0.00	67	12,884
J-220-2933	61	0.00	67	12,902
J-220-1923	61	0.00	67	12,905
J-220-2931	61	0.00	67	12,907
J-220-3552	61	0.00	67	12,909
J-220-2932	61	5.99	67	12,919
J-220-0443	26	0.31	78	13,109
J-220-1769	38	0.00	73	13,132
J-220-1235	22	0.36	80	13,406
J-220-0442	22	2.98	80	13,619
J-220-1591	60	0.00	67	13,670
J-220-1908	53	0.00	69	13,760
J-220-1917	53	8.58	69	14,185
J-220-1804	38	0.00	73	14,298
J-220-1915	53	0.00	69	14,430
J-220-1916	53	0.00	69	14,501
J-220-2607	22	1.83	80	14,566
J-220-1907	53	0.00	69	14,573
J-220-3264	58	4.23	68	14,599
J-220-3263	58	2.91	68	14,650
J-220-1805	38	0.00	73	14,690
J-220-1959	38	0.00	73	14,777
J-220-0441	22	0.00	80	14,838
J-220-1909	53	0.00	69	14,902
J-220-1958	38	0.00	73	15,034
J-220-2236	38	0.00	73	15,040
J-220-0440	22	0.53	80	15,108
J-220-2234	37	0.00	73	15,130
J-220-0243	25	2.60	78	15,130
J-220-1231	37	6.25	73	15,169
J-220-1913	53	0.34	69	15,179
J-220-1602	26	0.00	78	16,141
J-220-2592	22	0.00	80	16,594
J-220-1601	26	0.00	78	17,092
J-220-0975	22	0.00	80	17,255
J-220-0439	22	0.00	80	17,547
J-220-3266	53	5.34	70	17,878
J-220-1233	26	0.00	78	18,290
J-220-1914	53	7.31	70	18,389
J-220-3265	53	0.77	71	18,466
J-220-3670	52	0.00	71	18,553
J-220-0446	26	0.00	78	18,569
J-220-3669	52	0.87	71	18,643
J-220-2846	22	2.60	80	18,745
J-220-0445	26	4.71	78	18,808
J-220-2081	22	0.00	80	19,203
J-220-4629	52	0.00	71	19,283

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-220-2143	22	0.00	80	19,331
J-220-4628	52	0.00	71	19,666
J-220-4828	52	0.00	71	19,666
J-220-1177	22	0.00	80	19,902
J-220-1900	53	0.00	71	20,377
J-220-1899	53	0.00	71	20,422
J-220-3090	53	0.00	70	20,519
J-220-1893	53	0.00	71	20,520
J-220-0976	22	0.00	80	21,282
J-220-1901	52	0.00	72	21,476
J-220-2080	22	0.00	80	21,856
J-220-0977	22	0.00	80	22,474
J-220-1603	22	0.00	80	22,775
J-220-1833	22	0.00	80	22,858
J-220-0503	22	0.00	80	23,581
J-220-0502	22	0.00	80	23,593
J-220-0367	22	0.00	80	23,599
J-220-0366	22	0.00	80	23,633
J-220-2041	51	0.00	73	23,638
J-220-3422	51	0.00	73	24,296
J-220-3423	51	0.00	73	24,363
J-220-3421	51	0.00	73	24,428
J-220-2205	51	0.00	73	24,531
Zone 265				
J-265-007	126	0.00	48	513
J-265-006	126	10.84	48	531
J-265-005	134	3.80	44	1,241
J-265-004	130	1.16	46	1,310
J-265-003	127	0.00	47	1,318
J-265-002	129	1.73	47	1,319
Zone 319-A				
J-319-271	160	0.00	68	76
J-319-270	162	0.00	67	77
J-319-088	110	0.00	91	116
J-319-193	106	0.00	93	296
J-319-087	109	5.13	92	353
J-319-189	105	0.00	94	421
J-319-188	105	0.00	94	421
J-319-190	104	0.00	94	421
J-319-185	105	0.00	94	425
J-319-186	105	2.84	94	431
J-319-292	130	0.00	85	536
J-319-170	116	0.00	45	606
J-319-266	132	1.31	84	628
J-319-097	106	0.00	93	653
J-319-098	106	1.16	93	656
J-319-267	132	0.63	84	663
J-319-227	106	10.64	93	667

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-319-162	106	0.00	93	682
J-319-163	106	0.00	93	684
J-319-225	106	1.18	93	687
J-319-226	106	9.68	93	701
J-319-192	107	7.97	93	708
J-319-256	170	1.20	64	750
J-319-255	170	0.31	64	752
J-319-309	160	0.00	68	755
J-319-321	155	0.00	70	755
J-319-308	161	0.00	68	756
J-319-041	166	0.00	66	770
J-319-306	164	0.00	66	770
J-319-307	163	0.00	67	770
J-319-187	106	0.90	93	770
J-319-305	165	0.00	66	770
J-319-044	166	0.00	66	770
J-319-042	166	0.00	65	771
J-319-204	108	0.00	92	773
J-319-191	107	4.57	93	776
J-319-206	109	8.30	92	776
J-319-244	111	0.00	91	783
J-319-043	169	2.08	64	784
J-319-115	155	0.00	70	784
J-319-114	157	0.00	69	785
J-319-233	107	2.08	93	786
J-319-132	109	0.00	92	790
J-319-118	172	0.00	63	794
J-319-288	173	0.00	62	794
J-319-063	146	0.00	74	805
J-319-133	109	2.60	92	806
J-319-205	108	0.00	92	810
J-319-232	107	0.00	93	814
J-319-295	150	2.25	72	814
J-319-064	145	0.00	75	816
J-319-254	174	0.00	62	817
J-319-065	144	0.00	75	818
J-319-066	144	0.00	75	818
J-319-253	174	0.00	62	823
J-319-067	145	0.00	74	823
J-319-291	175	0.00	61	832
J-319-286	176	0.00	61	832
J-319-119	175	9.55	62	841
J-319-300	108	0.00	92	850
J-319-262	108	0.00	92	867
J-319-310	173	0.00	62	867
J-319-264	108	0.00	92	870
J-319-287	172	0.00	63	871
J-319-274	172	1.62	63	872

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-319-197	114	7.43	90	873
J-319-285	171	0.00	63	875
J-319-273	160	4.94	68	876
J-319-263	108	0.00	92	877
J-319-272	161	8.87	68	879
J-319-172	146	0.00	78	890
J-319-284	175	0.00	61	890
J-319-040	137	0.00	77	918
J-319-298	109	1.42	92	919
J-319-130	110	0.00	92	927
J-319-195	118	0.00	89	943
J-319-196	121	1.18	87	962
J-319-131	109	0.00	92	964
J-319-024	141	0.85	80	965
J-319-297	109	0.48	92	987
J-319-261	109	0.57	92	987
J-319-202	121	1.07	87	988
J-319-155	120	0.00	88	1,016
J-319-201	120	0.00	87	1,035
J-319-200	120	0.00	87	1,042
J-319-034	120	0.00	87	1,048
J-319-145	126	2.43	86	1,055
J-319-033	120	0.00	87	1,056
J-319-135	138	0.00	81	1,080
J-319-156	122	0.00	87	1,081
J-319-025	133	0.28	83	1,083
J-319-134	138	0.00	81	1,084
J-319-259	110	0.63	92	1,088
J-319-173	134	0.00	83	1,088
J-319-037	133	0.46	84	1,089
J-319-011	135	0.00	83	1,094
J-319-012	135	0.00	83	1,094
J-319-171	134	0.04	83	1,097
J-319-179	137	9.70	81	1,101
J-319-174	134	4.98	83	1,104
J-319-243	137	0.44	81	1,113
J-319-110	127	1.44	86	1,117
J-319-199	119	0.00	88	1,117
J-319-242	138	5.88	81	1,119
J-319-035	106	0.00	93	1,119
J-319-052	106	0.00	93	1,122
J-319-111	126	2.99	86	1,122
J-319-136	136	2.40	82	1,123
J-319-089	106	0.00	93	1,123
J-319-239	106	2.29	93	1,126
J-319-113	127	2.25	86	1,136
J-319-240	107	7.38	93	1,141
J-319-142	123	1.11	88	1,153

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-319-031	110	0.00	47	1,155
J-319-143	122	5.00	88	1,159
J-319-010	126	1.73	86	1,162
J-319-027	116	0.00	91	1,165
J-319-008	127	0.00	86	1,169
J-319-198	119	3.23	88	1,169
J-319-282	175	0.00	61	1,173
J-319-258	110	2.91	92	1,174
J-319-007	127	1.49	86	1,175
J-319-158	118	9.57	88	1,177
J-319-026	116	0.00	91	1,182
J-319-160	113	5.00	90	1,185
J-319-161	114	0.00	90	1,187
J-319-150	116	0.00	91	1,187
J-319-207	118	2.36	88	1,189
J-319-151	117	0.00	90	1,192
J-319-140	132	9.50	84	1,193
J-319-220	123	0.39	86	1,193
J-319-175	117	0.00	90	1,197
J-319-281	176	0.00	61	1,199
J-319-167	116	0.00	91	1,201
J-319-168	116	0.00	91	1,201
J-319-009	117	1.01	90	1,201
J-319-144	117	0.00	90	1,203
J-319-169	117	0.00	90	1,203
J-319-283	175	0.00	62	1,208
J-319-166	123	0.00	86	1,209
J-319-215	123	1.20	86	1,209
J-319-216	123	0.00	86	1,210
J-319-219	123	0.33	86	1,212
J-319-164	122	1.03	87	1,214
J-319-265	130	4.30	85	1,219
J-319-159	113	1.29	90	1,221
J-319-039	142	0.00	75	1,221
J-319-049	132	0.00	84	1,223
J-319-257	112	1.51	91	1,236
J-319-260	113	0.00	90	1,237
J-319-241	112	6.49	91	1,239
J-319-246	112	4.59	91	1,241
J-319-165	113	5.11	90	1,242
J-319-112	126	1.94	86	1,247
J-319-138	132	3.10	84	1,262
J-319-048	132	1.51	84	1,263
J-319-245	112	3.50	91	1,264
J-319-051	133	0.00	84	1,265
J-319-209	112	4.26	91	1,266
J-319-050	133	0.00	83	1,267
J-319-157	113	0.92	90	1,267

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-319-141	127	1.44	86	1,270
J-319-139	133	8.30	84	1,273
J-319-137	119	1.07	89	1,276
J-319-091	125	0.00	87	1,281
J-319-092	125	0.00	87	1,285
J-319-180	125	0.00	87	1,285
J-319-181	125	0.00	87	1,291
J-319-182	124	1.42	87	1,294
J-319-203	136	5.03	82	1,302
J-319-090	136	0.00	82	1,308
J-319-218	117	0.00	89	1,317
J-319-178	136	7.82	82	1,318
J-319-208	114	4.52	90	1,319
J-319-217	117	0.00	89	1,322
J-319-183	118	15.18	89	1,337
J-319-194	118	0.59	89	1,343
J-319-096	115	0.72	90	1,345
J-319-093	117	0.00	89	1,346
J-319-095	117	0.66	89	1,346
J-319-094	118	1.70	89	1,349
J-319-214	122	0.00	40	1,414
J-319-002	144	0.00	75	1,439
J-319-231	111	5.53	91	1,475
J-319-001	145	0.00	74	1,541
J-319-003	146	0.00	74	1,570
J-319-268	143	0.00	75	1,573
J-319-117	150	0.00	73	1,592
J-319-116	155	0.00	70	1,615
J-319-070	109	4.35	92	1,629
J-319-036	145	0.00	74	1,638
J-319-269	165	0.00	66	1,644
J-319-279	166	0.00	65	1,644
J-319-038	143	0.00	75	1,672
J-319-023	145	2.73	74	1,713
J-319-017	143	0.00	75	1,725
J-319-022	144	0.00	75	1,750
J-319-021	144	0.00	75	1,770
J-319-015	143	0.00	75	1,800
J-319-016	143	0.00	75	1,800
J-319-069	107	4.04	93	2,051
J-319-228	107	0.00	93	2,116
J-319-280	165	0.00	66	2,450
J-319-019	116	0.00	80	2,486
J-319-317	165	0.57	66	2,764
J-319-277	164	0.00	66	3,014
J-319-278	167	0.74	65	3,481
J-319-229	107	0.00	79	3,837
J-319-054	107	0.87	79	4,205

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-319-053	107	0.00	79	4,238
J-319-055	107	0.00	79	4,247
J-319-056	107	0.00	79	4,256
J-319-057	107	0.00	79	4,263
J-319-058	107	0.00	79	4,272
J-319-059	107	4.24	79	4,332
J-319-068	107	0.00	48	4,914
J-319-325	153	0.00	68	5,265
J-319-006	164	6.64	66	5,387
J-319-030	116	0.00	80	5,523
J-319-029	117	0.28	80	5,531
J-319-326	152	0.00	68	5,579
J-319-124	116	0.00	80	5,594
J-319-018	116	0.00	80	5,601
J-319-020	116	0.00	80	5,606
J-319-028	116	0.00	80	5,614
J-319-323	152	0.00	68	5,615
J-319-123	126	1.09	77	5,838
J-319-014	126	0.63	77	5,864
J-319-013	147	0.00	70	5,928
J-319-322	154	0.00	67	5,950
J-319-333	153	0.00	67	5,975
J-319-324	152	0.00	68	5,983
J-319-332	153	0.00	67	5,995
J-319-108	151	0.00	68	6,003
J-319-107	150	0.00	69	6,015
J-319-061	158	0.00	66	6,027
J-319-106	149	0.00	69	6,035
J-319-331	157	0.00	66	6,038
J-319-062	157	0.00	66	6,044
J-319-334	149	0.00	69	6,055
J-319-330	157	0.00	66	6,063
J-319-128	156	0.00	67	6,074
J-319-100	148	0.00	70	6,076
J-319-099	148	0.00	70	6,100
J-319-101	149	0.00	69	6,112
J-319-102	148	0.00	70	6,120
J-319-103	149	0.00	70	6,133
J-319-129	154	0.00	67	6,149
J-319-105	149	0.00	70	6,164
J-319-127	152	0.00	68	6,164
J-319-126	150	0.00	69	6,182
J-319-104	151	0.00	69	6,193
J-319-125	157	0.00	67	6,495
J-319-005	168	0.00	64	7,200
J-319-315	206	0.00	48	7,361
J-319-314	201	0.00	50	7,361
J-319-252	166	1.31	66	7,529

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-319-316	163	13.83	67	8,276
J-319-329	163	0.61	67	8,324
J-319-328	161	0.26	68	8,371
J-319-311	164	0.00	67	8,404
J-319-312	176	3.76	61	8,609
J-319-313	177	3.95	61	8,674
J-319-060	169	0.00	63	8,920
J-319-327	169	0.00	64	9,278
J-319-276	169	6.69	64	9,284
J-319-275	168	0.00	65	9,388
J-319-250	167	0.00	65	9,501
J-319-302	161	0.00	68	9,641
J-319-251	166	0.00	66	10,010
J-319-249	167	0.00	65	10,081
J-319-301	159	0.00	69	10,272
J-319-304	161	0.00	68	10,647
J-319-004	171	1.51	63	10,786
J-319-318	166	0.00	66	11,097
J-319-303	159	0.00	69	11,677
J-319-299	160	0.00	68	12,747
J-319-294	159	0.00	69	13,266
J-319-290	159	0.00	69	13,266
J-319-289	160	0.00	68	13,367
J-319-293	161	0.00	68	13,488
J-319-247	166	0.00	65	13,822
J-319-248	166	0.00	65	13,822
J-319-320	165	0.42	66	13,971
J-319-319	158	0.00	69	15,849
Zone 319-B				
J-319-146	118	3.10	86	1,805
J-319-236	109	0.00	90	2,159
J-319-147	109	0.00	90	2,162
J-319-148	109	0.00	90	2,165
J-319-234	109	0.00	90	2,168
J-319-109	109	5.53	90	2,194
J-319-235	109	0.00	90	2,200
J-319-045	109	0.00	90	2,203
J-319-046	109	0.00	90	2,209
J-319-047	109	0.00	90	2,215
J-319-149	108	0.00	91	2,220
J-319-074	108	0.61	91	2,225
J-319-075	107	0.00	91	2,305
J-319-213	108	0.00	91	2,310
J-319-211	108	0.00	91	2,315
J-319-210	108	0.00	91	2,322
J-319-238	108	0.72	91	2,347
J-319-237	108	0.00	91	2,368
J-319-122	110	0.00	90	2,565

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-319-121	112	0.00	89	2,986
J-319-184	114	1.97	88	3,516
J-319-086	115	1.97	88	4,334
J-319-212	116	0.00	50	4,902
J-319-120	116	1.24	87	5,196
J-319-085	116	0.00	87	6,425
J-319-084	116	0.00	87	8,134
J-319-083	116	0.00	87	10,730
J-319-152	116	0.00	87	12,418
J-319-082	116	0.00	87	14,559
J-319-081	117	0.00	87	15,071
J-319-153	116	0.00	87	15,223
J-319-221	117	0.00	87	15,234
J-319-154	117	0.00	87	15,360
J-319-078	116	0.00	87	15,588
J-319-222	117	0.00	87	16,041
J-319-077	117	0.00	87	17,134
J-319-080	117	0.00	87	18,283
J-319-223	119	0.00	86	19,016
J-319-079	118	0.00	86	23,249
J-319-076	118	0.00	87	27,307
J-319-296	118	0.00	87	27,366
J-319-071	118	0.00	87	28,711
J-319-072	118	0.00	87	29,349
J-319-073	118	0.00	87	39,881
J-319-176	117	0.00	87	43,480
Zone 395				
J-395-005	205	2.10	84	278
J-395-009	168	2.10	100	300
J-395-008	167	0.00	101	303
J-395-006	167	0.00	101	304
J-395-007	173	2.10	98	307
J-395-004	159	2.50	104	370
J-395-002	159	0.00	104	379
J-395-003	154	2.10	106	399
J-395-001	152	2.10	107	399
Zone 400				
J-400-0351	247	0.00	27	60
J-400-0046	247	0.00	28	60
J-400-0352	247	0.00	28	60
J-400-0220	244	0.00	29	60
J-400-0443	233	0.00	34	60
J-400-0045	193	0.00	51	60
J-400-0044	190	0.00	52	60
J-400-0219	192	0.00	51	60
J-400-0059	225	0.00	37	60
J-400-0353	172	0.00	60	61
J-400-0354	171	0.00	60	61

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0442	172	0.00	60	61
J-400-0348	197	0.00	49	61
J-400-0349	196	0.00	50	61
J-400-0350	197	0.00	49	61
J-400-0047	122	0.00	82	62
J-400-0049	140	0.00	74	62
J-400-0052	141	0.00	73	62
J-400-0058	124	0.00	81	62
J-400-0062	162	0.70	64	62
J-400-0051	121	0.91	82	63
J-400-0040	118	0.00	83	63
J-400-0041	118	0.00	83	63
J-400-0042	118	0.00	83	63
J-400-0043	118	0.51	83	63
J-400-0139	213	0.00	43	64
J-400-0138	213	0.00	43	64
J-400-0050	141	2.12	73	64
J-400-0056	132	1.39	77	64
J-400-0236	213	1.95	43	66
J-400-0235	123	5.17	81	67
J-400-0441	160	6.25	65	67
J-400-0060	216	5.84	41	67
J-400-0057	125	6.13	80	68
J-400-0217	215	4.95	42	69
J-400-0063	216	8.44	41	70
J-400-0055	214	6.32	42	70
J-400-0048	122	11.47	82	73
J-400-0693	133	12.07	77	74
J-400-0053	128	11.28	79	74
J-400-0522	162	19.91	64	81
J-400-0061	226	23.47	36	84
J-400-0054	147	22.89	71	86
J-400-1126	264	0.00	30	102
J-400-0120	164	0.00	99	104
J-400-0670	170	0.00	90	110
J-400-0119	163	0.00	99	110
J-400-1019	200	0.00	61	120
J-400-0118	161	0.00	100	123
J-400-1124	263	0.00	31	124
J-400-0551	169	7.07	90	125
J-400-1020	192	0.00	66	134
J-400-1021	229	0.00	51	156
J-400-0580	235	0.00	49	159
J-400-0973	240	0.00	48	165
J-400-1003	239	0.00	48	165
J-400-0279	240	2.24	48	167
J-400-1022	200	0.00	61	174
J-400-0272	238	10.05	49	175

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-1004	235	0.00	50	207
J-400-1018	235	0.00	50	207
J-400-0667	140	0.00	101	290
J-400-0666	140	0.00	101	291
J-400-0665	140	0.00	101	293
J-400-0662	141	1.68	101	303
J-400-0663	141	3.34	101	304
J-400-0271	141	15.41	100	306
J-400-0664	152	4.74	96	306
J-400-0809	154	0.00	96	323
J-400-0807	154	0.00	96	323
J-400-0808	156	0.00	95	325
J-400-0880	161	0.00	93	338
J-400-0882	162	0.00	93	344
J-400-0881	176	0.00	88	372
J-400-0812	181	0.00	86	373
J-400-0811	189	0.00	82	381
J-400-0810	193	0.00	81	386
J-400-0719	193	0.00	81	387
J-400-0718	192	0.00	81	387
J-400-0804	190	0.00	82	387
J-400-0717	193	0.00	81	388
J-400-0701	193	0.00	81	388
J-400-0700	193	0.00	81	388
J-400-0806	180	0.00	87	388
J-400-0805	179	0.00	87	388
J-400-0825	165	0.00	93	389
J-400-0699	194	0.00	81	389
J-400-0838	164	0.31	94	389
J-400-0837	151	0.00	99	389
J-400-0836	150	0.00	100	389
J-400-0835	149	0.00	100	389
J-400-0834	149	0.00	100	389
J-400-0848	197	0.00	79	390
J-400-0610	132	0.00	107	391
J-400-0803	198	0.00	79	391
J-400-0832	145	0.00	102	392
J-400-0833	146	0.00	102	392
J-400-0831	143	0.55	102	392
J-400-1017	146	0.00	101	392
J-400-1002	199	0.00	79	392
J-400-0322	141	1.18	104	392
J-400-1000	208	0.00	75	393
J-400-0323	130	2.84	108	394
J-400-0829	157	0.00	97	394
J-400-0828	158	0.00	96	395
J-400-1001	208	0.00	75	395
J-400-0830	171	0.00	90	398

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0879	168	0.00	92	398
J-400-0722	172	0.00	90	398
J-400-0827	163	2.79	94	399
J-400-0878	167	1.13	92	399
J-400-0877	170	2.07	91	400
J-400-0608	162	2.69	95	400
J-400-0609	143	3.15	103	401
J-400-0997	222	0.00	69	401
J-400-0826	171	3.80	91	401
J-400-1007	226	0.00	67	402
J-400-0816	223	0.00	68	402
J-400-0338	186	0.00	84	402
J-400-0339	185	0.00	85	402
J-400-0611	183	0.00	85	403
J-400-0998	224	0.00	68	403
J-400-0724	173	5.75	90	403
J-400-0999	225	0.00	67	403
J-400-0817	224	0.00	68	403
J-400-0996	225	0.00	68	403
J-400-0818	224	0.00	68	404
J-400-0819	226	0.00	67	404
J-400-0613	188	1.42	84	404
J-400-0612	182	1.13	86	404
J-400-0337	187	2.89	84	405
J-400-0607	166	7.67	93	405
J-400-1006	231	4.52	65	406
J-400-1005	224	5.12	68	409
J-400-0623	188	0.00	88	440
J-400-0101	145	0.00	107	456
J-400-0503	166	4.59	92	473
J-400-0908	142	2.57	102	558
J-400-0483	245	4.40	60	573
J-400-0534	110	4.04	118	585
J-400-0673	143	0.00	101	610
J-400-0360	268	0.00	53	611
J-400-0909	143	0.00	102	612
J-400-0659	142	1.39	102	613
J-400-0660	125	5.34	109	617
J-400-0672	143	4.28	101	620
J-400-1034	289	0.00	43	622
J-400-0359	269	0.00	53	631
J-400-0615	171	0.00	93	631
J-400-0431	162	0.00	93	632
J-400-0520	134	1.27	107	632
J-400-0482	211	9.16	74	636
J-400-0614	158	6.76	99	638
J-400-0616	160	7.31	98	639
J-400-1069	274	0.00	51	639

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0976	274	0.00	50	645
J-400-0243	228	0.00	67	652
J-400-0533	134	1.32	107	663
J-400-0242	206	0.00	76	664
J-400-0767	259	0.00	59	665
J-400-0241	184	7.19	86	691
J-400-0152	184	2.00	86	707
J-400-0545	137	1.78	106	710
J-400-0975	279	0.00	48	720
J-400-0561	123	0.00	39	721
J-400-0153	186	0.00	85	724
J-400-0974	275	0.00	50	727
J-400-0154	185	0.00	86	728
J-400-0261	275	0.00	50	728
J-400-0484	184	0.00	86	732
J-400-0324	184	13.30	86	749
J-400-0528	165	0.00	94	753
J-400-0766	278	0.00	50	767
J-400-0536	110	0.00	118	770
J-400-0922	150	0.07	76	815
J-400-0921	150	0.00	76	824
J-400-0920	149	0.00	76	832
J-400-0325	179	0.00	88	835
J-400-0419	179	2.02	88	843
J-400-1062	223	0.00	75	849
J-400-0622	154	0.00	102	887
J-400-0020	217	0.00	75	903
J-400-0207	217	7.69	75	905
J-400-0281	217	0.00	75	906
J-400-0245	102	0.39	123	912
J-400-0280	214	2.36	77	923
J-400-0077	153	6.44	103	937
J-400-1024	221	0.00	76	947
J-400-0225	247	2.55	64	961
J-400-1023	223	0.00	75	995
J-400-1063	248	0.00	64	995
J-400-1061	248	0.00	64	1,000
J-400-1060	249	0.00	64	1,002
J-400-0260	245	14.79	65	1,017
J-400-0765	288	3.85	46	1,029
J-400-0074	246	0.00	65	1,057
J-400-0076	121	5.43	117	1,064
J-400-0016	190	0.00	86	1,075
J-400-0017	190	0.00	87	1,076
J-400-0194	119	0.00	117	1,078
J-400-0671	162	0.00	92	1,086
J-400-0019	192	12.31	86	1,086
J-400-0018	188	14.57	88	1,091

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0080	119	1.11	117	1,094
J-400-0079	119	0.00	117	1,109
J-400-0362	294	0.00	43	1,110
J-400-0078	118	0.63	118	1,113
J-400-0375	148	0.91	99	1,123
J-400-0361	296	14.38	43	1,124
J-400-0635	136	4.76	110	1,130
J-400-0014	146	6.32	106	1,140
J-400-0091	137	0.00	105	1,143
J-400-0015	147	20.39	105	1,149
J-400-0321	117	0.00	118	1,164
J-400-0527	168	4.45	92	1,165
J-400-0320	117	0.99	118	1,169
J-400-0473	115	0.00	119	1,199
J-400-0471	115	0.00	119	1,201
J-400-0472	115	0.00	119	1,204
J-400-0469	115	0.55	119	1,210
J-400-0470	115	0.00	119	1,213
J-400-0478	115	0.00	119	1,215
J-400-0317	110	1.90	121	1,215
J-400-0204	161	0.67	92	1,218
J-400-0313	114	0.00	119	1,219
J-400-0318	110	0.00	121	1,224
J-400-0333	110	0.00	121	1,224
J-400-0334	110	0.00	121	1,224
J-400-0376	110	0.00	121	1,224
J-400-0377	110	0.00	121	1,224
J-400-0378	110	0.00	121	1,224
J-400-0379	110	0.00	121	1,224
J-400-0380	110	0.00	121	1,224
J-400-0315	114	0.00	119	1,224
J-400-0316	114	0.00	119	1,224
J-400-0474	114	0.00	119	1,224
J-400-0475	114	0.00	119	1,224
J-400-0939	171	0.00	95	1,224
J-400-0476	114	0.46	119	1,225
J-400-0314	114	0.75	119	1,225
J-400-0477	114	1.76	120	1,226
J-400-0198	169	0.00	90	1,226
J-400-0945	180	0.00	103	1,226
J-400-0336	110	0.00	121	1,228
J-400-0940	171	0.00	95	1,228
J-400-0075	227	20.87	73	1,228
J-400-0125	224	2.45	74	1,230
J-400-0941	170	9.95	96	1,230
J-400-0335	110	0.00	121	1,231
J-400-0841	172	0.00	95	1,232
J-400-0842	172	0.00	95	1,234

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0839	172	0.00	95	1,235
J-400-0723	172	0.00	95	1,235
J-400-0840	172	2.69	95	1,241
J-400-0122	226	4.21	74	1,256
J-400-0203	163	0.00	92	1,258
J-400-0529	168	0.00	92	1,264
J-400-0959	206	41.67	85	1,282
J-400-0374	148	0.10	99	1,289
J-400-0013	140	4.81	108	1,294
J-400-0128	140	0.00	108	1,294
J-400-0944	194	0.00	97	1,295
J-400-0124	217	9.40	77	1,296
J-400-0295	140	0.00	108	1,299
J-400-0887	283	0.00	54	1,302
J-400-0165	154	13.10	102	1,304
J-400-0121	217	5.75	78	1,305
J-400-0296	139	0.00	109	1,305
J-400-0982	262	0.00	59	1,311
J-400-0886	285	9.81	53	1,313
J-400-0521	143	25.87	107	1,316
J-400-0648	254	0.00	68	1,325
J-400-0649	239	0.00	74	1,325
J-400-0650	259	0.00	65	1,325
J-400-1011	244	0.00	72	1,325
J-400-0123	215	3.73	78	1,327
J-400-0943	191	0.00	98	1,333
J-400-0008	133	0.00	111	1,336
J-400-0009	133	0.00	111	1,336
J-400-0010	134	0.00	111	1,336
J-400-0531	168	0.00	92	1,337
J-400-0011	134	2.19	111	1,343
J-400-0012	134	0.00	111	1,343
J-400-0990	192	3.05	97	1,345
J-400-0202	162	1.20	92	1,373
J-400-0197	165	6.80	92	1,403
J-400-0933	277	0.00	52	1,406
J-400-0932	275	0.00	52	1,406
J-400-0606	165	4.50	92	1,411
J-400-0211	142	0.00	107	1,429
J-400-0448	142	0.00	107	1,429
J-400-0934	271	0.00	54	1,429
J-400-0449	142	0.00	107	1,429
J-400-0294	142	0.00	107	1,430
J-400-0343	143	0.00	80	1,432
J-400-0293	142	0.00	107	1,432
J-400-0292	142	0.00	108	1,433
J-400-0935	270	0.00	55	1,436
J-400-0430	163	7.04	93	1,441

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0291	131	0.00	112	1,442
J-400-0290	137	0.00	110	1,444
J-400-0652	228	0.00	79	1,445
J-400-0289	130	7.89	112	1,451
J-400-0284	134	4.23	111	1,456
J-400-0429	164	0.00	92	1,456
J-400-0286	132	5.19	112	1,457
J-400-0677	145	3.99	105	1,459
J-400-0552	144	0.00	107	1,460
J-400-0556	143	0.00	107	1,460
J-400-0282	144	0.00	107	1,460
J-400-0283	144	0.00	107	1,460
J-400-0875	209	0.00	81	1,463
J-400-0285	138	18.68	109	1,463
J-400-0287	132	15.36	112	1,468
J-400-0555	143	7.41	107	1,468
J-400-0874	208	11.47	81	1,474
J-400-0201	161	1.61	93	1,474
J-400-0674	261	2.69	59	1,476
J-400-0981	225	0.00	75	1,477
J-400-0099	134	1.47	111	1,483
J-400-0288	132	25.10	112	1,483
J-400-0212	135	6.20	111	1,484
J-400-0554	126	0.00	114	1,486
J-400-1087	202	13.90	90	1,492
J-400-0452	127	0.00	114	1,493
J-400-0100	134	3.37	111	1,496
J-400-0450	126	0.00	114	1,496
J-400-0553	126	0.00	115	1,496
J-400-0451	126	0.00	114	1,498
J-400-0581	260	0.00	59	1,504
J-400-0937	258	0.00	60	1,505
J-400-0936	261	0.00	59	1,506
J-400-0530	168	0.00	92	1,506
J-400-0199	160	1.76	93	1,506
J-400-0598	225	21.86	75	1,517
J-400-0432	163	0.00	93	1,518
J-400-0582	259	0.00	60	1,526
J-400-0418	155	0.60	99	1,548
J-400-1086	130	2.98	112	1,548
J-400-0910	166	0.41	93	1,590
J-400-0876	233	0.00	71	1,592
J-400-0915	166	0.00	93	1,594
J-400-0824	233	0.00	71	1,598
J-400-0417	154	1.42	99	1,598
J-400-0914	167	2.89	93	1,601
J-400-0911	167	0.00	93	1,605
J-400-0823	232	0.00	71	1,606

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0200	159	0.72	93	1,609
J-400-0912	167	0.00	93	1,611
J-400-0433	161	0.00	93	1,613
J-400-0942	233	1.59	71	1,614
J-400-0925	163	0.00	92	1,617
J-400-0913	167	0.63	93	1,619
J-400-1085	129	1.13	112	1,622
J-400-0196	164	1.13	94	1,623
J-400-0095	144	6.90	107	1,629
J-400-0425	159	2.04	94	1,650
J-400-0115	154	1.80	99	1,653
J-400-0096	145	0.00	107	1,655
J-400-0226	117	0.00	118	1,657
J-400-0227	118	5.65	118	1,663
J-400-0104	153	0.00	99	1,664
J-400-0427	161	1.76	94	1,673
J-400-0341	117	0.00	118	1,674
J-400-0342	117	0.00	118	1,674
J-400-0097	143	8.66	107	1,674
J-400-0428	161	2.89	94	1,675
J-400-0102	153	0.00	99	1,675
J-400-0166	117	2.19	118	1,676
J-400-0512	117	3.32	118	1,677
J-400-0127	117	0.00	118	1,704
J-400-0126	117	0.00	118	1,709
J-400-0572	157	0.00	97	1,715
J-400-0573	159	0.00	97	1,715
J-400-0574	161	0.00	96	1,715
J-400-0576	160	0.00	96	1,715
J-400-0592	157	0.00	98	1,715
J-400-0230	117	0.00	118	1,717
J-400-0103	155	2.38	99	1,717
J-400-0434	159	1.92	94	1,727
J-400-0596	159	2.77	97	1,729
J-400-0571	153	4.59	99	1,731
J-400-0328	155	0.00	99	1,733
J-400-0327	155	0.00	99	1,740
J-400-0532	168	2.31	92	1,746
J-400-0098	141	11.23	109	1,746
J-400-0588	154	5.53	99	1,753
J-400-0435	159	0.67	94	1,758
J-400-0651	193	2.45	94	1,759
J-400-1067	268	0.00	63	1,760
J-400-0231	117	0.00	118	1,761
J-400-0426	159	0.00	94	1,767
J-400-0228	117	0.00	118	1,769
J-400-0229	117	0.00	118	1,774
J-400-0822	246	0.00	65	1,776

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0821	247	0.00	65	1,780
J-400-0820	247	0.00	65	1,783
J-400-1077	192	0.00	94	1,785
J-400-0234	116	0.96	118	1,787
J-400-0985	245	0.00	66	1,794
J-400-0116	148	3.34	106	1,800
J-400-0326	157	0.00	98	1,800
J-400-1076	193	0.00	94	1,810
J-400-1064	278	2.74	59	1,811
J-400-0511	116	0.00	119	1,816
J-400-0258	182	0.00	93	1,816
J-400-1075	193	0.00	94	1,817
J-400-0259	187	2.96	90	1,819
J-400-1078	193	0.00	94	1,825
J-400-0232	116	0.00	119	1,826
J-400-1079	192	0.00	94	1,827
J-400-1068	194	0.00	94	1,827
J-400-1080	192	0.00	95	1,829
J-400-0233	116	0.00	119	1,832
J-400-0589	159	3.61	97	1,844
J-400-0400	191	22.19	95	1,853
J-400-0401	190	0.00	96	1,854
J-400-0590	159	6.66	97	1,855
J-400-0256	183	0.00	92	1,858
J-400-0254	186	0.00	91	1,864
J-400-0480	135	0.00	107	1,867
J-400-0568	135	3.82	107	1,867
J-400-0479	135	0.00	107	1,869
J-400-0257	184	7.00	92	1,875
J-400-0251	184	0.00	92	1,877
J-400-0252	185	4.09	91	1,890
J-400-0253	185	0.00	91	1,890
J-400-0567	134	0.00	108	1,893
J-400-0132	134	0.00	108	1,906
J-400-0566	134	1.49	108	1,908
J-400-0133	134	0.00	107	1,911
J-400-0569	134	1.29	107	1,912
J-400-0021	135	0.00	107	1,914
J-400-0445	173	0.00	91	1,919
J-400-0022	135	3.71	107	1,919
J-400-0444	173	3.32	91	1,919
J-400-0602	185	8.85	97	1,923
J-400-0263	195	0.00	87	1,925
J-400-0255	195	1.68	87	1,926
J-400-0424	157	0.00	94	1,927
J-400-0867	137	3.12	106	1,928
J-400-0865	137	0.00	107	1,929
J-400-0747	185	15.08	97	1,929

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0446	169	1.15	93	1,930
J-400-0504	137	0.00	107	1,931
J-400-0130	196	8.15	86	1,934
J-400-0505	136	0.00	107	1,935
J-400-0447	168	0.89	93	1,937
J-400-0213	136	1.73	107	1,938
J-400-0565	135	0.00	107	1,938
J-400-0570	147	8.35	102	1,943
J-400-0023	146	0.02	102	1,945
J-400-0986	238	0.00	69	1,946
J-400-0268	163	5.36	95	1,947
J-400-0869	132	0.00	109	1,948
J-400-0870	132	0.00	109	1,948
J-400-1106	132	0.00	109	1,948
J-400-1107	132	0.00	109	1,948
J-400-1109	132	0.00	109	1,948
J-400-0024	146	0.00	102	1,948
J-400-1108	132	0.11	109	1,948
J-400-0871	132	0.20	109	1,948
J-400-0866	132	0.59	109	1,948
J-400-0131	147	0.00	102	1,950
J-400-0868	132	3.17	109	1,951
J-400-1110	131	4.63	109	1,952
J-400-0269	140	2.07	105	1,954
J-400-0135	129	2.53	110	1,955
J-400-0849	166	9.45	93	1,959
J-400-0270	136	3.56	107	1,961
J-400-0117	175	7.33	95	1,964
J-400-0653	134	0.00	108	1,965
J-400-0654	133	0.00	108	1,967
J-400-0481	145	0.79	103	1,968
J-400-0037	132	0.00	109	1,969
J-400-0603	185	1.30	97	1,971
J-400-0214	131	0.00	109	1,973
J-400-0038	131	1.35	109	1,973
J-400-0039	129	0.00	110	1,974
J-400-0597	146	1.51	102	1,974
J-400-0600	184	0.00	98	1,976
J-400-0159	129	0.00	110	1,979
J-400-0215	128	0.00	110	1,980
J-400-0136	124	3.36	112	1,980
J-400-0160	128	1.25	110	1,980
J-400-0591	156	2.24	98	1,981
J-400-0601	184	0.00	98	1,981
J-400-1035	244	0.00	67	1,982
J-400-0594	156	2.43	99	1,983
J-400-0129	202	15.68	84	1,986
J-400-0593	155	4.23	99	1,986

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0697	184	0.00	98	1,993
J-400-0134	109	7.57	119	1,997
J-400-0584	109	0.00	119	2,000
J-400-0070	122	0.22	113	2,000
J-400-0299	124	0.67	112	2,003
J-400-0586	107	0.60	119	2,003
J-400-0579	125	0.00	112	2,003
J-400-0216	125	3.01	112	2,003
J-400-0506	108	0.70	119	2,003
J-400-0507	108	0.67	119	2,003
J-400-0298	126	0.00	112	2,004
J-400-0460	125	0.00	112	2,005
J-400-0585	108	1.08	119	2,005
J-400-0071	105	0.00	120	2,006
J-400-0137	107	6.49	119	2,006
J-400-0587	106	1.66	120	2,007
J-400-0068	105	1.90	120	2,008
J-400-0036	124	1.27	112	2,008
J-400-0413	108	3.68	119	2,008
J-400-0485	105	2.43	120	2,009
J-400-0297	127	6.56	111	2,010
J-400-0065	104	0.00	121	2,011
J-400-0064	104	0.00	121	2,011
J-400-0069	105	10.15	120	2,013
J-400-0239	185	4.33	91	2,023
J-400-0067	104	7.74	121	2,024
J-400-0414	110	0.43	118	2,031
J-400-0508	110	0.00	118	2,031
J-400-0510	123	0.00	113	2,034
J-400-0035	124	1.64	113	2,035
J-400-0066	122	3.58	113	2,035
J-400-0509	123	0.00	113	2,035
J-400-0583	110	0.00	118	2,036
J-400-0262	206	27.53	82	2,038
J-400-0034	124	0.58	113	2,038
J-400-0643	154	0.00	99	2,038
J-400-0646	153	0.00	99	2,039
J-400-0647	153	0.00	99	2,039
J-400-0206	153	0.00	99	2,039
J-400-0209	150	0.00	102	2,041
J-400-0563	124	0.00	113	2,042
J-400-0562	124	0.00	113	2,042
J-400-0208	150	0.89	101	2,042
J-400-0210	150	3.56	101	2,043
J-400-0595	149	3.97	102	2,044
J-400-0205	135	2.16	107	2,044
J-400-0519	134	2.24	107	2,044
J-400-0466	123	0.00	113	2,046

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0564	125	6.16	112	2,049
J-400-0535	110	0.00	118	2,052
J-400-0081	110	0.00	118	2,052
J-400-0082	110	0.00	118	2,052
J-400-0698	181	5.87	99	2,062
J-400-0274	104	3.29	122	2,062
J-400-0696	181	1.23	99	2,064
J-400-0856	155	0.89	98	2,064
J-400-0644	154	4.52	98	2,067
J-400-0195	159	8.30	96	2,071
J-400-0516	118	0.00	114	2,081
J-400-0517	118	0.00	114	2,082
J-400-0513	119	0.00	114	2,082
J-400-0514	118	0.00	114	2,082
J-400-0515	118	1.15	114	2,084
J-400-0459	118	3.13	114	2,089
J-400-0415	123	1.95	113	2,092
J-400-0141	149	1.49	102	2,094
J-400-0140	149	0.00	102	2,095
J-400-0423	158	2.48	94	2,096
J-400-0143	149	3.85	102	2,101
J-400-0142	147	0.00	103	2,101
J-400-0158	123	0.00	113	2,103
J-400-0300	147	0.00	103	2,105
J-400-0028	147	0.58	103	2,106
J-400-0420	123	0.00	113	2,106
J-400-0421	123	0.00	113	2,106
J-400-0073	124	5.12	113	2,110
J-400-0560	123	1.61	114	2,110
J-400-1114	165	0.00	102	2,116
J-400-0029	147	0.00	103	2,116
J-400-0027	146	0.00	103	2,119
J-400-0025	146	0.00	103	2,122
J-400-0544	137	0.00	106	2,122
J-400-0543	138	0.00	105	2,123
J-400-0542	138	0.00	105	2,123
J-400-0518	138	0.00	105	2,123
J-400-0072	146	5.55	104	2,124
J-400-0458	138	5.82	105	2,129
J-400-0164	117	3.78	118	2,132
J-400-0850	161	1.68	95	2,140
J-400-0538	160	0.00	96	2,149
J-400-0558	122	1.03	114	2,150
J-400-0537	160	0.00	96	2,152
J-400-0851	159	0.00	96	2,152
J-400-0163	117	0.00	118	2,152
J-400-0540	153	0.00	99	2,152
J-400-0157	122	0.00	114	2,153

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0032	122	0.19	114	2,153
J-400-0033	122	0.00	114	2,153
J-400-0557	122	0.63	114	2,154
J-400-0026	149	0.00	102	2,155
J-400-0559	122	5.36	114	2,158
J-400-0373	150	0.00	98	2,159
J-400-0694	188	0.00	96	2,159
J-400-0237	121	0.00	115	2,161
J-400-0238	121	0.00	115	2,161
J-400-0275	120	0.00	115	2,161
J-400-0278	120	0.00	115	2,161
J-400-0331	120	0.00	115	2,161
J-400-0332	121	0.00	115	2,161
J-400-0695	188	0.00	96	2,162
J-400-0330	120	0.00	115	2,163
J-400-0273	120	3.97	115	2,165
J-400-0853	157	0.00	97	2,166
J-400-0539	155	0.00	98	2,167
J-400-0577	188	0.00	96	2,167
J-400-0578	188	0.00	96	2,170
J-400-0852	157	0.00	97	2,170
J-400-0645	157	0.00	97	2,173
J-400-0223	188	0.00	96	2,173
J-400-0855	155	0.00	98	2,174
J-400-0150	148	0.53	103	2,175
J-400-0221	189	0.00	96	2,177
J-400-0151	148	0.00	103	2,177
J-400-0637	156	0.00	97	2,178
J-400-0440	146	5.05	109	2,179
J-400-0854	156	0.00	98	2,180
J-400-0240	193	8.85	88	2,181
J-400-0301	147	5.22	103	2,181
J-400-0222	190	0.00	95	2,183
J-400-0636	156	0.00	97	2,186
J-400-0162	117	0.00	118	2,197
J-400-0927	191	17.60	95	2,204
J-400-0954	194	19.57	93	2,206
J-400-0329	119	0.00	116	2,206
J-400-0464	119	0.00	116	2,210
J-400-0465	119	0.00	116	2,214
J-400-0661	156	3.25	97	2,214
J-400-0463	121	0.00	115	2,214
J-400-0007	120	0.00	115	2,214
J-400-0156	120	0.00	115	2,215
J-400-0005	120	0.00	115	2,215
J-400-0006	120	0.00	115	2,215
J-400-0277	118	0.00	116	2,219
J-400-0004	120	1.88	115	2,219

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0276	118	0.00	116	2,221
J-400-0248	117	0.00	117	2,223
J-400-0309	177	0.00	91	2,229
J-400-0305	144	0.00	105	2,230
J-400-0303	145	0.00	104	2,231
J-400-0304	145	0.00	104	2,231
J-400-0161	117	0.00	118	2,232
J-400-0302	146	0.00	104	2,233
J-400-0859	177	0.00	91	2,235
J-400-0312	148	0.00	103	2,235
J-400-0843	177	0.00	91	2,236
J-400-0145	152	1.95	102	2,236
J-400-0144	152	0.00	102	2,237
J-400-0860	177	0.00	91	2,238
J-400-0146	152	0.00	102	2,239
J-400-0311	149	0.00	103	2,239
J-400-0149	151	1.08	102	2,241
J-400-0306	152	0.79	102	2,242
J-400-0148	149	0.00	103	2,242
J-400-0147	152	4.52	102	2,246
J-400-0462	149	0.82	103	2,246
J-400-0307	155	1.49	100	2,246
J-400-0461	149	0.00	103	2,247
J-400-0031	149	0.00	103	2,248
J-400-0308	155	1.66	100	2,250
J-400-0003	124	2.31	114	2,251
J-400-0112	124	0.00	114	2,252
J-400-0107	125	0.00	113	2,252
J-400-0113	123	0.00	114	2,252
J-400-0109	148	3.75	103	2,252
J-400-0111	124	0.41	114	2,252
J-400-0155	126	0.31	113	2,252
J-400-0114	123	0.00	114	2,252
J-400-0108	124	0.00	114	2,253
J-400-0106	124	0.00	114	2,253
J-400-0001	123	3.41	114	2,256
J-400-0105	124	0.00	114	2,257
J-400-0002	104	3.65	122	2,258
J-400-0110	126	6.49	113	2,258
J-400-0437	145	12.89	110	2,259
J-400-0249	105	0.00	122	2,266
J-400-0984	189	0.00	96	2,266
J-400-0310	165	12.72	96	2,272
J-400-0250	103	0.00	123	2,272
J-400-0247	102	0.00	123	2,273
J-400-0726	176	0.00	91	2,277
J-400-200	300	0.00	45	2,280
J-400-0395	125	1.11	114	2,284

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0244	102	0.00	123	2,286
J-400-0393	126	0.00	113	2,287
J-400-0390	129	0.00	112	2,287
J-400-0731	125	0.00	114	2,287
J-400-0394	125	0.00	113	2,287
J-400-0605	123	0.24	114	2,288
J-400-0392	129	2.96	112	2,290
J-400-0604	122	2.36	115	2,291
J-400-0389	130	4.78	111	2,292
J-400-0388	125	2.86	113	2,293
J-400-0703	111	1.30	119	2,294
J-400-0780	184	3.99	98	2,294
J-400-0381	105	0.00	122	2,296
J-400-0382	105	0.00	122	2,297
J-400-0383	105	0.00	122	2,297
J-400-0702	106	1.90	122	2,297
J-400-0246	104	0.00	123	2,298
J-400-0735	104	0.00	123	2,298
J-400-0734	104	0.00	123	2,299
J-400-0736	104	0.00	123	2,299
J-400-0733	104	0.00	123	2,299
J-400-0030	154	0.91	101	2,300
J-400-0391	153	2.57	101	2,301
J-400-0725	156	0.00	100	2,311
J-400-0787	156	0.00	100	2,314
J-400-0786	155	1.78	101	2,314
J-400-0788	155	0.00	101	2,316
J-400-0858	155	0.00	101	2,316
J-400-0857	155	0.00	101	2,316
J-400-0732	108	0.00	121	2,316
J-400-0682	108	0.00	121	2,317
J-400-0785	154	0.00	101	2,319
J-400-0384	125	0.00	114	2,319
J-400-0385	125	0.00	114	2,320
J-400-0387	125	3.13	114	2,321
J-400-0625	129	0.00	112	2,322
J-400-0626	128	0.00	112	2,322
J-400-0657	128	0.00	112	2,322
J-400-0624	126	0.00	113	2,324
J-400-0861	136	0.00	109	2,325
J-400-0386	125	0.00	114	2,325
J-400-0526	139	0.00	108	2,328
J-400-0179	125	0.00	114	2,328
J-400-0680	109	0.00	121	2,331
J-400-0681	109	0.75	121	2,331
J-400-0525	146	0.00	105	2,334
J-400-0847	154	0.00	101	2,335
J-400-0169	109	4.88	121	2,336

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0846	154	0.00	101	2,337
J-400-0524	149	0.00	104	2,338
J-400-1036	149	0.00	103	2,339
J-400-1009	150	0.00	103	2,339
J-400-0845	154	0.00	101	2,342
J-400-0783	154	0.00	101	2,342
J-400-1008	154	0.00	101	2,342
J-400-0873	154	0.00	101	2,343
J-400-0784	154	0.00	101	2,345
J-400-0872	154	0.00	101	2,350
J-400-0968	153	0.00	101	2,353
J-400-0176	123	0.60	115	2,359
J-400-0175	123	0.00	115	2,360
J-400-0178	123	0.00	115	2,361
J-400-0170	123	5.24	115	2,362
J-400-0177	123	0.00	115	2,363
J-400-0621	155	0.00	101	2,363
J-400-0620	154	0.00	101	2,364
J-400-0173	124	0.00	114	2,366
J-400-0174	124	0.00	114	2,366
J-400-0168	125	0.00	114	2,366
J-400-0172	123	0.53	115	2,366
J-400-0618	153	0.00	101	2,367
J-400-0619	154	0.00	101	2,368
J-400-0167	125	1.97	114	2,368
J-400-0961	145	0.41	111	2,372
J-400-0617	153	0.00	102	2,376
J-400-0171	123	2.40	115	2,378
J-400-0495	151	0.00	103	2,396
J-400-1059	145	0.00	110	2,400
J-400-0737	294	0.00	45	2,403
J-400-0496	151	0.00	103	2,404
J-400-0599	150	0.00	103	2,404
J-400-1111	145	0.00	110	2,404
J-400-0501	151	0.00	103	2,407
J-400-0948	146	0.00	110	2,409
J-400-0949	145	0.00	111	2,409
J-400-0950	138	0.00	114	2,409
J-400-0499	151	0.00	103	2,414
J-400-0500	151	0.00	103	2,416
J-400-0502	151	0.00	103	2,419
J-400-1112	145	3.70	111	2,422
J-400-1113	145	11.59	111	2,425
J-400-0487	156	6.13	97	2,432
J-400-1088	199	10.22	95	2,432
J-400-0781	151	0.00	103	2,439
J-400-0494	125	4.35	114	2,440
J-400-0656	150	0.00	103	2,441

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0655	150	0.00	103	2,443
J-400-0720	296	0.00	44	2,446
J-400-0523	125	0.00	114	2,449
J-400-0493	124	0.00	115	2,450
J-400-0398	124	0.00	115	2,455
J-400-0779	176	9.30	101	2,469
J-400-0092	144	0.00	102	2,473
J-400-0093	144	0.00	102	2,473
J-400-0958	139	13.27	114	2,474
J-400-0721	297	0.00	44	2,474
J-400-0090	143	1.71	102	2,474
J-400-0094	144	2.00	102	2,475
J-400-0486	155	0.00	97	2,476
J-400-0641	146	0.00	105	2,476
J-400-0087	144	3.05	102	2,476
J-400-0183	146	0.00	105	2,477
J-400-0406	177	10.58	101	2,477
J-400-0340	224	1.76	75	2,483
J-400-0182	148	0.00	104	2,484
J-400-0498	225	0.00	75	2,491
J-400-0497	225	0.00	75	2,493
J-400-0266	116	0.00	119	2,495
J-400-1033	226	0.00	74	2,498
J-400-1081	298	0.00	44	2,504
J-400-0924	150	1.39	97	2,505
J-400-1010	231	0.00	72	2,523
J-400-0399	118	0.00	118	2,523
J-400-0676	117	0.00	118	2,526
J-400-0658	117	0.00	118	2,527
J-400-0490	225	3.73	75	2,529
J-400-0192	297	0.00	44	2,530
J-400-0224	295	0.00	45	2,535
J-400-0396	117	0.00	118	2,536
J-400-0774	268	0.00	64	2,536
J-400-1066	294	0.00	46	2,538
J-400-0397	116	0.00	118	2,539
J-400-0782	132	0.00	112	2,546
J-400-0180	115	0.00	119	2,546
J-400-0181	115	0.00	119	2,549
J-400-0844	115	0.00	119	2,549
J-400-0955	115	0.00	119	2,549
J-400-0956	115	0.00	119	2,549
J-400-0187	134	0.00	111	2,553
J-400-0186	131	0.00	112	2,558
J-400-0679	130	0.00	112	2,559
J-400-0678	130	0.00	113	2,560
J-400-0778	139	0.94	115	2,562
J-400-0628	119	0.00	117	2,563

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0629	119	0.00	117	2,563
J-400-0627	116	0.00	118	2,563
J-400-0633	119	0.00	117	2,563
J-400-0632	119	0.00	117	2,563
J-400-0491	116	0.00	118	2,563
J-400-0631	119	0.00	117	2,563
J-400-0630	120	0.00	117	2,563
J-400-0492	115	0.00	119	2,564
J-400-0083	152	0.00	97	2,564
J-400-0929	291	0.00	48	2,565
J-400-0185	132	2.62	112	2,568
J-400-0634	119	6.90	117	2,570
J-400-0675	115	0.00	119	2,571
J-400-0488	155	1.56	97	2,574
J-400-0191	115	0.00	119	2,582
J-400-1090	117	28.20	118	2,591
J-400-0190	115	0.00	119	2,592
J-400-0189	115	0.00	119	2,596
J-400-0188	115	0.00	119	2,599
J-400-0467	115	0.00	119	2,613
J-400-1065	271	0.00	56	2,618
J-400-0704	153	0.00	96	2,624
J-400-0084	152	0.00	97	2,626
J-400-0960	134	0.00	117	2,654
J-400-0085	150	0.07	99	2,654
J-400-0905	279	0.00	53	2,658
J-400-0992	297	3.58	46	2,662
J-400-0089	152	0.00	98	2,667
J-400-0086	151	0.00	99	2,667
J-400-0775	134	0.00	117	2,668
J-400-0776	134	0.00	117	2,668
J-400-0930	238	0.00	70	2,673
J-400-0088	151	2.16	98	2,682
J-400-0468	118	0.00	118	2,684
J-400-0436	152	0.00	97	2,692
J-400-0923	148	0.00	98	2,693
J-400-0980	149	0.00	98	2,693
J-400-0993	298	0.00	46	2,697
J-400-0439	171	0.00	96	2,698
J-400-0438	133	0.00	113	2,698
J-400-0184	132	11.23	113	2,710
J-400-0906	273	0.00	56	2,764
J-400-0422	149	1.71	98	2,790
J-400-0951	136	12.43	115	2,798
J-400-0777	137	2.89	115	2,831
J-400-0489	153	0.00	98	2,861
J-400-0265	119	0.00	118	2,910
J-400-0267	119	0.00	118	2,917

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0264	119	11.25	117	2,926
J-400-0983	172	0.00	102	3,001
J-400-0372	151	3.10	98	3,003
J-400-0705	150	0.00	97	3,045
J-400-0345	138	0.00	116	3,058
J-400-0346	158	0.00	108	3,058
J-400-0347	161	0.00	106	3,058
J-400-0947	157	0.00	108	3,058
J-400-0991	138	0.00	116	3,058
J-400-0946	140	21.88	116	3,080
J-400-0344	138	10.10	116	3,082
J-400-1031	274	0.00	57	3,084
J-400-0371	149	0.36	99	3,089
J-400-0370	148	0.99	99	3,117
J-400-0407	161	12.43	108	3,131
J-400-1029	291	0.00	49	3,141
J-400-0763	140	0.00	116	3,150
J-400-0952	140	0.00	116	3,150
J-400-0713	147	0.00	99	3,195
J-400-0762	142	0.00	115	3,232
J-400-0367	148	2.38	99	3,249
J-400-1027	268	0.00	60	3,265
J-400-1030	273	0.00	57	3,270
J-400-1028	267	0.00	60	3,272
J-400-1026	264	0.00	61	3,277
J-400-0903	267	0.00	60	3,277
J-400-0904	268	0.00	60	3,280
J-400-1016	266	0.00	61	3,281
J-400-1015	265	0.00	61	3,283
J-400-0411	263	0.00	62	3,308
J-400-0706	149	47.67	98	3,322
J-400-0714	146	0.00	99	3,344
J-400-0366	147	0.00	99	3,398
J-400-0368	146	2.09	100	3,417
J-400-0759	144	0.00	115	3,436
J-400-0758	146	12.33	114	3,496
J-400-0715	146	0.00	99	3,508
J-400-0917	147	0.00	32	3,520
J-400-0755	146	0.00	114	3,559
J-400-0753	148	0.00	113	3,564
J-400-0752	149	0.00	113	3,569
J-400-0712	146	0.00	99	3,577
J-400-0863	152	0.00	96	3,579
J-400-0754	149	0.00	113	3,586
J-400-0749	178	0.00	100	3,595
J-400-0750	157	0.00	109	3,595
J-400-0405	152	0.00	112	3,604
J-400-0751	159	4.59	109	3,611

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0748	158	17.26	109	3,612
J-400-0404	147	0.00	114	3,667
J-400-0707	148	0.00	98	3,732
J-400-1089	147	0.00	99	3,761
J-400-0403	147	4.54	114	3,787
J-400-0412	267	0.00	62	3,793
J-400-1054	173	10.92	87	3,867
J-400-1053	173	5.22	87	3,875
J-400-0716	144	0.00	100	3,938
J-400-0708	148	0.00	98	3,945
J-400-0409	154	0.00	29	3,981
J-400-0901	225	0.00	81	3,986
J-400-0862	147	0.00	99	4,035
J-400-0369	143	1.73	100	4,043
J-400-0549	146	0.00	99	4,120
J-400-0550	146	0.00	99	4,135
J-400-0864	147	0.00	99	4,176
J-400-0900	211	0.00	88	4,199
J-400-0548	144	14.23	100	4,234
J-400-0547	144	0.43	100	4,281
J-400-0546	144	0.00	100	4,287
J-400-1057	147	0.00	99	4,473
J-400-0902	205	0.00	91	4,494
J-400-1032	144	0.00	100	4,498
J-400-1104	150	0.00	97	4,522
J-400-0709	148	0.00	98	4,542
J-400-1058	144	0.00	100	4,555
J-400-1051	144	0.00	100	4,563
J-400-1102	144	0.00	100	4,567
J-400-1050	145	0.00	99	4,569
J-400-1049	147	0.00	99	4,579
J-400-1048	148	0.00	98	4,586
J-400-1101	144	0.00	100	4,591
J-400-0710	148	0.00	98	4,592
J-400-0711	145	0.10	100	4,610
J-400-1056	147	0.00	99	4,628
J-400-1052	160	15.22	93	4,633
J-400-1096	160	0.00	93	4,648
J-400-1117	191	0.00	97	4,690
J-400-1093	158	0.00	94	4,694
J-400-1091	154	0.00	96	4,721
J-400-1092	152	0.00	96	4,734
J-400-1103	151	0.00	97	4,751
J-400-1105	150	0.00	97	4,755
J-400-1055	147	0.00	98	4,788
J-400-1095	155	0.00	95	4,809
J-400-1100	148	0.00	98	4,824
J-400-1094	154	0.00	95	4,825

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-1046	148	0.00	98	4,827
J-400-1097	154	0.00	95	4,833
J-400-1047	149	0.00	98	4,834
J-400-1098	154	0.00	96	4,935
J-400-1099	153	0.00	67	4,944
J-400-0971	187	0.00	100	4,952
J-400-0989	166	9.23	109	5,101
J-400-1044	186	0.00	100	5,196
J-400-0970	193	0.00	97	5,296
J-400-0953	165	0.00	109	5,516
J-400-0402	163	0.00	110	5,556
J-400-0967	186	0.00	101	5,592
J-400-0969	199	0.00	95	5,615
J-400-0919	165	0.00	109	5,710
J-400-0987	165	14.81	109	5,724
J-400-0988	168	0.00	108	5,869
J-400-0918	165	0.00	109	6,002
J-400-0740	172	0.00	106	6,111
J-400-0966	183	0.00	102	6,436
J-400-0688	180	0.00	103	6,668
J-400-0687	182	0.00	102	6,761
J-400-0965	183	0.00	102	6,761
J-400-0686	186	0.00	101	6,861
J-400-0962	196	0.00	97	7,564
J-400-0453	255	0.00	70	8,600
J-400-0963	183	0.00	103	9,283
J-400-0638	191	0.00	100	9,301
J-400-1025	186	0.00	102	9,415
J-400-0684	280	0.00	56	9,440
J-400-9981	190	0.00	100	9,475
J-400-0769	279	0.00	56	9,484
J-400-0771	276	0.00	57	9,537
J-400-0815	279	0.00	55	9,540
J-400-1082	191	2.84	99	9,544
J-400-1118	189	0.00	100	9,546
J-400-0773	277	0.00	56	9,603
J-400-0792	275	0.00	57	9,608
J-400-0793	275	0.00	57	9,608
J-400-0794	274	0.00	57	9,631
J-400-0770	276	0.00	57	9,647
J-400-0791	273	0.00	58	9,653
J-400-0772	275	0.00	57	9,683
J-400-0768	274	0.00	57	9,713
J-400-0642	191	0.00	99	9,742
J-400-0964	192	0.00	99	9,751
J-400-0746	275	0.00	57	9,817
J-400-0790	275	0.00	57	9,844
J-400-0454	250	0.00	72	10,480

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-400-0358	177	0.00	19	33,277
J-400-0893	179	0.00	60	140,580
Zone 440				
J-440-047	367	0.00	62	345
J-440-048	366	0.00	62	347
J-440-046	328	0.00	79	381
J-440-007	324	0.85	80	396
J-440-049	320	0.35	82	401
J-440-093	348	0.00	70	455
J-440-092	349	0.44	69	455
J-440-102	284	0.00	98	536
J-440-081	326	0.00	80	590
J-440-008	273	1.42	103	614
J-440-020	305	3.78	89	622
J-440-086	271	0.00	104	623
J-440-101	271	0.00	103	623
J-440-100	314	0.00	85	710
J-440-033	243	8.37	116	822
J-440-083	321	0.00	82	952
J-440-150	329	3.28	78	973
J-440-094	344	3.36	72	1,219
J-440-087	289	0.00	96	1,301
J-440-001	290	0.68	95	1,357
J-440-099	291	0.00	95	1,412
J-440-095	343	0.00	72	1,465
J-440-080	289	2.86	96	1,486
J-440-019	341	0.00	73	1,513
J-440-074	276	2.80	101	1,516
J-440-089	291	0.00	95	1,565
J-440-068	299	0.37	91	1,566
J-440-082	294	0.68	93	1,568
J-440-098	290	0.74	95	1,577
J-440-088	291	0.00	95	1,578
J-440-042	288	4.06	96	1,580
J-440-009	292	4.30	94	1,586
J-440-003	288	0.50	96	1,600
J-440-050	308	1.40	87	1,607
J-440-079	342	0.00	72	1,617
J-440-006	348	2.47	70	1,618
J-440-005	349	1.33	70	1,627
J-440-096	333	0.83	76	1,628
J-440-075	366	2.10	62	1,654
J-440-097	288	0.46	96	1,656
J-440-045	366	0.00	62	1,657
J-440-002	265	0.00	106	1,660
J-440-036	348	0.66	70	1,669
J-440-069	341	0.00	73	1,671
J-440-004	265	0.00	106	1,672

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-440-043	363	0.00	64	1,673
J-440-044	363	0.00	64	1,681
J-440-040	249	0.00	113	1,688
J-440-032	247	1.11	114	1,689
J-440-070	364	0.00	63	1,696
J-440-039	238	0.00	118	1,696
J-440-052	359	0.00	65	1,696
J-440-067	287	0.00	97	1,700
J-440-073	256	0.00	110	1,701
J-440-037	285	1.20	97	1,709
J-440-063	255	0.00	110	1,714
J-440-077	293	0.72	94	1,715
J-440-084	253	0.00	111	1,717
J-440-085	248	0.00	113	1,727
J-440-053	247	0.00	114	1,728
J-440-054	247	0.00	114	1,728
J-440-055	244	0.00	115	1,728
J-440-056	247	0.00	114	1,730
J-440-057	247	3.19	114	1,735
J-440-066	298	1.77	92	1,741
J-440-051	358	0.92	66	1,759
J-440-041	285	0.00	97	1,761
J-440-034	324	0.48	80	1,771
J-440-090	251	0.79	112	1,774
J-440-104	274	0.00	102	1,781
J-440-078	251	1.07	112	1,781
J-440-016	341	0.00	73	1,785
J-440-031	254	1.62	111	1,787
J-440-091	250	0.00	113	1,795
J-440-012	349	0.92	69	1,798
J-440-029	276	0.00	101	1,799
J-440-065	349	1.44	69	1,800
J-440-030	277	1.18	101	1,801
J-440-014	341	0.00	73	1,802
J-440-038	276	1.01	102	1,803
J-440-076	308	1.99	87	1,803
J-440-018	341	0.00	73	1,805
J-440-017	340	0.00	74	1,810
J-440-013	341	0.61	73	1,813
J-440-015	337	2.88	75	1,819
J-440-064	284	0.00	98	1,823
J-440-103	274	1.92	102	1,829
J-440-035	323	0.00	81	1,849
J-440-058	296	0.00	92	1,851
J-440-010	299	1.77	91	1,858
J-440-011	298	3.76	91	1,863
J-440-072	351	0.00	69	1,876
J-440-071	349	0.00	70	1,889

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-440-023	345	0.00	71	1,920
J-440-021	308	0.00	87	1,951
J-440-022	310	0.00	86	1,955
J-440-024	310	4.22	86	1,966
J-440-025	267	0.00	105	2,702
J-440-026	264	0.00	106	2,981
J-440-027	264	0.00	106	2,991
J-440-059	264	0.00	106	2,991
J-440-060	260	12.37	108	3,004
J-440-061	265	0.00	106	3,022
J-440-062	265	0.00	106	3,037
Zone 470				
J-470-049	335	10.03	56	341
J-470-026	339	11.03	54	342
J-470-036	278	0.00	80	397
J-470-037	278	0.00	81	397
J-470-038	278	0.00	81	397
J-470-032	305	0.00	69	398
J-470-040	305	0.00	69	398
J-470-022	253	0.57	92	398
J-470-019	279	1.90	80	399
J-470-039	272	6.77	83	404
J-470-020	306	8.41	69	406
J-470-021	304	11.12	69	409
J-470-033	320	0.00	62	440
J-470-001	275	0.00	82	572
J-470-025	326	0.00	60	856
J-470-016	273	0.00	83	858
J-470-044	325	0.00	60	932
J-470-051	286	0.00	78	991
J-470-017	287	0.00	77	1,011
J-470-045	324	0.00	61	1,195
J-470-047	324	1.97	61	1,204
J-470-050	322	0.00	62	1,208
J-470-002	278	0.00	81	1,214
J-470-023	322	4.41	62	1,218
J-470-048	323	8.72	61	1,220
J-470-034	278	0.00	81	1,281
J-470-046	275	0.00	82	1,300
J-470-024	290	7.23	75	1,321
J-470-005	267	5.05	86	1,356
J-470-006	239	1.40	98	1,635
J-470-030	238	0.00	98	1,647
J-470-029	237	0.00	99	1,652
J-470-027	237	0.00	99	1,659
J-470-041	228	0.00	102	1,659
J-470-031	235	0.79	99	1,659
J-470-028	237	0.00	99	1,666

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-470-035	242	0.00	97	1,809
J-470-013	237	3.06	98	1,846
J-470-008	293	12.26	74	2,732
J-470-042	228	0.00	74	2,759
J-470-007	293	0.00	74	3,043
J-470-043	300	0.00	72	3,151
J-470-003	290	0.00	76	3,209
J-470-018	293	0.00	74	3,261
J-470-004	292	0.00	75	3,326
J-470-010	293	0.00	75	3,410
J-470-057	316	26.46	65	3,661
J-470-009	293	0.00	75	3,721
J-470-012	292	0.00	75	4,269
J-470-011	292	0.00	75	4,326
J-470-015	292	12.77	75	4,442
J-470-052	299	0.00	72	4,458
J-470-056	299	0.00	72	6,840
J-470-014	297	3.58	73	7,802
J-470-058	299	0.00	72	8,246
J-470-055	298	0.00	72	9,396
J-470-059	299	0.00	72	9,533
J-470-054	300	0.00	72	13,021
J-470-053	295	0.00	74	16,743
Zone 475-A				
J-475-002	275	0.00	41	352
J-475-013	233	0.00	72	392
J-475-031	385	0.00	49	433
J-475-014	385	0.00	49	434
J-475-021	381	0.00	51	434
J-475-001	385	13.76	49	445
J-475-022	322	0.00	76	491
J-475-009	334	2.56	71	499
J-475-008	299	0.00	86	499
J-475-010	297	0.00	87	499
J-475-004	292	0.00	89	499
J-475-011	239	0.00	112	500
J-475-012	257	0.00	104	500
J-475-024	248	0.81	108	501
J-475-017	277	0.00	95	501
J-475-005	316	2.08	78	502
J-475-018	276	0.00	95	502
J-475-019	257	2.80	104	502
J-475-003	276	0.00	96	503
J-475-023	277	0.00	95	504
J-475-007	276	5.68	96	505
J-475-006	294	7.08	88	505
J-475-016	275	0.00	96	509
J-475-035	265	0.00	100	509

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-475-015	328	0.11	73	509
J-475-034	337	3.67	69	512
J-475-038	367	1.42	56	516
J-475-030	346	0.00	65	516
J-475-020	340	12.32	68	518
J-475-037	368	0.00	56	523
J-475-039	370	0.00	55	534
Zone 475-B				
J-475-026	316	0.00	51	203
J-475-029	320	0.00	49	278
J-475-036	321	0.00	48	282
J-475-032	225	0.00	90	282
J-475-028	320	0.00	49	282
J-475-033	226	22.50	89	299
J-475-025	319	31.40	49	305
Zone 500				
J-500-005	311	4.78	80	277
J-500-004	313	5.99	79	440
J-500-001	306	0.00	82	444
J-500-007	313	0.00	79	444
J-500-008	314	0.00	79	444
J-500-006	313	0.00	79	445
J-500-009	314	0.00	79	445
J-500-002	314	2.38	79	447
Zone 510				
J-510-007	337	0.00	93	81
J-510-004	320	0.00	100	88
J-510-006	361	0.00	82	88
J-510-005	355	0.00	85	561
J-510-020	351	0.00	86	657
J-510-015	353	8.24	86	663
J-510-003	319	0.00	100	781
J-510-016	332	0.00	95	907
J-510-017	330	0.00	96	928
J-510-010	330	0.00	96	966
J-510-008	328	0.00	96	994
J-510-002	462	1.29	38	1,010
J-510-009	325	0.00	98	1,028
J-510-013	324	0.00	98	1,030
J-510-018	319	0.00	100	1,030
J-510-019	319	0.00	100	1,030
J-510-011	325	4.76	98	1,033
J-510-014	320	6.62	100	1,035
J-510-012	324	7.36	98	1,035
Zone 525				
J-525-005	349	0.00	83	332
J-525-004	350	8.41	83	339
J-525-017	366	0.00	76	416

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-525-006	365	5.75	76	419
Zone 560				
J-560-071	452	0.00	54	424
J-560-020	345	2.47	100	430
J-560-044	364	0.00	92	461
J-560-019	377	0.00	86	496
J-560-049	454	0.00	53	528
J-560-017	369	0.00	90	530
J-560-018	371	0.00	89	530
J-560-016	371	0.98	89	531
J-560-067	373	0.00	88	536
J-560-031	453	0.00	54	540
J-560-027	383	0.00	84	637
J-560-068	389	0.00	81	637
J-560-026	389	0.00	81	644
J-560-070	415	0.00	70	654
J-560-025	360	0.00	94	659
J-560-062	387	0.00	82	659
J-560-065	388	0.00	82	662
J-560-064	385	0.00	83	685
J-560-045	386	0.85	83	686
J-560-066	385	0.00	83	687
J-560-063	385	1.27	83	687
J-560-057	349	0.37	98	701
J-560-056	363	0.48	92	701
J-560-032	414	0.00	71	701
J-560-033	413	0.00	71	701
J-560-034	415	0.00	70	705
J-560-035	441	0.00	59	781
J-560-029	453	0.00	54	782
J-560-028	446	0.00	57	789
J-560-078	448	0.00	56	790
J-560-030	449	0.00	55	790
J-560-077	436	0.00	61	795
J-560-076	435	0.59	61	797
J-560-074	455	0.07	53	865
J-560-007	371	1.44	89	908
J-560-002	349	0.00	70	920
J-560-054	350	0.00	98	939
J-560-012	360	0.00	94	948
J-560-053	334	0.59	105	968
J-560-048	335	0.00	105	978
J-560-051	406	0.00	74	1,005
J-560-050	406	0.00	74	1,005
J-560-011	406	0.00	74	1,006
J-560-004	420	0.00	68	1,019
J-560-003	433	0.00	62	1,023
J-560-061	433	0.00	63	1,023

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-560-059	425	0.00	66	1,027
J-560-058	429	0.00	64	1,027
J-560-046	420	0.00	68	1,027
J-560-037	375	2.27	88	1,028
J-560-014	374	0.00	88	1,029
J-560-015	393	0.00	80	1,029
J-560-021	410	0.00	72	1,029
J-560-022	405	0.00	75	1,029
J-560-024	407	0.00	74	1,029
J-560-047	434	0.00	62	1,029
J-560-038	308	0.00	117	1,029
J-560-039	311	0.00	115	1,029
J-560-040	304	0.00	118	1,029
J-560-041	313	0.00	115	1,029
J-560-042	310	1.09	116	1,030
J-560-023	401	1.22	77	1,030
J-560-009	435	0.00	62	1,030
J-560-043	315	1.84	114	1,030
J-560-036	282	6.97	128	1,034
J-560-010	438	0.00	61	1,034
Zone 590				
J-590-0691	378	5.00	99	98
J-590-0042	454	5.55	62	100
J-590-0255	456	2.02	61	116
J-590-1367	382	0.00	97	117
J-590-1368	378	0.14	99	118
J-590-1365	374	0.00	101	119
J-590-1366	384	0.00	96	119
J-590-1364	361	0.00	106	125
J-590-0510	404	0.00	88	127
J-590-0511	406	1.61	87	131
J-590-1362	383	3.53	97	132
J-590-1363	374	0.00	101	135
J-590-1370	376	0.00	100	137
J-590-1369	377	0.00	100	138
J-590-0522	380	0.00	98	139
J-590-0523	383	0.65	97	140
J-590-1143	389	1.13	94	141
J-590-0509	410	0.00	85	153
J-590-0507	414	0.00	84	172
J-590-0272	424	0.00	82	193
J-590-0270	419	0.00	85	199
J-590-0273	397	0.00	94	262
J-590-0508	414	0.00	83	289
J-590-1002	393	0.00	93	307
J-590-0732	414	0.55	83	311
J-590-1327	367	26.13	79	320
J-590-0976	461	0.00	63	320

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0284	385	0.77	96	334
J-590-1110	424	0.00	74	345
J-590-0051	386	0.00	94	350
J-590-0221	386	0.96	94	365
J-590-1112	414	0.00	78	370
J-590-0290	419	0.00	83	371
J-590-0230	419	0.00	83	371
J-590-1111	413	1.97	79	372
J-590-0234	411	10.92	79	377
J-590-1114	414	8.78	78	378
J-590-0041	430	4.76	72	384
J-590-0934	322	0.00	125	387
J-590-0254	437	0.00	69	404
J-590-0317	422	3.61	75	408
J-590-0318	403	0.00	82	418
J-590-1216	282	0.00	143	418
J-590-0999	374	0.00	101	423
J-590-1000	373	0.00	102	423
J-590-1001	375	8.70	101	424
J-590-1359	366	0.00	107	431
J-590-0328	323	0.00	125	436
J-590-1213	288	0.00	140	437
J-590-1214	282	0.00	143	437
J-590-1277	324	0.00	121	441
J-590-0578	395	10.46	87	448
J-590-0733	416	0.00	83	449
J-590-0229	410	0.00	87	452
J-590-1360	368	3.53	106	453
J-590-0233	403	66.38	83	484
J-590-0975	466	11.81	61	536
J-590-1100	431	0.00	51	545
J-590-0817	387	0.00	98	552
J-590-0734	415	0.00	83	555
J-590-0903	470	1.71	60	578
J-590-1116	449	16.30	66	583
J-590-0998	409	12.29	86	585
J-590-1131	386	0.00	96	597
J-590-0997	430	4.18	77	616
J-590-0093	340	0.00	118	619
J-590-0329	322	0.00	126	620
J-590-0334	338	0.00	119	620
J-590-0463	339	0.00	119	620
J-590-0314	430	6.73	77	620
J-590-0315	429	6.25	77	620
J-590-0464	340	0.00	118	621
J-590-0640	397	0.00	88	621
J-590-0327	323	4.66	125	625
J-590-0220	425	5.96	79	628

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-1115	440	2.52	70	637
J-590-0487	497	0.00	38	639
J-590-0022	426	4.16	78	642
J-590-0639	396	0.00	89	643
J-590-0933	349	0.00	114	644
J-590-0497	351	0.89	114	645
J-590-0495	384	1.95	100	646
J-590-0496	385	0.00	99	649
J-590-0215	493	0.00	40	649
J-590-0901	352	7.14	113	651
J-590-0214	492	0.00	40	654
J-590-0815	489	0.00	51	656
J-590-0638	396	0.00	89	667
J-590-0873	458	0.00	64	669
J-590-0875	464	1.56	62	673
J-590-0816	461	6.90	63	674
J-590-0874	468	0.00	60	675
J-590-0742	395	0.00	92	678
J-590-0813	466	0.00	61	679
J-590-1108	396	2.36	91	679
J-590-0521	360	0.00	107	679
J-590-0520	360	0.00	107	679
J-590-0519	359	0.00	107	680
J-590-0518	359	0.00	107	680
J-590-0274	396	0.00	94	680
J-590-0741	396	0.00	92	680
J-590-0740	396	0.00	91	681
J-590-0271	404	0.00	92	681
J-590-0446	488	1.61	52	683
J-590-1065	418	0.00	82	684
J-590-0505	465	4.98	62	685
J-590-0716	403	1.35	88	691
J-590-0715	406	2.69	87	700
J-590-0306	495	0.00	44	701
J-590-1117	436	4.45	72	702
J-590-0842	419	1.80	82	706
J-590-0714	407	1.39	87	707
J-590-0225	483	6.08	54	712
J-590-0799	447	0.00	69	721
J-590-0803	428	0.00	77	722
J-590-0802	428	0.00	78	722
J-590-0117	425	0.00	79	722
J-590-0278	381	0.00	98	722
J-590-0279	404	0.00	88	722
J-590-0448	405	0.00	87	722
J-590-0731	405	0.00	87	722
J-590-0800	425	0.00	79	722
J-590-0912	365	0.00	105	722

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0942	404	0.00	88	722
J-590-0943	403	0.00	88	722
J-590-0944	404	0.00	88	722
J-590-1142	365	0.00	105	722
J-590-0571	414	0.19	83	723
J-590-0797	447	0.55	69	723
J-590-0572	415	0.51	83	723
J-590-0449	405	0.75	87	723
J-590-0801	426	0.89	78	723
J-590-0476	465	0.00	52	723
J-590-0143	425	1.01	79	724
J-590-0375	409	0.77	86	724
J-590-0138	419	0.00	82	724
J-590-0139	415	0.00	83	724
J-590-0142	416	0.00	83	724
J-590-0039	430	0.00	73	724
J-590-0040	429	0.00	73	724
J-590-0096	366	1.61	104	724
J-590-0450	407	1.73	87	724
J-590-0118	425	1.83	79	724
J-590-0097	374	1.92	101	724
J-590-0909	367	2.07	104	724
J-590-0841	420	7.69	81	727
J-590-0798	448	6.25	69	727
J-590-0099	380	4.52	98	727
J-590-0140	425	0.00	79	728
J-590-0141	426	0.00	79	728
J-590-0119	409	5.39	86	728
J-590-0739	425	0.00	79	728
J-590-0222	453	3.65	67	728
J-590-0738	422	0.00	80	728
J-590-0275	424	0.00	83	729
J-590-0098	376	6.88	100	729
J-590-0223	471	0.87	59	729
J-590-0224	473	0.36	58	729
J-590-0445	489	1.73	51	732
J-590-0374	408	0.00	86	732
J-590-0878	409	0.89	86	733
J-590-0226	483	1.47	54	736
J-590-0792	482	0.00	54	738
J-590-0447	482	0.00	54	738
J-590-0790	482	0.00	54	739
J-590-0791	482	0.00	54	739
J-590-0326	482	0.00	54	740
J-590-0316	481	0.00	55	745
J-590-0977	480	0.00	55	746
J-590-0167	480	0.00	55	746
J-590-0475	441	0.00	63	765

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0477	442	0.00	62	765
J-590-0478	439	0.00	64	774
J-590-0700	448	0.00	66	787
J-590-0699	451	0.00	65	791
J-590-0672	463	0.87	62	793
J-590-0698	451	0.00	65	795
J-590-1221	451	0.00	65	799
J-590-1220	451	0.00	65	801
J-590-0434	412	4.23	85	845
J-590-1219	456	0.00	63	846
J-590-1218	456	0.00	63	849
J-590-0935	469	15.32	56	852
J-590-0276	418	0.00	85	853
J-590-0978	497	0.00	43	858
J-590-1118	414	3.34	82	860
J-590-0982	495	0.00	44	862
J-590-0979	497	7.26	43	863
J-590-1119	413	3.90	82	864
J-590-1137	456	12.38	63	868
J-590-0981	495	4.38	44	869
J-590-1227	497	0.00	43	884
J-590-1228	457	0.00	61	884
J-590-1059	379	0.00	99	893
J-590-0671	434	0.00	75	895
J-590-0592	450	0.00	68	896
J-590-0735	433	0.00	75	901
J-590-0736	435	0.00	75	901
J-590-0974	451	0.00	64	904
J-590-0586	438	0.00	74	904
J-590-0264	451	0.00	64	904
J-590-0265	452	0.00	63	904
J-590-0883	467	12.55	58	904
J-590-0263	449	0.00	64	905
J-590-0241	447	0.00	65	905
J-590-0240	445	0.00	66	905
J-590-0262	445	0.00	66	906
J-590-0267	450	0.72	64	906
J-590-0266	452	2.52	63	906
J-590-0737	432	0.00	76	907
J-590-0433	439	11.95	74	910
J-590-0283	477	0.00	57	913
J-590-0587	435	0.00	76	913
J-590-0008	475	0.00	58	915
J-590-0946	443	1.20	72	917
J-590-0009	473	0.63	59	917
J-590-0415	341	4.66	116	918
J-590-0896	471	0.00	60	918
J-590-0414	433	5.63	76	919

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0011	475	4.04	58	920
J-590-0553	426	0.00	78	923
J-590-0247	430	0.00	73	924
J-590-0244	430	0.00	73	925
J-590-0245	430	0.00	73	926
J-590-0246	429	0.00	73	926
J-590-0373	437	8.32	75	926
J-590-0043	429	0.00	73	927
J-590-0010	471	12.38	60	930
J-590-0100	436	11.85	75	931
J-590-0253	436	1.01	70	931
J-590-0044	428	0.00	73	931
J-590-0045	428	3.65	73	937
J-590-0075	399	5.29	91	945
J-590-0012	401	1.20	90	947
J-590-0013	403	5.00	90	950
J-590-0003	429	0.00	73	952
J-590-0014	430	1.66	73	952
J-590-0004	429	0.00	73	953
J-590-0261	428	0.00	74	953
J-590-0087	426	0.00	75	957
J-590-0088	425	0.00	75	957
J-590-0248	425	0.00	75	957
J-590-0086	425	0.00	75	958
J-590-0084	425	0.00	75	958
J-590-0085	424	0.00	75	959
J-590-0250	426	5.94	74	960
J-590-0083	425	0.00	75	960
J-590-0355	413	0.00	75	961
J-590-0050	425	0.00	75	961
J-590-0251	437	19.55	69	962
J-590-1053	419	0.00	78	967
J-590-0565	453	0.00	62	968
J-590-1054	420	0.00	77	970
J-590-0249	424	0.00	75	971
J-590-0297	433	3.78	71	972
J-590-0049	427	0.00	74	976
J-590-0024	405	0.00	90	979
J-590-0308	406	0.00	90	979
J-590-0349	413	0.00	75	980
J-590-0350	414	0.00	74	980
J-590-0309	405	1.61	90	981
J-590-0025	368	0.00	107	981
J-590-0422	368	0.00	107	981
J-590-0347	367	0.00	107	981
J-590-0310	366	0.00	108	981
J-590-0351	412	2.31	75	982
J-590-0168	407	5.58	89	984

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0311	366	2.96	107	984
J-590-1235	371	0.00	84	985
J-590-0048	430	0.00	73	986
J-590-0218	398	1.01	81	987
J-590-0219	398	2.24	81	987
J-590-0390	359	0.00	112	989
J-590-0391	358	0.00	112	989
J-590-0313	362	0.00	110	990
J-590-0092	360	0.00	112	990
J-590-0023	407	6.40	89	991
J-590-0047	433	0.00	71	993
J-590-0312	361	5.07	111	994
J-590-0076	360	7.17	111	996
J-590-0091	308	0.00	135	997
J-590-0046	433	4.81	71	997
J-590-0333	431	5.34	67	998
J-590-0187	381	0.00	88	1,003
J-590-0186	381	0.00	89	1,003
J-590-0188	376	0.00	91	1,007
J-590-0189	375	0.00	91	1,007
J-590-0885	454	0.00	64	1,008
J-590-0954	492	9.22	50	1,009
J-590-0190	374	0.00	91	1,010
J-590-0242	426	0.00	75	1,015
J-590-0307	374	5.55	91	1,016
J-590-1058	376	3.44	100	1,018
J-590-0243	417	0.00	78	1,020
J-590-1047	408	0.00	83	1,024
J-590-0330	429	2.81	68	1,027
J-590-1048	402	0.00	85	1,028
J-590-0332	429	4.66	68	1,029
J-590-1049	402	0.00	85	1,029
J-590-1050	401	0.00	86	1,030
J-590-1052	400	0.00	86	1,031
J-590-0348	373	29.04	92	1,039
J-590-0153	433	0.00	76	1,051
J-590-0177	286	0.00	139	1,064
J-590-0892	408	0.00	85	1,064
J-590-0926	434	0.00	74	1,064
J-590-0179	288	4.38	138	1,068
J-590-0178	287	4.45	138	1,068
J-590-0416	456	0.00	58	1,074
J-590-0420	456	0.00	57	1,079
J-590-0418	458	3.20	57	1,082
J-590-1099	418	0.00	57	1,089
J-590-0882	461	0.00	61	1,093
J-590-0182	407	0.00	87	1,094
J-590-0570	424	0.00	81	1,096

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0421	403	16.93	81	1,096
J-590-0886	461	0.00	61	1,103
J-590-0881	461	0.00	61	1,103
J-590-0884	460	0.00	61	1,103
J-590-0365	422	15.56	81	1,104
J-590-0402	470	0.00	59	1,111
J-590-0936	434	4.09	75	1,127
J-590-0001	491	0.00	50	1,127
J-590-0988	422	0.00	75	1,128
J-590-0880	462	6.11	60	1,131
J-590-0002	489	0.00	50	1,133
J-590-0369	485	0.00	52	1,137
J-590-0403	489	0.00	51	1,140
J-590-0645	456	5.12	65	1,142
J-590-0676	490	0.00	51	1,144
J-590-1051	422	10.53	77	1,145
J-590-0452	320	0.00	124	1,146
J-590-0675	478	0.00	56	1,149
J-590-1233	492	0.00	46	1,149
J-590-0516	485	14.11	52	1,151
J-590-0986	459	0.00	57	1,152
J-590-1232	491	3.05	46	1,152
J-590-0419	459	2.04	57	1,153
J-590-0133	392	0.00	94	1,156
J-590-0366	445	0.00	71	1,156
J-590-0132	445	0.00	71	1,156
J-590-0777	478	4.35	56	1,158
J-590-0405	446	0.00	71	1,158
J-590-0404	446	0.00	71	1,159
J-590-0696	446	0.00	71	1,159
J-590-0693	445	0.00	71	1,161
J-590-1234	493	0.00	46	1,161
J-590-0692	446	0.00	71	1,163
J-590-0694	445	0.00	71	1,163
J-590-0695	446	0.00	71	1,164
J-590-0451	318	0.00	125	1,168
J-590-0928	452	0.00	63	1,171
J-590-1229	494	0.00	45	1,173
J-590-0674	472	0.00	58	1,177
J-590-0532	471	0.00	59	1,181
J-590-0805	476	1.39	54	1,185
J-590-0361	430	0.00	78	1,185
J-590-0453	308	0.00	130	1,187
J-590-0839	477	10.22	54	1,188
J-590-0706	491	0.00	47	1,198
J-590-1225	497	0.00	44	1,198
J-590-1231	494	0.00	45	1,200
J-590-1226	496	0.00	45	1,200

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0362	410	0.00	87	1,202
J-590-0908	309	0.00	131	1,203
J-590-0647	360	0.00	97	1,207
J-590-0646	360	0.00	97	1,208
J-590-0627	360	7.07	97	1,208
J-590-1230	495	6.47	45	1,208
J-590-0474	369	0.00	101	1,210
J-590-1340	359	0.00	97	1,211
J-590-1341	358	0.46	98	1,213
J-590-1113	413	0.00	81	1,214
J-590-1342	356	0.00	99	1,218
J-590-0370	437	0.00	73	1,218
J-590-1343	357	0.00	99	1,219
J-590-0280	438	4.91	73	1,223
J-590-0907	301	0.00	135	1,225
J-590-0649	358	0.00	98	1,225
J-590-0577	385	0.00	93	1,227
J-590-0927	449	0.00	64	1,230
J-590-0945	419	13.39	82	1,232
J-590-0454	318	0.00	125	1,233
J-590-0648	358	12.55	98	1,235
J-590-0541	465	0.00	56	1,237
J-590-0079	475	0.00	54	1,239
J-590-0913	475	0.00	53	1,240
J-590-0914	475	0.00	53	1,240
J-590-0960	448	4.35	71	1,241
J-590-0193	475	0.00	54	1,241
J-590-0192	475	0.00	54	1,241
J-590-0298	476	0.00	53	1,242
J-590-0259	476	0.00	53	1,242
J-590-0191	473	1.76	55	1,243
J-590-0683	368	0.00	94	1,250
J-590-0363	331	0.00	121	1,252
J-590-1344	370	0.00	93	1,253
J-590-0342	326	0.00	123	1,254
J-590-0628	371	0.00	92	1,254
J-590-0930	445	0.00	66	1,267
J-590-0531	455	1.49	66	1,267
J-590-0256	457	0.00	60	1,268
J-590-0321	344	0.00	112	1,268
J-590-0932	456	0.00	62	1,268
J-590-0918	453	0.00	62	1,269
J-590-0543	477	0.00	51	1,269
J-590-0920	451	0.00	63	1,270
J-590-0547	461	0.00	58	1,272
J-590-0107	461	6.80	63	1,273
J-590-0258	452	12.17	63	1,273
J-590-1212	303	0.00	134	1,274

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0106	456	8.22	65	1,274
J-590-0546	462	3.70	57	1,274
J-590-0931	457	0.00	62	1,277
J-590-0540	474	0.00	52	1,277
J-590-0542	474	0.00	52	1,279
J-590-1144	311	0.00	128	1,281
J-590-1098	416	0.00	57	1,281
J-590-0915	416	0.00	80	1,283
J-590-0916	415	0.00	80	1,283
J-590-0917	415	0.00	80	1,283
J-590-0984	444	0.00	67	1,283
J-590-0985	447	0.00	66	1,283
J-590-0281	468	21.71	59	1,284
J-590-0081	432	2.09	72	1,285
J-590-0108	438	0.00	73	1,285
J-590-0252	440	5.17	68	1,286
J-590-0343	328	0.00	122	1,287
J-590-0082	417	4.78	79	1,287
J-590-0924	414	4.81	80	1,288
J-590-0109	438	0.00	73	1,288
J-590-0539	313	0.00	128	1,290
J-590-0663	396	11.88	89	1,290
J-590-0110	438	5.31	73	1,290
J-590-0923	417	14.67	79	1,293
J-590-0919	454	0.00	62	1,297
J-590-1211	305	1.49	133	1,299
J-590-0078	452	0.00	63	1,305
J-590-0662	397	0.00	89	1,309
J-590-1120	408	7.29	84	1,321
J-590-0835	357	0.00	110	1,322
J-590-0661	397	0.00	89	1,322
J-590-0538	315	0.00	127	1,323
J-590-0548	402	0.00	84	1,327
J-590-0320	306	0.00	128	1,328
J-590-0319	306	0.00	128	1,329
J-590-0077	448	0.00	65	1,330
J-590-0359	348	8.82	111	1,330
J-590-0323	305	0.00	128	1,330
J-590-0335	291	0.77	134	1,331
J-590-0473	305	3.44	129	1,334
J-590-0472	297	3.49	132	1,334
J-590-0637	386	0.00	93	1,334
J-590-0634	386	0.00	93	1,335
J-590-0635	386	0.00	93	1,335
J-590-0346	362	0.00	107	1,336
J-590-0632	386	0.00	93	1,336
J-590-0659	396	0.00	89	1,336
J-590-0660	397	0.00	89	1,336

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0806	457	0.00	62	1,339
J-590-0336	290	13.08	135	1,339
J-590-0550	404	0.00	83	1,339
J-590-0527	390	0.00	93	1,340
J-590-0549	404	0.00	83	1,341
J-590-0360	335	19.62	116	1,341
J-590-0921	446	0.00	66	1,342
J-590-0636	386	8.13	93	1,342
J-590-0633	386	6.95	93	1,343
J-590-0911	364	0.00	105	1,344
J-590-0910	363	0.00	106	1,344
J-590-0094	362	0.00	106	1,347
J-590-0095	362	0.00	106	1,347
J-590-0537	335	0.00	118	1,347
J-590-0684	346	0.00	113	1,347
J-590-0685	346	0.00	113	1,347
J-590-0686	350	0.00	112	1,347
J-590-0785	359	0.00	108	1,347
J-590-0358	374	3.99	100	1,348
J-590-0338	290	18.30	135	1,349
J-590-0357	374	3.63	100	1,349
J-590-0630	381	0.00	95	1,350
J-590-0585	381	0.00	95	1,351
J-590-0584	381	0.00	95	1,352
J-590-0337	290	23.35	135	1,354
J-590-0631	381	4.18	95	1,355
J-590-0582	380	0.00	95	1,355
J-590-0583	380	0.00	95	1,355
J-590-0581	380	0.00	95	1,356
J-590-0579	380	0.00	95	1,360
J-590-0551	390	0.00	89	1,364
J-590-0322	307	9.38	128	1,365
J-590-0544	389	0.00	89	1,365
J-590-0545	389	0.00	89	1,367
J-590-0707	390	0.00	89	1,367
J-590-0929	439	0.00	68	1,367
J-590-0838	456	19.02	63	1,372
J-590-0552	391	0.91	89	1,373
J-590-0021	430	0.00	76	1,374
J-590-0345	350	0.00	113	1,374
J-590-0625	373	0.00	92	1,380
J-590-0237	386	0.00	93	1,382
J-590-0236	384	0.00	94	1,382
J-590-0922	438	0.00	69	1,382
J-590-0235	384	0.00	94	1,382
J-590-0893	384	0.00	94	1,382
J-590-1361	373	0.77	92	1,382
J-590-0260	442	0.63	67	1,383

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0238	384	0.00	94	1,383
J-590-0894	384	0.00	94	1,383
J-590-0895	384	0.00	94	1,383
J-590-0124	404	4.54	88	1,384
J-590-0689	354	4.74	110	1,385
J-590-0580	384	2.98	94	1,385
J-590-1276	381	0.00	97	1,386
J-590-0526	384	0.00	95	1,388
J-590-0853	440	0.00	68	1,398
J-590-0409	432	17.82	74	1,400
J-590-0641	386	0.00	93	1,409
J-590-0642	386	0.00	93	1,409
J-590-0643	385	0.00	93	1,409
J-590-0020	430	0.00	76	1,413
J-590-1109	387	6.80	93	1,415
J-590-0774	371	0.00	101	1,420
J-590-0644	385	14.23	93	1,423
J-590-0969	370	3.15	101	1,425
J-590-0111	423	0.00	80	1,431
J-590-0772	370	0.00	101	1,431
J-590-0114	423	0.00	80	1,433
J-590-0115	423	0.00	80	1,435
J-590-0852	440	0.00	68	1,437
J-590-1016	373	0.00	101	1,437
J-590-0773	369	0.00	102	1,439
J-590-0344	335	0.00	119	1,439
J-590-0987	422	0.00	76	1,441
J-590-0989	422	0.00	76	1,441
J-590-0690	447	8.80	68	1,443
J-590-0116	422	0.00	80	1,444
J-590-0859	422	5.12	76	1,444
J-590-0356	440	8.10	68	1,445
J-590-0968	369	0.00	102	1,445
J-590-0112	422	0.00	80	1,446
J-590-0239	384	0.00	94	1,447
J-590-0971	447	13.03	68	1,447
J-590-0113	423	0.00	80	1,448
J-590-0364	334	6.52	120	1,449
J-590-0459	407	0.00	87	1,454
J-590-0181	406	0.00	87	1,459
J-590-0595	423	19.40	75	1,461
J-590-1155	369	9.55	102	1,461
J-590-0778	431	0.00	76	1,462
J-590-0970	443	18.56	70	1,463
J-590-0016	431	0.00	76	1,464
J-590-1079	448	13.22	66	1,470
J-590-0569	433	12.53	77	1,472
J-590-0015	433	0.00	75	1,483

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0898	430	0.00	76	1,484
J-590-0101	367	0.00	103	1,486
J-590-0102	366	0.00	103	1,488
J-590-0775	367	0.00	103	1,491
J-590-1153	366	3.68	103	1,492
J-590-0017	434	0.00	75	1,492
J-590-0614	366	0.00	105	1,494
J-590-0776	366	0.00	103	1,495
J-590-0018	433	0.00	75	1,495
J-590-0897	432	0.00	76	1,495
J-590-1154	367	9.11	103	1,497
J-590-0034	408	5.05	86	1,499
J-590-1148	324	0.55	120	1,500
J-590-0656	385	0.00	94	1,503
J-590-0810	385	0.00	94	1,503
J-590-0811	385	0.00	94	1,503
J-590-1152	366	0.00	103	1,503
J-590-0655	385	5.00	94	1,508
J-590-0019	433	0.00	75	1,508
J-590-1149	325	7.72	120	1,510
J-590-0657	386	8.94	94	1,512
J-590-0713	433	0.00	75	1,513
J-590-0899	431	0.00	76	1,513
J-590-0658	387	2.45	93	1,520
J-590-0668	387	0.00	93	1,523
J-590-0667	387	0.00	93	1,525
J-590-0512	347	1.88	113	1,526
J-590-0666	387	1.88	93	1,528
J-590-0712	433	0.00	75	1,528
J-590-1075	426	0.00	79	1,531
J-590-0458	405	4.09	88	1,544
J-590-0973	389	0.00	93	1,549
J-590-0972	389	0.48	92	1,549
J-590-1018	388	5.24	93	1,554
J-590-0161	404	0.00	89	1,555
J-590-0576	354	17.50	91	1,557
J-590-1339	358	0.00	86	1,560
J-590-0135	406	1.76	87	1,560
J-590-0594	438	10.96	69	1,565
J-590-0951	355	0.00	91	1,591
J-590-1266	451	0.00	64	1,598
J-590-0513	360	1.15	107	1,599
J-590-1151	365	10.39	104	1,603
J-590-1265	451	0.00	64	1,607
J-590-0162	420	0.00	82	1,613
J-590-1280	422	0.00	81	1,613
J-590-1260	350	0.00	93	1,613
J-590-0575	350	1.30	93	1,615

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0030	433	20.85	69	1,615
J-590-0573	356	1.95	91	1,615
J-590-1185	423	2.93	80	1,616
J-590-1150	365	0.00	104	1,616
J-590-0567	450	3.97	68	1,617
J-590-0163	450	0.00	69	1,618
J-590-0574	356	5.60	91	1,619
J-590-0131	265	0.00	150	1,619
J-590-0134	422	9.67	81	1,622
J-590-0007	449	0.00	69	1,634
J-590-1147	333	2.60	116	1,656
J-590-1146	334	0.00	116	1,657
J-590-0387	364	0.00	103	1,658
J-590-1159	422	13.75	77	1,662
J-590-0514	370	1.06	103	1,666
J-590-1237	352	0.00	92	1,676
J-590-1127	388	0.00	89	1,677
J-590-0006	446	2.65	70	1,679
J-590-0555	429	0.00	77	1,698
J-590-0554	430	0.00	77	1,698
J-590-0720	429	0.00	77	1,699
J-590-0719	429	0.00	77	1,700
J-590-1011	377	0.00	98	1,702
J-590-0665	402	27.31	88	1,703
J-590-1009	377	4.54	98	1,705
J-590-1012	378	0.00	98	1,706
J-590-1139	403	0.00	67	1,708
J-590-0626	369	0.00	92	1,708
J-590-1013	378	1.83	98	1,709
J-590-0718	429	14.40	77	1,715
J-590-0629	402	0.00	84	1,719
J-590-1010	377	18.66	98	1,721
J-590-0038	365	12.36	104	1,724
J-590-0754	423	0.00	82	1,727
J-590-0029	431	4.86	71	1,731
J-590-0028	431	0.00	71	1,733
J-590-0027	430	0.00	71	1,736
J-590-0031	430	0.00	71	1,737
J-590-0032	429	0.00	72	1,737
J-590-1128	430	0.00	71	1,738
J-590-0026	430	0.00	71	1,739
J-590-0196	429	0.00	72	1,743
J-590-0963	431	0.00	70	1,746
J-590-1129	423	0.67	74	1,750
J-590-1274	338	0.00	115	1,750
J-590-0381	396	0.00	88	1,752
J-590-0498	412	0.00	79	1,755
J-590-0501	410	0.00	80	1,755

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-1122	396	0.00	86	1,755
J-590-0499	406	0.00	82	1,755
J-590-0500	408	0.00	81	1,755
J-590-0502	411	0.00	80	1,755
J-590-0503	418	0.00	77	1,755
J-590-1121	397	0.00	86	1,755
J-590-1123	396	0.00	86	1,755
J-590-1126	389	0.00	89	1,755
J-590-1078	440	3.46	69	1,756
J-590-1124	389	0.75	89	1,756
J-590-0937	396	3.85	88	1,756
J-590-0301	418	1.01	76	1,756
J-590-0529	422	0.00	82	1,756
J-590-0524	386	2.52	96	1,757
J-590-1125	389	2.09	89	1,757
J-590-0195	433	0.00	70	1,758
J-590-0194	433	0.00	70	1,758
J-590-0382	397	8.61	88	1,761
J-590-0303	427	0.00	73	1,763
J-590-0304	408	0.00	81	1,763
J-590-0305	426	0.00	73	1,766
J-590-0385	338	0.00	114	1,767
J-590-0120	388	0.00	95	1,767
J-590-1132	388	0.00	95	1,767
J-590-1133	387	0.00	95	1,767
J-590-1008	400	11.23	89	1,769
J-590-0879	426	24.84	73	1,771
J-590-1273	337	0.00	115	1,772
J-590-1283	431	0.00	72	1,772
J-590-0299	428	6.37	73	1,773
J-590-0384	337	0.00	115	1,776
J-590-0383	338	0.00	114	1,776
J-590-0104	429	0.00	73	1,778
J-590-0105	429	0.00	73	1,778
J-590-1071	423	0.00	80	1,780
J-590-1072	423	0.00	80	1,780
J-590-1073	423	0.00	80	1,780
J-590-1074	423	0.00	80	1,780
J-590-0302	428	17.41	72	1,780
J-590-0408	395	6.06	90	1,781
J-590-0073	432	0.00	71	1,782
J-590-0072	432	0.00	72	1,783
J-590-0300	429	18.99	72	1,785
J-590-0762	395	0.00	89	1,786
J-590-1070	421	0.53	81	1,786
J-590-1076	439	3.90	69	1,786
J-590-1023	398	0.00	88	1,788
J-590-0717	422	8.05	80	1,788

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0071	430	12.48	72	1,795
J-590-0845	436	0.00	71	1,802
J-590-0843	436	0.00	71	1,803
J-590-0844	435	0.00	71	1,803
J-590-0763	394	0.00	89	1,803
J-590-0847	434	0.00	71	1,803
J-590-0846	434	0.00	71	1,803
J-590-0849	433	0.00	72	1,803
J-590-0851	433	0.00	72	1,804
J-590-1267	428	0.00	74	1,806
J-590-1066	414	0.00	84	1,807
J-590-1068	414	0.00	84	1,807
J-590-1069	414	0.00	84	1,807
J-590-0769	432	3.15	72	1,808
J-590-0721	427	3.65	74	1,810
J-590-1067	413	2.43	84	1,810
J-590-1269	362	0.00	105	1,810
J-590-0037	362	0.00	105	1,810
J-590-0891	415	2.79	83	1,810
J-590-1268	362	0.00	105	1,813
J-590-0324	432	33.54	71	1,815
J-590-0722	393	0.00	90	1,818
J-590-0070	361	0.00	105	1,818
J-590-0848	434	16.47	71	1,819
J-590-0061	398	0.00	91	1,819
J-590-0425	458	0.00	66	1,823
J-590-1263	389	1.47	91	1,824
J-590-1295	403	0.00	86	1,825
J-590-1294	403	0.00	86	1,825
J-590-0725	405	0.00	85	1,827
J-590-0677	406	0.00	85	1,827
J-590-0678	406	0.00	84	1,827
J-590-1095	406	0.00	84	1,827
J-590-0862	403	0.00	86	1,828
J-590-1096	407	0.00	84	1,828
J-590-0836	407	0.00	84	1,828
J-590-0863	404	0.00	85	1,828
J-590-1061	407	0.00	87	1,829
J-590-1063	407	0.00	87	1,829
J-590-1062	407	1.20	87	1,829
J-590-1296	405	0.00	85	1,829
J-590-0864	404	1.27	85	1,829
J-590-1077	398	10.41	88	1,830
J-590-1060	407	0.00	87	1,830
J-590-1293	403	4.66	86	1,831
J-590-1270	401	0.00	86	1,832
J-590-1271	402	0.00	86	1,832
J-590-0412	415	0.00	81	1,833

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-1217	415	0.00	81	1,833
J-590-0005	449	8.68	69	1,835
J-590-0410	378	3.41	97	1,839
J-590-0679	409	13.22	83	1,843
J-590-0807	376	7.84	98	1,843
J-590-1020	433	0.00	73	1,844
J-590-1021	432	0.00	74	1,844
J-590-1222	408	0.00	84	1,844
J-590-1022	413	0.00	82	1,844
J-590-1223	405	0.00	85	1,845
J-590-1015	375	0.00	100	1,845
J-590-0837	415	11.54	81	1,845
J-590-0407	404	0.00	86	1,845
J-590-0065	403	0.00	88	1,847
J-590-1162	409	10.36	83	1,847
J-590-1161	390	4.57	91	1,848
J-590-0411	407	5.05	84	1,849
J-590-0865	404	0.00	86	1,850
J-590-1272	409	13.25	83	1,850
J-590-0057	402	0.00	89	1,850
J-590-0074	430	68.31	72	1,850
J-590-1014	376	5.53	100	1,850
J-590-0058	402	0.00	89	1,851
J-590-0866	400	0.00	87	1,852
J-590-0056	402	0.00	89	1,852
J-590-1064	407	23.63	87	1,853
J-590-0840	403	0.00	88	1,853
J-590-0055	402	1.23	89	1,855
J-590-1264	381	0.00	96	1,855
J-590-0062	403	0.00	88	1,855
J-590-0861	381	0.00	96	1,855
J-590-0860	381	0.00	96	1,856
J-590-0063	403	2.16	88	1,856
J-590-0765	381	0.00	96	1,856
J-590-0197	458	0.00	67	1,856
J-590-0059	403	0.00	88	1,856
J-590-0759	381	0.00	96	1,856
J-590-0764	381	0.00	95	1,856
J-590-0767	381	0.00	95	1,856
J-590-0850	433	52.17	72	1,856
J-590-0766	382	0.00	95	1,857
J-590-0388	365	0.00	103	1,859
J-590-0389	366	0.00	103	1,859
J-590-0758	365	2.07	103	1,861
J-590-0768	401	29.57	86	1,861
J-590-0064	402	8.61	89	1,861
J-590-0867	400	9.98	88	1,862
J-590-0394	384	0.00	95	1,863

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0962	436	0.00	68	1,866
J-590-0760	366	8.56	102	1,867
J-590-0393	384	4.57	95	1,867
J-590-0406	392	0.00	92	1,869
J-590-0868	391	0.00	92	1,870
J-590-0888	389	0.00	93	1,870
J-590-0857	390	0.00	92	1,871
J-590-0887	389	0.00	93	1,871
J-590-0869	389	0.00	93	1,871
J-590-0060	404	9.88	88	1,872
J-590-0955	389	0.00	93	1,872
J-590-0824	389	0.00	93	1,872
J-590-0825	390	0.00	93	1,872
J-590-1019	409	28.80	84	1,873
J-590-0871	387	0.00	94	1,873
J-590-1024	388	0.00	93	1,873
J-590-0858	389	0.00	93	1,873
J-590-1094	387	0.00	94	1,873
J-590-0761	382	16.28	95	1,874
J-590-0367	388	0.00	93	1,874
J-590-1093	387	0.00	94	1,874
J-590-0870	386	0.00	94	1,874
J-590-0872	387	0.00	94	1,874
J-590-0681	386	0.00	94	1,874
J-590-0368	386	0.00	94	1,874
J-590-0392	386	0.00	94	1,874
J-590-0682	386	0.00	94	1,874
J-590-0941	389	7.04	93	1,876
J-590-0808	387	0.00	94	1,877
J-590-0440	372	9.47	101	1,877
J-590-0809	386	0.00	94	1,878
J-590-0424	444	27.29	72	1,880
J-590-1007	396	0.00	90	1,883
J-590-0164	446	11.95	71	1,883
J-590-0439	374	1.54	100	1,885
J-590-1358	386	14.91	94	1,890
J-590-0680	406	44.86	85	1,893
J-590-0052	401	0.00	90	1,894
J-590-0460	401	0.00	90	1,896
J-590-0461	401	0.00	90	1,896
J-590-0462	401	0.00	90	1,896
J-590-1017	374	2.28	101	1,899
J-590-0033	401	4.04	90	1,900
J-590-0399	347	0.00	112	1,903
J-590-0398	347	0.00	112	1,904
J-590-0400	348	0.00	112	1,906
J-590-0397	348	0.00	112	1,907
J-590-0396	348	0.00	111	1,907

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0395	348	0.00	112	1,907
J-590-0217	434	0.00	68	1,907
J-590-0354	430	0.00	70	1,907
J-590-0352	434	0.00	68	1,907
J-590-1026	348	0.00	111	1,908
J-590-0401	348	0.00	112	1,908
J-590-1025	348	0.00	111	1,908
J-590-0822	347	0.00	112	1,908
J-590-0823	347	0.00	112	1,908
J-590-0967	347	0.00	112	1,909
J-590-0130	191	0.72	182	1,910
J-590-0053	400	14.31	90	1,910
J-590-0771	325	0.00	120	1,910
J-590-0664	397	29.45	90	1,912
J-590-1193	349	1.92	111	1,912
J-590-0966	347	8.17	112	1,914
J-590-0069	323	0.00	121	1,914
J-590-0770	323	0.00	121	1,914
J-590-0353	435	8.15	68	1,916
J-590-0216	433	17.05	68	1,927
J-590-0609	362	0.00	106	1,928
J-590-0610	361	0.00	107	1,928
J-590-1195	351	0.00	111	1,928
J-590-1196	352	0.00	110	1,929
J-590-1197	352	0.00	110	1,929
J-590-1224	353	0.00	110	1,930
J-590-1090	353	0.00	110	1,930
J-590-1091	353	0.00	110	1,930
J-590-1092	353	0.00	110	1,930
J-590-1194	351	2.16	111	1,930
J-590-1028	354	0.00	109	1,930
J-590-0612	360	0.00	107	1,930
J-590-1027	354	0.00	109	1,930
J-590-0855	354	0.00	109	1,930
J-590-0854	355	0.00	109	1,930
J-590-0611	360	0.00	107	1,931
J-590-0856	354	0.00	109	1,931
J-590-0746	356	0.00	109	1,934
J-590-1037	353	6.73	110	1,936
J-590-1186	362	10.46	106	1,937
J-590-0438	375	0.00	100	1,939
J-590-1198	352	11.35	110	1,941
J-590-0947	360	11.73	107	1,943
J-590-0613	363	0.00	106	1,945
J-590-0747	363	0.00	106	1,945
J-590-0687	362	0.00	106	1,947
J-590-0688	362	0.00	107	1,948
J-590-0748	362	0.00	106	1,948

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0749	362	0.00	107	1,948
J-590-1160	362	0.00	107	1,949
J-590-0491	379	0.00	99	1,949
J-590-0286	378	0.67	99	1,949
J-590-0492	377	0.00	100	1,949
J-590-0437	375	9.86	100	1,949
J-590-0125	397	0.00	91	1,950
J-590-0126	398	0.00	91	1,950
J-590-0129	398	0.00	91	1,950
J-590-1189	359	0.00	108	1,950
J-590-0287	370	6.28	103	1,950
J-590-1038	361	0.00	107	1,951
J-590-1258	361	0.00	107	1,952
J-590-0144	379	0.00	99	1,952
J-590-0965	360	0.00	107	1,952
J-590-0180	398	2.62	91	1,952
J-590-0964	360	0.00	107	1,953
J-590-0599	360	0.00	108	1,954
J-590-0455	403	0.00	89	1,955
J-590-0617	401	0.00	90	1,955
J-590-0145	385	2.72	96	1,955
J-590-1055	396	0.00	92	1,957
J-590-1057	405	0.00	88	1,957
J-590-1056	399	0.00	91	1,957
J-590-0598	359	0.00	108	1,958
J-590-0616	398	0.00	91	1,960
J-590-0950	372	0.00	102	1,961
J-590-1299	202	0.00	177	1,961
J-590-1348	196	0.00	180	1,961
J-590-1355	262	0.00	151	1,961
J-590-1356	279	0.00	144	1,961
J-590-1298	204	0.00	177	1,961
J-590-1347	197	0.00	180	1,961
J-590-1349	194	0.00	181	1,961
J-590-1350	197	0.00	180	1,961
J-590-1351	190	0.00	183	1,961
J-590-1352	189	0.00	183	1,961
J-590-1353	190	0.00	182	1,961
J-590-1354	203	0.00	177	1,961
J-590-0615	401	1.44	90	1,961
J-590-0621	366	0.00	105	1,962
J-590-0622	367	0.00	105	1,962
J-590-0607	364	0.00	106	1,962
J-590-0620	367	0.00	105	1,962
J-590-1256	365	0.00	106	1,962
J-590-1257	366	0.00	105	1,963
J-590-0597	366	0.00	105	1,963
J-590-0561	366	0.00	105	1,963

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0562	367	0.00	105	1,963
J-590-0563	367	0.00	104	1,963
J-590-0601	367	0.00	105	1,963
J-590-0564	368	0.00	104	1,964
J-590-0949	373	0.13	102	1,964
J-590-1187	372	0.00	102	1,964
J-590-0826	369	0.00	104	1,964
J-590-0619	371	0.00	103	1,964
J-590-0618	371	0.00	103	1,964
J-590-0782	372	0.00	103	1,964
J-590-0127	394	0.00	92	1,965
J-590-0121	395	0.00	92	1,965
J-590-0122	395	0.00	92	1,965
J-590-0515	395	0.31	92	1,966
J-590-1043	390	0.00	95	1,966
J-590-1044	389	0.00	95	1,966
J-590-1045	386	0.00	96	1,966
J-590-1177	373	0.00	102	1,966
J-590-1178	374	0.00	102	1,966
J-590-0560	374	0.00	102	1,966
J-590-0559	376	0.00	101	1,966
J-590-0156	387	0.00	96	1,966
J-590-0155	388	0.00	95	1,966
J-590-0157	388	0.00	95	1,966
J-590-0158	390	0.00	95	1,966
J-590-0159	390	0.00	94	1,966
J-590-0154	399	0.00	91	1,966
J-590-0556	400	0.00	90	1,966
J-590-0608	400	0.00	90	1,966
J-590-1089	399	0.00	91	1,966
J-590-1180	379	0.00	99	1,966
J-590-1215	442	0.00	72	1,966
J-590-1179	379	0.00	100	1,966
J-590-1181	379	0.00	99	1,966
J-590-0558	380	0.00	99	1,966
J-590-0557	380	0.00	99	1,966
J-590-0948	372	6.53	103	1,967
J-590-0165	401	0.63	90	1,967
J-590-1328	190	6.73	182	1,968
J-590-0430	404	0.00	89	1,968
J-590-0211	404	0.00	89	1,968
J-590-0428	399	0.00	91	1,968
J-590-0212	403	0.00	89	1,968
J-590-0213	402	0.00	90	1,968
J-590-0427	401	0.00	90	1,968
J-590-0426	402	0.00	90	1,968
J-590-0128	394	3.15	93	1,968
J-590-0054	396	19.07	92	1,969

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0429	405	0.00	89	1,969
J-590-0602	371	0.00	103	1,969
J-590-1188	359	19.33	108	1,969
J-590-0603	371	0.00	103	1,970
J-590-1182	372	0.00	103	1,970
J-590-1136	372	3.78	103	1,970
J-590-0753	370	26.01	102	1,970
J-590-0744	386	6.04	96	1,970
J-590-0123	395	4.71	92	1,970
J-590-0654	403	5.70	89	1,972
J-590-0745	386	6.37	96	1,972
J-590-0160	391	7.36	94	1,974
J-590-0152	390	7.96	94	1,974
J-590-0147	401	0.19	91	1,975
J-590-0209	387	0.00	96	1,975
J-590-1104	395	0.00	93	1,976
J-590-1105	394	0.00	93	1,976
J-590-1106	393	0.00	94	1,976
J-590-1103	393	0.00	94	1,976
J-590-1107	393	0.00	94	1,976
J-590-0604	392	0.20	94	1,977
J-590-1183	373	7.01	102	1,977
J-590-0166	401	10.48	90	1,977
J-590-1206	389	2.38	95	1,977
J-590-0146	391	0.00	95	1,980
J-590-1184	390	0.00	95	1,981
J-590-0210	390	0.00	95	1,982
J-590-0900	375	8.25	82	1,984
J-590-0431	396	0.00	93	1,985
J-590-0432	393	0.00	94	1,987
J-590-0469	394	0.00	94	1,987
J-590-1102	394	0.00	94	1,987
J-590-0148	393	0.00	94	1,987
J-590-0150	389	0.00	96	1,987
J-590-0471	390	0.00	95	1,987
J-590-0596	392	0.00	95	1,987
J-590-0149	392	0.00	95	1,987
J-590-0605	392	0.00	95	1,987
J-590-0606	395	0.00	93	1,988
J-590-1190	377	0.00	101	1,988
J-590-1191	377	0.00	101	1,988
J-590-0289	392	0.00	95	1,989
J-590-1101	390	0.00	95	1,989
J-590-0288	391	0.00	95	1,989
J-590-0729	391	0.00	95	1,989
J-590-0728	390	0.00	96	1,989
J-590-1192	390	0.00	96	1,989
J-590-0727	388	0.00	96	1,989

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-1003	389	0.00	96	1,989
J-590-1004	388	0.00	96	1,989
J-590-1006	389	0.00	96	1,989
J-590-0726	388	0.00	97	1,989
J-590-0730	388	0.00	96	1,989
J-590-1005	388	0.00	97	1,989
J-590-0151	387	6.18	97	1,993
J-590-1085	389	0.00	96	1,993
J-590-0423	454	0.00	68	1,994
J-590-1084	376	0.00	102	1,994
J-590-1281	383	0.00	99	1,994
J-590-1282	380	0.00	100	1,994
J-590-1167	364	0.00	107	1,995
J-590-1168	368	0.00	105	1,995
J-590-0536	353	0.00	92	1,996
J-590-1173	400	0.00	92	1,997
J-590-1169	400	0.00	92	1,997
J-590-1170	393	0.00	95	1,998
J-590-1171	396	0.00	93	1,998
J-590-1172	404	0.00	90	1,999
J-590-1174	403	0.00	91	1,999
J-590-0199	387	0.00	97	2,000
J-590-0467	396	0.00	93	2,000
J-590-0200	390	0.00	96	2,000
J-590-0468	395	0.00	94	2,000
J-590-1175	395	0.00	94	2,000
J-590-0465	387	0.00	97	2,000
J-590-0750	389	0.00	97	2,000
J-590-0751	390	0.00	96	2,000
J-590-0752	392	0.00	95	2,000
J-590-0779	400	0.00	92	2,000
J-590-0786	397	0.00	93	2,000
J-590-0787	389	0.00	96	2,000
J-590-0789	401	0.00	92	2,000
J-590-0957	396	0.00	94	2,000
J-590-0958	399	0.00	92	2,000
J-590-0959	390	0.00	96	2,000
J-590-1080	393	0.00	95	2,000
J-590-0780	400	0.00	92	2,000
J-590-0788	392	0.00	95	2,000
J-590-1083	405	9.86	89	2,000
J-590-1176	393	0.00	95	2,000
J-590-0470	391	13.13	95	2,000
J-590-1209	310	0.00	130	2,000
J-590-1207	311	0.00	130	2,000
J-590-1208	311	0.00	130	2,000
J-590-1210	310	0.00	131	2,000
J-590-1081	390	0.00	96	2,001

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0231	390	0.00	96	2,001
J-590-1145	411	7.33	87	2,002
J-590-0232	394	0.00	95	2,002
J-590-1087	384	0.00	99	2,003
J-590-1166	381	0.00	100	2,004
J-590-1164	381	0.00	100	2,004
J-590-0205	379	0.00	101	2,004
J-590-0206	379	0.00	101	2,004
J-590-0202	379	0.00	101	2,004
J-590-0203	380	0.00	100	2,004
J-590-0204	382	0.00	100	2,004
J-590-0489	383	0.00	99	2,004
J-590-1165	375	0.00	103	2,004
J-590-0757	306	0.00	132	2,004
J-590-1082	408	13.27	88	2,004
J-590-1088	310	0.00	131	2,005
J-590-0201	310	0.00	131	2,005
J-590-0755	303	0.00	134	2,005
J-590-0443	306	0.00	133	2,005
J-590-0781	307	0.00	133	2,005
J-590-0490	304	0.00	134	2,005
J-590-0228	305	0.00	133	2,005
J-590-1042	375	16.33	102	2,005
J-590-0378	311	0.00	131	2,005
J-590-0756	309	0.00	131	2,005
J-590-0377	311	0.00	131	2,005
J-590-0227	307	0.00	132	2,005
J-590-0568	313	0.00	130	2,005
J-590-0441	313	0.00	130	2,005
J-590-1086	282	0.00	143	2,005
J-590-0444	282	0.00	143	2,005
J-590-0670	293	0.00	138	2,007
J-590-0136	292	0.00	139	2,007
J-590-0669	294	0.00	138	2,007
J-590-0198	454	13.30	68	2,008
J-590-0828	303	0.00	134	2,008
J-590-0830	306	0.00	133	2,008
J-590-0466	330	0.00	122	2,008
J-590-0829	326	0.00	124	2,008
J-590-0591	324	0.00	125	2,008
J-590-0906	329	0.00	123	2,008
J-590-0590	327	0.00	124	2,008
J-590-0905	362	0.00	109	2,009
J-590-0589	356	0.00	111	2,009
J-590-0834	360	0.00	109	2,010
J-590-0833	359	0.00	110	2,010
J-590-0956	357	0.00	111	2,011
J-590-1163	357	0.00	111	2,012

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0067	360	0.00	110	2,014
J-590-0820	359	0.00	110	2,014
J-590-0904	359	0.00	110	2,014
J-590-0068	360	0.00	110	2,014
J-590-0588	359	0.00	110	2,014
J-590-0493	360	0.00	110	2,015
J-590-0494	360	0.00	109	2,015
J-590-0517	361	0.00	109	2,015
J-590-0821	376	0.00	103	2,018
J-590-0902	269	0.00	149	2,018
J-590-0653	259	0.00	153	2,021
J-590-0066	360	7.67	110	2,022
J-590-0652	256	5.64	154	2,028
J-590-0277	405	0.00	91	2,029
J-590-0819	404	0.00	92	2,029
J-590-0269	406	0.00	91	2,030
J-590-0818	403	10.92	92	2,040
J-590-1041	380	0.00	103	2,042
J-590-0137	291	48.00	139	2,055
J-590-0268	381	20.82	103	2,063
J-590-0961	403	0.00	94	2,080
J-590-0170	401	0.00	96	2,080
J-590-0169	395	0.00	98	2,083
J-590-0890	407	3.73	93	2,090
J-590-0376	403	14.26	95	2,094
J-590-1097	409	0.00	61	2,200
J-590-0600	372	0.00	91	2,314
J-590-0623	372	0.00	91	2,319
J-590-0624	372	6.68	91	2,325
J-590-1243	359	0.00	93	2,327
J-590-1244	359	0.00	93	2,327
J-590-1245	359	0.00	93	2,327
J-590-1242	359	0.00	93	2,327
J-590-1035	359	0.00	93	2,327
J-590-1130	359	7.26	93	2,334
J-590-1241	359	0.87	93	2,337
J-590-1240	359	0.00	93	2,344
J-590-1301	359	0.00	93	2,353
J-590-1300	358	2.38	93	2,369
J-590-1308	350	0.00	97	2,399
J-590-1307	350	0.00	96	2,403
J-590-1236	350	0.00	96	2,406
J-590-0533	350	0.00	96	2,409
J-590-1303	350	0.00	96	2,410
J-590-1302	350	0.00	96	2,410
J-590-1305	350	0.00	96	2,411
J-590-1304	350	0.00	96	2,413
J-590-0535	350	0.00	96	2,414

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-0534	348	0.00	97	2,437
J-590-1321	395	0.00	68	2,449
J-590-1239	348	0.00	95	2,556
J-590-1238	352	0.00	93	2,635
J-590-1306	353	0.00	92	2,659
J-590-0339	354	0.00	92	2,662
J-590-0457	357	0.00	90	2,662
J-590-1287	356	0.00	91	2,662
J-590-1288	356	0.00	91	2,662
J-590-1290	354	0.00	92	2,662
J-590-1357	355	0.00	91	2,662
J-590-0341	353	0.00	92	2,662
J-590-1135	353	0.00	92	2,662
J-590-1289	354	0.00	92	2,662
J-590-1291	355	0.00	91	2,662
J-590-1292	355	0.00	91	2,662
J-590-0340	353	1.80	92	2,664
J-590-0456	358	7.29	90	2,670
J-590-1034	407	1.47	61	2,789
J-590-0804	378	18.25	78	2,879
J-590-0992	378	3.27	78	2,881
J-590-1134	376	0.00	79	2,884
J-590-1334	376	0.00	79	2,887
J-590-0993	377	0.00	79	2,888
J-590-1333	377	0.00	79	2,888
J-590-1332	377	0.00	79	2,888
J-590-1330	378	0.00	79	2,888
J-590-1331	377	0.00	79	2,889
J-590-1329	377	0.00	79	2,889
J-590-0996	376	0.00	79	2,892
J-590-0994	377	0.00	79	2,895
J-590-0995	377	0.00	79	2,896
J-590-1138	377	12.29	78	2,909
J-590-0990	392	0.00	72	2,910
J-590-0991	392	0.00	72	2,910
J-590-1336	392	0.00	72	2,910
J-590-1337	393	0.00	72	2,910
J-590-1335	389	1.20	73	2,910
J-590-1259	389	1.71	73	2,912
J-590-1033	409	3.25	61	2,937
J-590-1297	389	5.27	73	2,946
J-590-1338	387	8.10	74	2,949
J-590-1199	383	0.00	75	2,971
J-590-1039	383	0.00	75	2,972
J-590-1286	380	0.00	77	2,972
J-590-1285	383	0.58	75	2,973
J-590-1040	391	0.00	72	2,975
J-590-1310	394	0.00	71	2,975

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-590-1309	394	0.00	71	2,975
J-590-1311	394	0.00	71	2,975
J-590-1284	394	0.26	71	2,976
J-590-1202	383	0.00	75	2,977
J-590-1203	384	0.00	75	2,977
J-590-1346	392	0.00	71	2,982
J-590-1261	383	6.20	75	2,986
J-590-1325	402	0.00	65	2,988
J-590-1323	397	0.00	67	3,009
J-590-1204	397	0.00	67	3,011
J-590-1312	391	0.00	71	3,016
J-590-1200	391	0.00	71	3,016
J-590-1205	397	0.00	67	3,016
J-590-1201	395	0.00	69	3,016
J-590-1324	397	0.00	67	3,022
J-590-1326	397	2.31	67	3,024
J-590-1700	405	0.00	116	3,129
J-590-1031	395	0.00	68	3,151
J-590-1262	395	3.94	68	3,152
J-590-1500	405	0.55	116	3,184
J-590-1319	434	2.36	104	3,245
J-590-1313	404	0.00	62	3,247
J-590-1314	405	0.00	62	3,309
J-590-1315	404	0.00	62	3,317
J-590-1032	405	0.00	62	3,318
J-590-1322	401	0.00	64	3,324
J-590-1345	400	0.00	64	3,325
J-590-1279	405	0.00	62	3,336
J-590-1029	401	0.00	64	3,336
J-590-1030	405	0.00	62	3,336
J-590-1701	405	0.00	62	3,336
J-590-1140	430	0.00	105	3,396
J-590-1317	425	0.53	108	3,926
J-590-1141	420	0.00	109	3,939
J-590-1320	420	0.00	109	3,949
Zone 640				
J-640-022	555	0.00	23	103
J-640-028	493	0.00	56	113
J-640-033	492	0.00	56	113
J-640-034	491	0.00	56	113
J-640-042	447	0.00	70	113
J-640-043	448	0.00	69	113
J-640-027	491	9.50	57	122
J-640-065	437	4.06	80	151
J-640-064	438	9.92	80	153
J-640-052	441	22.12	78	159
J-640-046	424	0.00	87	198
J-640-047	424	0.00	87	200

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-640-051	423	0.00	88	213
J-640-050	423	0.00	88	215
J-640-045	424	22.04	87	219
J-640-048	423	5.37	88	222
J-640-049	429	0.00	86	274
J-640-060	429	0.00	86	277
J-640-030	430	0.00	86	283
J-640-029	430	0.00	86	290
J-640-035	476	0.00	66	317
J-640-011	431	0.00	86	317
J-640-012	434	0.00	84	317
J-640-037	434	0.00	84	317
J-640-010	455	0.00	75	317
J-640-038	433	0.00	84	317
J-640-009	431	0.00	85	317
J-640-056	431	0.00	86	317
J-640-008	432	6.66	85	324
J-640-023	555	1.22	34	388
J-640-057	555	0.00	34	397
J-640-058	551	0.42	36	409
J-640-024	550	0.00	36	421
J-640-025	547	3.41	37	425
J-640-007	494	0.00	131	509
J-640-062	492	4.83	61	579
J-640-061	494	0.00	60	582
J-640-063	494	0.00	60	585
J-640-003	497	0.00	59	585
J-640-016	495	0.00	60	585
J-640-017	496	0.00	59	585
J-640-018	508	0.00	54	585
J-640-004	498	0.00	59	586
J-640-015	493	0.59	61	588
J-640-006	499	0.00	58	596
J-640-001	500	0.00	57	609
J-640-002	502	5.09	57	616
J-640-013	518	0.00	50	696
J-640-014	519	0.00	49	735
J-640-020	543	0.00	39	758
J-640-055	427	0.00	89	795
J-640-040	427	9.31	89	808
J-640-005	515	3.61	51	893
J-640-019	519	11.47	50	1,110
J-640-053	518	0.00	50	1,117
J-640-021	513	1.84	52	1,211
J-640-054	463	1.70	73	2,408
J-640-039	455	5.27	77	4,401
J-640-041	446	0.00	81	4,756
J-640-044	449	0.00	80	5,207

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-640-031	446	0.00	81	5,699
J-640-032	462	0.00	74	11,231
Zone 655				
J-655-027	451	0.00	104	43
J-655-028	451	0.00	104	157
J-655-029	519	2.88	75	597
J-655-005	532	0.00	69	624
J-655-004	548	0.00	62	824
J-655-024	393	0.00	129	893
J-655-023	465	2.91	98	895
J-655-025	483	4.41	90	917
J-655-026	492	1.75	86	928
J-655-011	545	5.83	63	931
J-655-017	523	0.00	73	1,122
J-655-014	522	0.00	73	1,129
J-655-013	522	0.00	73	1,133
J-655-012	520	0.00	74	1,137
J-655-006	454	0.00	102	1,141
J-655-007	456	0.00	102	1,141
J-655-008	456	0.00	102	1,141
J-655-010	517	0.00	75	1,141
J-655-015	515	0.00	76	1,141
J-655-016	461	0.00	100	1,141
J-655-009	519	0.48	75	1,142
J-655-022	514	5.67	77	1,145
J-655-001	616	0.00	33	1,179
J-655-002	615	0.00	33	1,179
J-655-003	616	0.00	32	1,180
J-655-021	614	4.17	33	1,181
J-655-020	617	0.00	32	1,186
J-655-019	618	0.00	32	1,188
Zone 660				
J-660-043	476	0.00	83	147
J-660-182	426	0.00	103	193
J-660-117	519	0.00	57	535
J-660-229	465	0.00	81	686
J-660-175	469	8.39	80	704
J-660-234	543	0.00	46	714
J-660-123	541	0.00	47	717
J-660-235	540	0.00	48	717
J-660-174	526	0.00	57	741
J-660-072	470	6.64	79	750
J-660-116	512	6.47	60	768
J-660-124	543	2.84	46	808
J-660-152	540	4.42	47	814
J-660-073	478	17.24	76	858
J-660-233	394	0.00	112	861
J-660-139	511	0.00	61	884

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-660-018	458	14.26	83	901
J-660-149	525	7.96	54	926
J-660-090	495	2.84	68	926
J-660-103	485	3.68	75	949
J-660-019	424	0.00	98	958
J-660-115	470	1.88	78	959
J-660-069	396	0.00	110	962
J-660-068	421	2.48	99	965
J-660-070	431	11.35	95	974
J-660-006	514	0.00	60	998
J-660-238	465	0.00	80	1,016
J-660-236	464	0.00	80	1,016
J-660-237	460	0.00	82	1,016
J-660-232	465	8.44	80	1,025
J-660-023	438	0.00	92	1,050
J-660-021	453	0.00	86	1,053
J-660-005	507	3.61	63	1,057
J-660-089	484	11.08	73	1,060
J-660-003	484	0.00	73	1,079
J-660-091	405	20.12	106	1,085
J-660-004	484	0.00	73	1,090
J-660-141	554	16.47	42	1,092
J-660-223	484	12.43	73	1,114
J-660-035	513	4.30	60	1,159
J-660-122	406	0.41	106	1,174
J-660-121	403	0.00	107	1,181
J-660-120	403	5.65	107	1,189
J-660-022	405	19.33	106	1,203
J-660-150	479	1.44	74	1,230
J-660-044	455	0.00	92	1,273
J-660-050	397	0.00	111	1,276
J-660-125	519	3.80	57	1,282
J-660-036	521	0.00	56	1,290
J-660-126	521	2.50	56	1,293
J-660-227	445	2.91	90	1,297
J-660-048	441	0.00	92	1,337
J-660-186	442	8.78	92	1,343
J-660-020	437	12.48	92	1,430
J-660-049	415	2.77	103	1,437
J-660-051	436	3.17	93	1,452
J-660-058	434	7.89	94	1,456
J-660-059	414	17.72	104	1,457
J-660-230	472	0.00	78	1,461
J-660-108	514	0.00	60	1,468
J-660-228	412	2.48	104	1,666
J-660-119	507	0.00	63	1,673
J-660-140	507	11.47	63	1,675
J-660-212	451	0.00	89	1,679

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-660-052	443	7.62	90	1,696
J-660-031	474	4.47	77	1,721
J-660-153	506	0.00	63	1,737
J-660-172	436	7.50	94	1,830
J-660-218	473	2.86	78	1,845
J-660-133	472	0.00	78	1,881
J-660-085	472	3.53	78	1,895
J-660-132	472	5.87	78	1,897
J-660-118	505	0.00	63	1,908
J-660-017	498	1.54	67	1,933
J-660-105	505	0.00	64	1,945
J-660-102	460	10.94	85	1,962
J-660-159	459	0.00	86	1,991
J-660-061	423	0.00	105	1,991
J-660-062	423	0.00	105	1,991
J-660-207	479	0.00	75	1,992
J-660-179	423	0.00	105	1,993
J-660-180	424	1.90	105	1,995
J-660-065	423	5.65	105	1,996
J-660-187	448	0.00	95	2,005
J-660-160	460	12.24	85	2,010
J-660-181	428	1.03	103	2,039
J-660-151	537	13.44	49	2,065
J-660-076	466	0.00	80	2,117
J-660-131	466	2.31	81	2,122
J-660-075	465	3.58	81	2,122
J-660-157	456	0.00	87	2,150
J-660-161	456	0.00	87	2,150
J-660-156	457	0.00	87	2,172
J-660-188	447	0.00	95	2,173
J-660-163	451	7.74	87	2,177
J-660-158	456	0.00	87	2,196
J-660-128	458	7.84	84	2,210
J-660-201	499	0.00	67	2,220
J-660-214	498	0.00	67	2,220
J-660-215	498	0.00	67	2,220
J-660-104	476	0.00	78	2,221
J-660-209	468	0.00	82	2,221
J-660-210	466	0.00	82	2,221
J-660-211	466	0.00	82	2,221
J-660-224	467	0.00	82	2,221
J-660-200	499	2.36	67	2,223
J-660-130	463	2.96	82	2,228
J-660-197	475	7.17	78	2,229
J-660-046	456	16.69	87	2,238
J-660-060	440	0.00	95	2,241
J-660-047	440	1.88	95	2,242
J-660-185	440	0.00	95	2,242

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-660-074	439	0.15	95	2,244
J-660-183	437	0.00	96	2,253
J-660-184	437	0.00	96	2,253
J-660-014	438	4.41	96	2,257
J-660-064	440	1.15	97	2,262
J-660-063	442	8.39	97	2,274
J-660-011	441	0.65	97	2,287
J-660-078	478	15.24	75	2,291
J-660-077	479	0.00	75	2,301
J-660-010	441	0.00	97	2,302
J-660-127	458	0.00	84	2,312
J-660-204	480	0.00	75	2,325
J-660-114	441	0.00	97	2,329
J-660-222	536	0.00	49	2,348
J-660-113	442	0.00	97	2,351
J-660-008	448	1.35	94	2,353
J-660-007	448	1.73	94	2,353
J-660-009	448	6.54	94	2,357
J-660-226	447	0.00	95	2,376
J-660-045	446	1.61	95	2,378
J-660-129	459	8.34	84	2,381
J-660-106	503	0.00	64	2,420
J-660-037	528	3.51	53	2,435
J-660-032	537	0.00	49	2,453
J-660-041	536	0.89	49	2,453
J-660-221	537	3.39	49	2,457
J-660-012	435	0.89	102	2,464
J-660-013	434	0.00	102	2,466
J-660-055	433	0.00	103	2,466
J-660-056	432	0.00	103	2,466
J-660-057	431	0.00	104	2,466
J-660-086	431	0.00	104	2,466
J-660-087	434	0.00	103	2,466
J-660-206	482	0.00	74	2,469
J-660-088	434	3.85	102	2,471
J-660-039	529	0.00	52	2,511
J-660-205	483	1.27	73	2,518
J-660-194	505	0.00	64	2,519
J-660-040	527	4.54	53	2,523
J-660-038	530	5.82	52	2,525
J-660-189	429	0.00	106	2,534
J-660-225	407	0.00	116	2,543
J-660-112	407	0.00	116	2,544
J-660-190	407	2.00	115	2,545
J-660-111	415	0.00	112	2,546
J-660-192	502	0.00	65	2,633
J-660-167	456	0.00	84	2,694
J-660-166	456	0.00	84	2,720

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-660-169	457	0.00	83	2,728
J-660-168	457	0.00	83	2,748
J-660-191	456	0.00	84	2,778
J-660-066	457	0.00	83	2,780
J-660-170	500	0.00	66	2,832
J-660-143	468	0.00	79	2,859
J-660-042	470	0.00	78	2,877
J-660-171	500	0.00	66	2,888
J-660-195	501	0.00	66	2,890
J-660-033	516	8.92	58	2,891
J-660-193	500	0.00	66	2,896
J-660-198	499	0.00	67	2,908
J-660-199	499	0.00	67	2,908
J-660-203	499	0.00	67	2,909
J-660-202	499	0.00	67	2,909
J-660-213	498	0.00	67	2,909
J-660-196	517	1.42	59	2,943
J-660-154	517	0.00	59	2,946
J-660-155	517	0.89	59	2,949
J-660-138	508	0.00	63	3,015
J-660-164	506	0.00	64	3,015
J-660-165	506	0.00	64	3,015
J-660-107	508	5.51	63	3,021
J-660-208	506	7.62	64	3,023
J-660-220	490	7.74	70	3,347
J-660-100	444	0.00	90	3,397
J-660-101	444	0.00	90	3,401
J-660-173	444	8.73	90	3,404
J-660-134	443	0.00	91	3,410
J-660-137	443	9.76	91	3,412
J-660-135	442	0.00	91	3,416
J-660-136	441	0.00	91	3,445
J-660-084	441	0.00	92	3,450
J-660-082	441	0.00	92	3,460
J-660-081	439	0.00	92	3,499
J-660-083	439	0.00	92	3,510
J-660-030	460	1.49	83	3,519
J-660-110	440	8.54	92	3,529
J-660-162	452	0.00	86	3,532
J-660-142	404	0.00	61	3,752
J-660-109	454	0.00	86	3,987
J-660-093	455	0.00	85	3,999
J-660-094	455	0.00	85	4,001
J-660-097	454	0.00	86	4,006
J-660-095	454	0.00	86	4,006
J-660-096	455	0.00	85	4,056
J-660-001	457	0.00	84	4,119
J-660-002	458	0.00	84	4,129

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-660-099	457	0.00	84	4,139
J-660-098	458	3.05	84	4,152
J-660-092	456	5.22	85	4,396
J-660-216	457	0.00	85	4,415
J-660-217	456	6.04	85	4,444
J-660-029	521	0.00	57	4,507
J-660-079	457	1.73	84	4,513
J-660-080	463	2.77	82	4,637
J-660-219	477	3.27	76	4,859
J-660-016	480	2.09	75	4,903
J-660-015	480	8.32	74	4,910
J-660-071	510	0.00	62	4,953
J-660-034	513	8.99	60	5,424
J-660-026	512	5.24	61	5,438
J-660-027	525	0.00	55	6,146
J-660-028	523	0.00	56	6,218
J-660-024	521	0.00	57	6,265
J-660-025	530	4.02	53	7,356
Zone 675-A				
J-675-013	538	0.00	29	357
J-675-022	524	0.00	35	392
J-675-004	481	0.00	55	452
J-675-033	491	0.00	86	997
J-675-032	520	14.21	74	1,022
J-675-034	500	9.33	83	1,035
J-675-057	496	1.42	84	1,059
J-675-017	512	7.45	77	1,282
J-675-014	513	27.88	77	1,298
J-675-011	531	3.89	69	1,341
J-675-012	531	23.97	69	1,356
J-675-003	481	5.27	91	1,378
J-675-002	481	0.00	91	1,382
J-675-001	482	0.00	91	1,392
J-675-047	486	0.00	89	1,408
J-675-023	524	0.00	72	1,549
J-675-018	531	16.76	69	1,554
J-675-029	524	0.00	72	1,566
J-675-056	523	10.20	72	1,576
J-675-016	524	24.68	72	1,611
J-675-030	523	17.87	72	1,615
J-675-019	540	0.00	65	1,680
J-675-010	540	0.11	66	1,701
J-675-009	538	2.18	66	1,857
J-675-054	502	0.00	82	1,867
J-675-031	538	0.74	66	1,891
J-675-015	555	10.57	59	2,080
J-675-007	554	1.79	59	2,177
J-675-008	556	0.00	58	2,279

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-675-025	561	0.00	57	3,394
J-675-024	561	0.00	57	3,627
J-675-055	561	0.00	57	3,800
J-675-035	561	0.00	57	4,007
J-675-049	557	27.43	59	5,226
J-675-048	558	0.00	58	5,719
J-675-006	558	0.00	58	6,190
J-675-027	559	0.00	58	8,436
J-675-028	559	0.00	58	10,160
J-675-005	564	0.00	55	14,037
Zone 675-B				
J-675-059	555	0.00	52	79
J-675-074	537	2.45	60	96
J-675-058	560	0.00	50	303
J-675-021	559	0.00	50	451
J-675-066	566	0.00	47	885
J-675-053	567	0.00	47	887
J-675-052	567	0.00	47	887
J-675-050	566	0.00	48	888
J-675-064	499	0.00	77	903
J-675-065	496	0.00	78	906
J-675-063	493	3.47	79	909
J-675-062	496	9.44	78	913
J-675-061	498	3.95	77	925
J-675-040	549	0.00	55	925
J-675-038	549	0.00	55	927
J-675-039	550	0.00	54	928
J-675-041	551	0.00	54	928
J-675-042	551	0.00	54	928
J-675-067	484	0.02	83	944
J-675-060	485	1.77	83	944
J-675-068	480	7.75	85	949
J-675-043	547	0.00	56	956
J-675-046	547	0.00	56	958
J-675-072	547	0.17	56	958
J-675-069	486	2.34	82	958
J-675-073	496	5.68	78	965
J-675-044	537	0.00	60	975
J-675-045	538	0.00	60	975
J-675-070	536	1.53	61	975
J-675-051	542	2.25	58	979
J-675-020	560	3.60	50	1,003
J-675-071	539	0.79	59	1,019
J-675-036	538	0.00	60	1,020
Zone 680				
J-680-024	455	0.00	105	305
J-680-019	574	0.00	54	348
J-680-029	551	0.00	64	348

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-680-030	548	0.00	65	348
J-680-031	575	0.00	53	348
J-680-051	574	0.00	54	348
J-680-018	577	1.92	53	349
J-680-023	457	0.00	105	352
J-680-017	550	0.00	64	353
J-680-016	548	0.00	65	354
J-680-028	548	0.00	65	354
J-680-041	548	0.00	65	354
J-680-003	549	0.37	64	355
J-680-002	540	0.00	68	356
J-680-001	541	0.00	68	356
J-680-049	571	0.00	55	375
J-680-038	571	0.00	55	375
J-680-050	573	1.70	54	375
J-680-044	552	0.00	63	384
J-680-005	526	0.00	74	384
J-680-020	453	0.00	106	384
J-680-021	452	0.00	107	384
J-680-022	461	0.00	103	384
J-680-025	467	0.00	100	384
J-680-026	469	0.00	99	384
J-680-035	470	0.00	99	384
J-680-027	457	0.00	104	384
J-680-006	556	0.00	61	385
J-680-045	550	0.00	64	385
J-680-046	553	0.00	63	385
J-680-048	554	0.00	62	385
J-680-042	526	0.59	74	385
J-680-047	552	0.74	63	385
J-680-043	549	0.90	65	385
J-680-004	456	0.00	105	780
J-680-032	459	0.00	104	780
J-680-037	460	0.00	103	783
J-680-036	452	0.00	106	788
J-680-039	426	0.00	118	806
J-680-040	429	0.00	117	808
J-680-011	414	0.00	123	826
J-680-012	417	0.00	122	826
J-680-013	457	0.00	104	826
J-680-033	440	0.00	112	826
J-680-008	439	0.00	112	827
J-680-007	444	1.81	110	828
J-680-034	439	0.00	60	832
J-680-015	495	0.28	88	894
J-680-014	558	0.52	61	1,030
Zone 715				
J-715-178	591	0.00	54	74

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-327	536	2.45	78	94
J-715-326	535	0.00	78	125
J-715-356	559	0.00	49	482
J-715-355	559	4.02	49	487
J-715-354	546	0.00	55	493
J-715-353	542	0.00	57	494
J-715-357	535	0.00	60	499
J-715-363	541	0.00	61	558
J-715-177	569	0.00	64	561
J-715-364	548	0.00	59	587
J-715-362	539	0.00	63	601
J-715-359	538	0.00	64	602
J-715-358	538	0.00	64	603
J-715-361	551	0.00	60	644
J-715-381	493	0.00	93	683
J-715-360	521	1.35	75	723
J-715-350	603	2.72	46	764
J-715-116	602	10.65	49	787
J-715-115	597	0.00	52	788
J-715-242	597	5.58	52	794
J-715-380	502	0.00	89	819
J-715-139	589	11.11	53	884
J-715-090	583	1.08	57	884
J-715-158	582	11.85	58	891
J-715-289	588	0.00	55	907
J-715-385	502	0.00	86	923
J-715-159	562	12.98	67	928
J-715-052	617	0.00	42	940
J-715-051	617	0.00	42	946
J-715-053	616	0.00	42	947
J-715-301	616	0.00	42	947
J-715-054	615	0.00	42	949
J-715-300	613	0.00	43	952
J-715-382	516	0.00	80	968
J-715-384	517	0.00	80	971
J-715-317	562	1.03	66	980
J-715-092	563	20.15	65	1,006
J-715-163	542	0.00	74	1,022
J-715-162	541	0.00	75	1,023
J-715-161	536	0.00	76	1,030
J-715-160	534	0.00	77	1,032
J-715-324	533	0.00	78	1,034
J-715-203	494	0.00	79	1,037
J-715-268	527	0.00	81	1,049
J-715-267	526	0.00	81	1,051
J-715-106	526	0.00	81	1,053
J-715-164	526	4.14	81	1,057
J-715-105	523	3.44	82	1,058

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-104	514	12.26	86	1,077
J-715-191	582	0.00	57	1,086
J-715-011	527	0.00	80	1,087
J-715-012	527	0.00	80	1,093
J-715-151	527	0.00	80	1,096
J-715-190	580	1.07	58	1,099
J-715-152	528	0.00	80	1,099
J-715-183	545	7.77	74	1,103
J-715-091	527	14.72	81	1,108
J-715-261	578	0.00	57	1,122
J-715-260	578	0.00	57	1,125
J-715-057	578	0.00	57	1,129
J-715-056	579	2.31	57	1,138
J-715-368	477	0.00	100	1,147
J-715-019	495	0.00	95	1,162
J-715-018	495	0.00	95	1,166
J-715-016	498	0.00	94	1,172
J-715-094	574	0.00	61	1,178
J-715-369	478	0.00	100	1,181
J-715-093	573	0.00	61	1,182
J-715-095	572	0.00	62	1,187
J-715-017	498	0.00	94	1,189
J-715-096	570	0.00	62	1,194
J-715-204	499	2.43	94	1,194
J-715-378	479	0.00	99	1,203
J-715-377	482	0.00	98	1,208
J-715-180	535	1.39	79	1,212
J-715-376	485	0.00	96	1,217
J-715-179	534	0.00	79	1,223
J-715-097	564	0.00	65	1,226
J-715-370	488	0.00	95	1,226
J-715-120	495	7.09	95	1,231
J-715-371	492	0.00	94	1,234
J-715-099	563	3.99	65	1,239
J-715-084	534	2.26	79	1,245
J-715-089	579	0.77	59	1,273
J-715-243	548	2.07	72	1,277
J-715-245	550	0.00	71	1,283
J-715-107	523	1.11	82	1,286
J-715-244	544	0.00	74	1,287
J-715-246	545	0.00	73	1,288
J-715-098	544	0.00	74	1,288
J-715-142	543	0.00	74	1,288
J-715-143	542	0.00	75	1,288
J-715-030	541	0.00	75	1,289
J-715-141	543	0.91	74	1,289
J-715-031	539	0.00	76	1,289
J-715-034	534	0.00	78	1,290

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-032	534	0.00	78	1,291
J-715-042	552	0.00	70	1,294
J-715-193	552	0.00	70	1,294
J-715-043	553	0.00	70	1,294
J-715-021	501	2.45	93	1,294
J-715-040	535	5.77	77	1,295
J-715-033	531	4.78	79	1,296
J-715-020	502	1.97	92	1,298
J-715-039	527	0.00	81	1,300
J-715-192	548	1.35	72	1,300
J-715-038	529	0.00	80	1,300
J-715-214	528	0.00	81	1,301
J-715-041	528	1.11	81	1,301
J-715-184	550	0.00	71	1,302
J-715-185	550	0.00	71	1,302
J-715-157	550	0.00	71	1,302
J-715-153	598	0.00	50	1,302
J-715-186	553	0.00	70	1,302
J-715-290	598	0.00	50	1,302
J-715-294	576	0.00	60	1,302
J-715-014	577	0.00	60	1,303
J-715-002	529	0.00	81	1,303
J-715-003	532	0.00	79	1,303
J-715-005	558	0.00	68	1,303
J-715-006	558	0.00	68	1,303
J-715-015	578	0.00	59	1,303
J-715-037	537	0.00	77	1,303
J-715-212	557	0.00	68	1,303
J-715-001	528	0.00	81	1,303
J-715-292	580	0.42	58	1,303
J-715-316	538	0.87	77	1,303
J-715-013	575	1.30	61	1,304
J-715-213	557	1.54	68	1,304
J-715-155	533	0.00	79	1,304
J-715-071	534	0.46	78	1,305
J-715-004	556	2.55	69	1,305
J-715-291	598	3.05	50	1,305
J-715-187	555	3.10	69	1,306
J-715-009	557	0.00	68	1,307
J-715-315	536	4.26	78	1,307
J-715-072	522	0.00	84	1,308
J-715-073	526	0.00	82	1,308
J-715-074	523	0.00	83	1,308
J-715-075	523	0.00	83	1,308
J-715-077	532	0.34	79	1,308
J-715-076	546	0.55	73	1,309
J-715-303	506	0.00	90	1,311
J-715-049	506	0.00	91	1,311

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-050	505	0.00	91	1,311
J-715-047	505	0.00	91	1,311
J-715-136	505	0.00	91	1,311
J-715-048	504	0.58	91	1,312
J-715-137	503	0.00	92	1,312
J-715-135	503	0.00	92	1,313
J-715-134	503	0.00	92	1,313
J-715-028	508	0.00	90	1,313
J-715-069	508	0.00	90	1,313
J-715-083	502	0.00	92	1,313
J-715-046	505	1.49	91	1,313
J-715-133	504	0.00	91	1,313
J-715-010	558	5.18	67	1,313
J-715-070	507	0.91	90	1,313
J-715-205	502	0.96	92	1,314
J-715-029	508	1.06	90	1,314
J-715-126	514	0.65	87	1,315
J-715-130	521	1.03	84	1,315
J-715-124	509	0.00	89	1,315
J-715-129	526	1.30	82	1,315
J-715-128	501	0.48	93	1,315
J-715-311	510	0.00	89	1,315
J-715-312	510	0.00	89	1,316
J-715-181	510	0.00	89	1,316
J-715-313	511	0.00	89	1,316
J-715-132	504	3.01	91	1,316
J-715-082	509	1.13	89	1,316
J-715-304	531	2.33	80	1,316
J-715-127	506	1.92	91	1,316
J-715-182	510	0.79	89	1,316
J-715-314	508	0.00	90	1,316
J-715-309	511	0.00	89	1,317
J-715-310	511	0.00	89	1,317
J-715-125	510	1.42	89	1,317
J-715-007	509	0.70	89	1,318
J-715-081	535	0.00	78	1,319
J-715-307	537	0.00	78	1,319
J-715-080	536	0.00	78	1,319
J-715-305	535	0.00	79	1,319
J-715-199	535	0.00	78	1,319
J-715-067	544	0.00	75	1,320
J-715-215	544	0.00	75	1,320
J-715-216	544	0.00	75	1,320
J-715-308	543	0.00	75	1,320
J-715-023	541	0.00	76	1,320
J-715-022	541	0.00	76	1,320
J-715-131	531	7.93	80	1,320
J-715-066	535	0.99	78	1,320

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-024	547	0.00	73	1,321
J-715-198	548	0.00	73	1,321
J-715-025	548	0.00	73	1,321
J-715-306	534	2.33	79	1,322
J-715-008	532	2.52	80	1,322
J-715-122	549	0.00	73	1,322
J-715-108	523	0.00	82	1,322
J-715-123	503	11.56	92	1,323
J-715-109	523	0.00	82	1,331
J-715-114	544	1.86	73	1,333
J-715-146	536	0.00	79	1,335
J-715-121	536	0.29	79	1,335
J-715-171	535	0.00	80	1,336
J-715-172	535	0.00	80	1,336
J-715-211	518	1.90	83	1,342
J-715-113	524	0.00	82	1,343
J-715-110	523	0.00	82	1,343
J-715-288	512	0.00	90	1,344
J-715-248	511	0.00	90	1,344
J-715-247	511	0.00	90	1,345
J-715-287	511	0.00	91	1,345
J-715-189	506	0.00	93	1,348
J-715-175	506	0.00	93	1,348
J-715-262	506	0.00	93	1,348
J-715-174	506	0.00	93	1,348
J-715-188	506	0.00	93	1,348
J-715-173	506	0.00	93	1,348
J-715-197	505	0.19	93	1,348
J-715-254	504	0.00	94	1,348
J-715-194	505	0.00	93	1,349
J-715-195	506	0.00	93	1,349
J-715-263	505	0.00	93	1,349
J-715-264	505	0.00	93	1,350
J-715-156	521	44.53	84	1,352
J-715-111	515	2.12	86	1,357
J-715-372	496	0.00	92	1,358
J-715-286	519	0.00	83	1,360
J-715-079	484	5.55	98	1,379
J-715-176	545	90.83	74	1,410
J-715-255	532	6.64	77	1,436
J-715-257	421	0.00	125	1,502
J-715-258	416	0.00	127	1,503
J-715-256	423	4.91	124	1,506
J-715-259	400	0.00	134	1,506
J-715-325	397	0.00	135	1,510
J-715-118	395	0.00	136	1,510
J-715-318	397	0.00	135	1,513
J-715-206	598	0.72	49	1,516

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-119	383	8.19	142	1,518
J-715-064	415	0.00	128	1,523
J-715-320	390	0.00	139	1,533
J-715-321	382	0.00	142	1,538
J-715-322	374	0.00	146	1,544
J-715-341	371	0.00	147	1,547
J-715-319	397	34.65	135	1,549
J-715-297	366	0.00	149	1,551
J-715-333	414	0.00	128	1,553
J-715-338	380	0.00	143	1,553
J-715-340	433	0.00	120	1,553
J-715-298	365	0.00	149	1,553
J-715-299	364	0.00	150	1,553
J-715-328	365	0.00	150	1,553
J-715-329	365	0.00	149	1,553
J-715-330	366	0.00	149	1,553
J-715-331	369	0.00	148	1,553
J-715-332	410	0.00	130	1,553
J-715-334	368	0.00	148	1,553
J-715-335	378	0.00	144	1,553
J-715-336	378	0.00	144	1,553
J-715-339	379	0.00	143	1,553
J-715-337	378	0.28	144	1,553
J-715-323	365	0.00	150	1,554
J-715-225	364	0.00	150	1,555
J-715-224	365	0.00	149	1,556
J-715-218	365	0.00	149	1,557
J-715-112	487	1.56	97	1,561
J-715-217	367	0.00	148	1,563
J-715-138	487	6.97	97	1,567
J-715-219	367	0.00	148	1,567
J-715-253	449	0.00	112	1,570
J-715-220	367	3.93	148	1,572
J-715-373	501	0.00	90	1,575
J-715-240	374	0.00	145	1,589
J-715-390	498	0.00	91	1,622
J-715-374	504	0.00	88	1,625
J-715-389	497	0.00	91	1,638
J-715-252	445	0.00	114	1,648
J-715-366	506	0.00	88	1,649
J-715-367	510	0.00	86	1,649
J-715-375	506	0.00	87	1,649
J-715-379	504	0.00	88	1,649
J-715-365	508	2.79	87	1,652
J-715-386	497	0.00	91	1,658
J-715-387	512	0.00	85	1,658
J-715-388	512	0.00	85	1,658
J-715-392	509	0.00	86	1,658

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-500	506	0.00	87	1,658
J-715-239	401	0.00	134	1,663
J-715-238	402	0.00	133	1,665
J-715-237	413	0.00	129	1,698
J-715-279	479	0.00	100	1,699
J-715-236	414	0.00	128	1,699
J-715-280	511	2.07	86	1,701
J-715-235	416	0.00	127	1,702
J-715-234	416	0.00	127	1,703
J-715-383	477	0.00	100	1,706
J-715-102	479	8.70	100	1,708
J-715-233	433	0.00	120	1,743
J-715-232	433	0.00	120	1,745
J-715-278	433	0.00	120	1,749
J-715-342	431	0.00	121	1,751
J-715-391	467	0.00	104	1,755
J-715-062	467	0.00	105	1,771
J-715-036	468	0.00	104	1,771
J-715-085	459	0.00	108	1,771
J-715-086	459	0.00	108	1,771
J-715-087	459	0.00	108	1,771
J-715-088	459	0.00	108	1,771
J-715-147	457	0.00	109	1,771
J-715-148	457	0.00	109	1,771
J-715-149	457	0.00	109	1,771
J-715-207	459	0.00	108	1,771
J-715-208	459	0.00	108	1,771
J-715-209	459	0.00	108	1,771
J-715-210	459	0.00	108	1,771
J-715-249	457	0.00	109	1,771
J-715-251	454	0.00	110	1,771
J-715-250	455	0.00	110	1,771
J-715-059	468	0.00	105	1,771
J-715-103	474	0.12	102	1,771
J-715-035	468	0.07	104	1,771
J-715-058	467	0.05	105	1,771
J-715-283	472	1.95	103	1,773
J-715-061	468	3.05	104	1,774
J-715-271	428	0.00	122	1,782
J-715-230	419	0.00	126	1,790
J-715-231	420	0.00	125	1,794
J-715-277	421	0.00	125	1,795
J-715-276	421	0.00	125	1,796
J-715-272	422	0.00	125	1,800
J-715-273	423	0.00	124	1,810
J-715-275	423	0.00	124	1,815
J-715-274	424	0.00	124	1,816
J-715-269	425	0.00	123	1,821

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-715-270	425	0.00	123	1,823
J-715-150	473	0.00	103	1,856
J-715-223	438	0.00	118	1,860
J-715-222	439	0.00	117	1,862
J-715-065	432	0.00	120	1,863
J-715-221	439	0.00	117	1,863
J-715-226	439	0.00	117	1,863
J-715-295	437	0.00	118	1,863
J-715-296	437	0.00	118	1,863
J-715-229	440	0.00	117	1,865
J-715-063	432	5.24	120	1,869
J-715-227	438	7.43	117	1,871
J-715-284	469	0.00	104	1,877
J-715-302	467	0.00	105	1,877
J-715-228	440	20.15	117	1,881
J-715-285	472	3.63	103	1,886
J-715-282	465	0.00	106	1,892
J-715-241	467	34.84	105	1,926
J-715-170	504	0.00	89	1,945
J-715-055	505	3.80	89	1,949
J-715-169	504	0.00	89	1,952
J-715-281	471	0.00	104	1,961
J-715-101	504	14.45	89	1,969
J-715-045	570	1.49	61	2,112
J-715-078	569	11.61	61	2,122
J-715-196	507	2.52	63	2,434
J-715-165	541	0.00	73	2,463
J-715-168	543	0.00	73	2,464
J-715-167	550	0.00	69	2,468
J-715-100	541	9.95	73	2,469
J-715-068	563	2.19	64	2,470
J-715-166	550	1.71	70	2,470
J-715-140	550	1.76	69	2,470
J-715-044	564	4.62	63	2,471
Zone 750				
J-750-028	654	0.00	55	562
J-750-094	653	3.54	56	564
J-750-029	659	0.00	53	630
J-750-091	660	0.00	53	674
J-750-092	663	0.00	51	889
J-750-031	588	0.00	55	903
J-750-069	653	1.07	56	912
J-750-039	677	3.10	45	914
J-750-040	672	6.36	48	917
J-750-038	678	4.00	45	930
J-750-041	667	0.00	49	938
J-750-021	671	0.00	48	938
J-750-020	673	0.00	47	940

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-750-042	673	0.00	47	940
J-750-025	670	0.00	48	947
J-750-024	669	0.00	49	952
J-750-023	668	0.00	49	959
J-750-022	667	0.00	49	962
J-750-027	668	0.00	49	962
J-750-026	667	0.00	50	977
J-750-037	662	0.00	52	995
J-750-067	663	0.00	51	1,003
J-750-035	664	0.00	51	1,007
J-750-064	663	0.00	51	1,010
J-750-066	664	0.00	51	1,011
J-750-065	663	1.46	51	1,016
J-750-036	663	0.37	51	1,017
J-750-056	657	1.92	54	1,049
J-750-057	658	0.63	53	1,055
J-750-079	659	0.57	53	1,059
J-750-077	660	0.00	53	1,077
J-750-078	660	0.00	53	1,078
J-750-059	660	0.00	53	1,080
J-750-060	660	0.00	53	1,083
J-750-071	660	0.00	53	1,084
J-750-043	641	2.38	61	1,087
J-750-030	641	12.98	61	1,095
J-750-072	660	0.66	53	1,096
J-750-073	660	0.00	53	1,108
J-750-070	660	0.00	53	1,119
J-750-052	659	2.29	53	1,152
J-750-046	576	0.00	60	1,157
J-750-074	647	5.66	58	1,168
J-750-053	651	9.61	56	1,202
J-750-068	656	1.49	54	1,203
J-750-075	656	0.00	54	1,214
J-750-076	657	0.00	54	1,215
J-750-058	657	3.89	54	1,219
J-750-013	655	4.63	55	1,236
J-750-093	631	2.43	65	1,267
J-750-085	628	0.00	66	1,280
J-750-086	628	0.00	67	1,285
J-750-044	627	0.00	67	1,288
J-750-087	626	0.00	67	1,290
J-750-045	626	0.00	68	1,292
J-750-088	626	1.29	68	1,294
J-750-084	620	3.15	70	1,326
J-750-034	560	0.00	67	1,353
J-750-089	605	0.96	76	1,360
J-750-018	604	0.00	77	1,361
J-750-019	604	0.68	77	1,362

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-750-062	611	0.00	74	1,393
J-750-002	612	3.08	73	1,408
J-750-012	645	2.47	59	1,432
J-750-063	640	0.00	61	1,482
J-750-007	640	4.37	61	1,489
J-750-006	639	0.00	62	1,490
J-750-005	637	0.00	62	1,505
J-750-004	636	0.00	63	1,517
J-750-008	636	0.00	63	1,522
J-750-083	600	0.00	79	1,569
J-750-055	599	0.00	79	1,610
J-750-001	630	0.85	66	1,623
J-750-003	630	5.53	65	1,634
J-750-014	583	0.00	86	1,787
J-750-010	584	2.40	86	1,801
J-750-011	584	2.10	86	1,802
J-750-081	585	4.26	85	1,824
J-750-015	588	0.00	84	1,825
J-750-017	588	0.00	84	1,826
J-750-016	588	9.20	84	1,835
J-750-050	588	0.00	84	1,836
J-750-080	584	0.00	86	1,836
J-750-082	583	0.00	86	1,852
J-750-051	588	0.00	84	1,854
J-750-049	581	0.00	87	1,871
J-750-048	581	0.00	87	1,874
J-750-032	588	0.00	84	1,876
J-750-009	606	3.02	76	1,897
J-750-047	578	0.00	88	1,935
J-750-090	600	0.00	79	1,954
J-750-061	600	2.84	78	1,974
J-750-033	563	5.11	95	2,277
Zone 795-1				
J-7951-316	623	0.61	76	52
J-7951-119	493	3.23	131	119
J-7951-103	531	0.39	115	185
J-7951-314	632	0.00	71	268
J-7951-110	692	0.00	46	268
J-7951-102	521	0.00	120	308
J-7951-118	522	0.57	119	325
J-7951-112	678	7.43	52	346
J-7951-304	614	0.00	79	386
J-7951-303	614	0.00	79	389
J-7951-305	595	0.00	87	420
J-7951-302	595	0.00	87	426
J-7951-120	529	0.00	116	448
J-7951-300	583	0.00	93	524
J-7951-126	651	0.00	63	784

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-7951-308	646	0.00	66	924
J-7951-309	645	0.00	66	1,018
J-7951-313	645	0.00	66	1,042
J-7951-315	634	0.00	71	1,380
J-7951-116	610	0.00	81	1,535
J-7951-115	609	0.74	82	1,554
J-7951-114	609	0.00	82	1,559
J-7951-113	608	0.00	82	1,560
J-7951-312	639	0.00	68	1,565
J-7951-106	581	6.05	95	1,603
J-7951-107	574	0.96	99	1,607
J-7951-111	631	0.00	72	1,620
J-7951-318	639	0.00	68	1,634
J-7951-024	553	0.00	109	1,638
J-7951-317	643	0.00	67	1,644
J-7951-127	641	0.00	67	1,645
J-7951-125	640	0.37	68	1,645
J-7951-122	571	0.00	98	1,648
J-7951-121	570	0.00	98	1,648
J-7951-123	535	0.00	113	1,648
J-7951-124	572	0.00	97	1,648
J-7951-301	578	0.00	95	1,648
J-7951-117	644	0.00	66	1,648
J-7951-037	643	0.00	66	1,660
J-7951-306	653	1.31	62	1,698
J-7951-006	644	1.44	66	1,764
J-7951-005	672	1.59	53	2,021
J-7951-052	671	0.00	54	2,071
J-7951-311	672	0.00	54	2,111
J-7951-307	677	1.92	51	2,131
J-7951-310	673	0.13	53	2,137
J-7951-104	678	0.00	51	2,153
J-7951-105	679	0.00	50	2,153
Zone 795-1 Subzone				
J-7951-101	703	0.00	61	57
J-7951-319	721	0.00	53	57
J-7951-010	770	0.00	32	65
J-7951-001	770	0.00	32	65
J-7951-002	768	0.00	33	65
J-7951-003	746	0.00	42	65
J-7951-047	741	0.00	44	65
J-7951-048	742	0.00	44	65
J-7951-049	731	0.00	49	65
J-7951-050	744	0.00	43	65
J-7951-051	743	0.00	44	65
J-7951-108	742	0.00	44	65
J-7951-012	770	0.00	32	65
J-7951-011	769	0.00	32	65

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-7951-022	769	0.00	32	65
J-7951-021	770	0.00	32	65
J-7951-023	716	0.00	55	66
J-7951-013	768	0.35	33	66
J-7951-014	768	0.00	33	67
J-7951-008	773	1.73	31	69
J-7951-009	773	0.00	30	70
J-7951-019	769	0.00	32	73
J-7951-015	775	0.00	30	76
J-7951-018	770	0.00	32	85
J-7951-045	774	0.00	30	310
Zone 795-2				
J-7952-001	725	0.00	33	1,392
J-7952-002	713	0.00	39	1,392
J-7952-003	671	0.00	57	1,392
J-7952-004	648	0.00	67	1,392
J-7952-005	619	0.00	79	1,392
J-7952-006	670	0.00	57	1,392
J-7952-007	667	0.00	59	1,392
J-7952-008	680	0.15	53	1,392
J-7952-009	690	0.41	48	1,392
J-7952-010	729	0.00	32	1,392
J-7952-011	674	0.00	55	1,392
J-7952-012	650	0.48	66	1,392
J-7952-013	675	0.00	55	1,392
J-7952-014	615	0.00	81	1,392
Zone 800				
J-800-001	606	0.00	84	891
J-800-002	605	0.00	84	891
J-800-003	609	0.00	83	891
J-800-004	611	0.00	81	891
J-800-005	609	0.00	82	891
J-800-006	614	0.00	80	891
J-800-007	636	0.00	71	891
J-800-008	738	0.00	27	891
J-800-009	647	0.00	66	891
J-800-010	643	0.00	68	891
J-800-011	640	0.00	69	891
J-800-012	734	0.00	28	891
J-800-013	733	0.00	29	891
J-800-014	681	0.00	51	891
J-800-016	710	0.00	39	891
J-800-018	735	0.00	28	891
J-800-019	736	0.00	27	891
J-800-020	736	0.00	28	891
J-800-021	737	0.00	27	891
J-800-022	612	0.00	81	891
J-800-023	639	0.00	70	891

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-800-024	638	0.00	70	891
J-800-026	639	0.00	70	891
J-800-027	652	0.00	64	891
J-800-028	651	0.00	64	891
J-800-029	637	0.00	70	891
J-800-030	649	0.00	65	891
J-800-031	650	0.00	65	891
J-800-017	731	1.05	29	892
J-800-025	615	1.51	80	892
J-800-015	654	9.94	63	898
Zone 805				
J-805-096	586	2.49	90	606
J-805-028	574	2.32	95	714
J-805-118	571	4.11	97	726
J-805-093	493	0.00	130	738
J-805-094	493	0.00	131	738
J-805-099	493	0.00	131	738
J-805-100	494	0.00	130	739
J-805-048	494	0.00	130	739
J-805-063	479	0.00	137	739
J-805-064	478	0.00	137	739
J-805-075	479	0.00	137	739
J-805-101	495	0.00	130	739
J-805-013	479	0.00	136	739
J-805-014	480	0.00	136	739
J-805-102	495	0.00	129	739
J-805-091	493	3.85	130	742
J-805-117	565	0.57	99	749
J-805-044	519	0.00	119	751
J-805-089	534	0.00	113	751
J-805-038	519	0.26	119	751
J-805-095	519	0.52	119	751
J-805-049	485	12.39	134	751
J-805-116	565	0.00	99	751
J-805-090	539	2.75	110	754
J-805-027	565	0.00	99	755
J-805-119	565	0.00	99	756
J-805-029	565	0.00	99	757
J-805-026	564	1.42	100	758
J-805-092	494	22.87	130	759
J-805-001	557	0.00	103	768
J-805-002	560	0.00	101	768
J-805-037	560	0.00	101	768
J-805-007	557	0.50	103	768
J-805-039	557	2.86	103	770
J-805-043	519	7.32	119	770
J-805-041	544	6.18	108	799
J-805-040	545	7.87	108	802

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-805-042	546	20.19	108	813
J-805-113	657	0.00	61	1,145
J-805-114	649	0.00	64	1,145
J-805-003	476	0.00	139	1,146
J-805-004	479	0.00	137	1,146
J-805-010	601	0.00	85	1,147
J-805-022	646	0.00	65	1,147
J-805-023	654	0.00	62	1,147
J-805-024	654	0.00	62	1,147
J-805-025	646	0.00	65	1,147
J-805-070	605	0.00	83	1,147
J-805-110	646	0.00	65	1,147
J-805-111	655	0.00	61	1,147
J-805-112	657	0.00	61	1,147
J-805-005	497	0.00	130	1,147
J-805-006	497	0.00	130	1,147
J-805-008	475	0.00	139	1,147
J-805-009	584	0.00	92	1,147
J-805-011	603	0.00	84	1,147
J-805-012	476	0.00	139	1,147
J-805-016	476	0.00	139	1,147
J-805-034	579	0.00	94	1,147
J-805-035	494	0.00	131	1,147
J-805-036	492	0.00	132	1,147
J-805-045	497	0.00	130	1,147
J-805-051	494	0.00	131	1,147
J-805-059	570	0.00	98	1,147
J-805-060	596	0.00	87	1,147
J-805-062	590	0.00	90	1,147
J-805-066	577	0.00	95	1,147
J-805-068	608	0.00	82	1,147
J-805-069	630	0.00	72	1,147
J-805-076	492	0.00	132	1,147
J-805-104	630	0.00	72	1,147
J-805-105	610	0.00	81	1,147
J-805-106	610	0.00	81	1,147
J-805-107	609	0.00	81	1,147
J-805-108	628	0.00	73	1,147
J-805-109	628	0.00	73	1,147
J-805-046	497	0.00	130	1,147
J-805-047	496	0.00	130	1,147
J-805-052	493	0.00	132	1,147
J-805-053	493	0.00	131	1,147
J-805-050	524	6.42	118	1,153
J-805-061	491	16.08	132	1,163
J-805-103	549	0.00	107	1,176
J-805-021	579	0.00	95	1,176
J-805-065	575	0.00	96	1,176

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-805-067	571	0.00	98	1,176
J-805-115	652	0.00	63	1,184
J-805-015	522	40.39	119	1,187
J-805-079	644	0.00	66	1,193
J-805-054	525	0.00	118	1,197
J-805-055	495	0.00	131	1,197
J-805-056	527	0.00	117	1,197
J-805-057	540	0.00	111	1,197
J-805-058	542	0.00	110	1,197
J-805-086	649	5.07	64	1,197
J-805-087	646	0.00	65	1,237
J-805-088	652	0.59	63	1,237
J-805-077	690	1.57	46	1,238
J-805-018	706	2.38	39	1,239
J-805-098	646	5.00	65	1,242
Zone 815				
J-815-187	648	0.00	71	206
J-815-193	582	0.22	50	339
J-815-053	717	0.00	43	504
J-815-052	659	4.30	68	576
J-815-173	604	0.00	90	658
J-815-092	703	0.48	47	658
J-815-153	619	11.85	83	675
J-815-051	576	14.64	104	722
J-815-140	626	0.00	80	729
J-815-247	575	7.98	104	730
J-815-143	571	0.00	106	737
J-815-044	568	1.11	108	738
J-815-043	566	0.00	108	740
J-815-213	567	0.00	108	740
J-815-046	568	0.00	108	741
J-815-045	568	0.00	108	749
J-815-142	565	20.65	109	758
J-815-180	609	6.04	89	765
J-815-222	567	0.00	108	766
J-815-131	642	0.00	74	769
J-815-132	642	0.00	75	769
J-815-133	659	0.00	67	769
J-815-134	640	0.00	75	769
J-815-135	641	0.00	75	769
J-815-136	649	0.00	72	769
J-815-137	649	0.00	71	769
J-815-245	639	0.00	76	769
J-815-257	620	0.00	84	769
J-815-258	641	0.00	75	769
J-815-274	652	0.00	70	769
J-815-275	659	0.00	67	769
J-815-276	641	0.00	75	769

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-815-277	644	0.00	74	769
J-815-278	647	0.00	72	769
J-815-279	619	0.00	85	769
J-815-280	618	0.00	85	769
J-815-281	618	0.00	85	769
J-815-179	618	1.15	85	770
J-815-093	706	2.43	46	780
J-815-246	618	15.70	85	784
J-815-221	551	0.00	116	785
J-815-244	658	0.00	67	795
J-815-214	658	0.00	67	796
J-815-243	659	10.24	67	807
J-815-085	583	0.00	98	810
J-815-027	646	0.00	72	811
J-815-102	648	2.81	72	814
J-815-089	646	0.00	71	818
J-815-028	652	7.69	70	818
J-815-033	615	8.82	86	820
J-815-049	559	0.00	113	839
J-815-151	539	3.15	118	839
J-815-150	537	0.87	118	841
J-815-050	597	0.00	96	848
J-815-048	566	0.00	110	848
J-815-047	563	6.80	111	855
J-815-101	614	4.21	86	856
J-815-088	656	0.00	67	879
J-815-032	588	0.00	97	884
J-815-031	586	4.04	98	888
J-815-282	617	0.00	41	924
J-815-015	526	0.00	128	939
J-815-111	515	14.55	133	954
J-815-014	514	21.74	133	961
J-815-090	657	4.83	67	966
J-815-116	560	0.60	60	975
J-815-141	506	0.00	137	999
J-815-054	505	5.00	138	1,011
J-815-055	634	6.68	82	1,012
J-815-021	505	6.83	138	1,012
J-815-098	576	1.49	102	1,013
J-815-099	577	0.00	101	1,015
J-815-236	577	0.00	101	1,015
J-815-100	578	9.71	101	1,029
J-815-148	603	0.00	90	1,050
J-815-147	632	13.78	77	1,065
J-815-083	601	5.00	90	1,083
J-815-013	599	0.00	91	1,086
J-815-091	639	0.36	75	1,092
J-815-149	633	1.71	77	1,158

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-815-190	633	0.00	77	1,167
J-815-215	528	3.08	123	1,169
J-815-216	444	6.04	159	1,172
J-815-191	632	0.00	77	1,173
J-815-152	461	0.00	152	1,178
J-815-194	604	1.32	90	1,222
J-815-192	623	6.68	81	1,236
J-815-114	563	2.60	107	1,253
J-815-237	588	0.00	97	1,290
J-815-208	596	0.00	23	1,306
J-815-062	598	0.00	92	1,346
J-815-209	587	0.00	27	1,389
J-815-212	589	0.00	26	1,410
J-815-154	556	8.97	111	1,410
J-815-069	529	5.87	122	1,434
J-815-301	712	0.00	42	1,436
J-815-186	649	7.02	71	1,478
J-815-242	608	0.94	88	1,493
J-815-302	688	0.00	52	1,495
J-815-303	687	0.00	53	1,496
J-815-001	562	0.00	107	1,497
J-815-012	564	0.00	106	1,497
J-815-138	685	0.00	54	1,497
J-815-139	663	0.00	63	1,497
J-815-171	675	0.00	58	1,497
J-815-305	686	0.00	53	1,497
J-815-087	688	0.00	52	1,501
J-815-103	606	0.00	89	1,512
J-815-104	604	0.00	90	1,512
J-815-241	602	0.00	91	1,512
J-815-002	552	5.55	111	1,537
J-815-146	577	0.00	101	1,575
J-815-263	534	0.00	120	1,595
J-815-115	643	0.00	73	1,604
J-815-225	642	0.00	73	1,635
J-815-227	641	0.00	74	1,635
J-815-118	520	0.36	126	1,699
J-815-117	520	1.80	126	1,702
J-815-177	571	0.00	104	1,723
J-815-178	570	0.00	104	1,723
J-815-228	594	2.81	94	1,749
J-815-203	594	0.00	94	1,768
J-815-204	595	0.00	94	1,771
J-815-202	593	1.78	94	1,772
J-815-205	599	2.14	92	1,788
J-815-229	586	0.00	97	1,838
J-815-230	588	0.00	97	1,838
J-815-211	589	0.00	96	1,839

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-815-231	590	0.00	96	1,843
J-815-198	458	0.00	153	1,846
J-815-030	590	4.76	96	1,851
J-815-210	590	14.74	96	1,853
J-815-061	627	3.37	80	1,874
J-815-109	460	0.00	152	1,879
J-815-175	460	0.00	152	1,880
J-815-004	667	0.00	63	1,885
J-815-003	666	0.00	63	1,886
J-815-018	663	0.00	64	1,891
J-815-174	461	9.14	152	1,894
J-815-009	662	5.07	64	1,897
J-815-108	463	0.00	150	1,903
J-815-020	521	5.29	134	1,907
J-815-005	668	29.72	62	1,908
J-815-064	582	7.67	99	1,926
J-815-206	622	9.64	82	1,931
J-815-200	469	0.00	148	1,939
J-815-022	512	0.00	138	1,939
J-815-201	471	0.00	147	1,945
J-815-019	522	6.95	133	1,946
J-815-105	468	0.00	148	1,951
J-815-106	469	0.00	148	1,951
J-815-107	471	0.00	147	1,951
J-815-145	472	0.00	147	1,951
J-815-176	477	8.01	145	1,959
J-815-026	573	2.09	103	1,969
J-815-068	598	0.00	92	1,981
J-815-158	621	0.00	83	1,982
J-815-067	598	4.50	92	1,985
J-815-261	525	10.87	124	1,987
J-815-029	530	0.43	121	1,989
J-815-262	523	0.00	125	1,993
J-815-025	524	3.90	124	1,997
J-815-008	577	6.28	101	1,999
J-815-269	661	0.00	65	2,010
J-815-273	660	0.00	66	2,013
J-815-084	625	0.00	81	2,022
J-815-268	660	11.71	65	2,025
J-815-071	599	0.00	92	2,026
J-815-063	583	0.82	99	2,026
J-815-072	600	1.47	91	2,027
J-815-073	600	3.01	91	2,032
J-815-007	545	0.00	115	2,036
J-815-006	545	1.15	115	2,037
J-815-199	530	3.80	122	2,075
J-815-011	525	1.08	124	2,078
J-815-037	679	7.74	58	2,106

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-815-144	492	0.60	138	2,130
J-815-016	493	0.00	138	2,133
J-815-010	495	0.00	137	2,138
J-815-024	532	6.20	121	2,139
J-815-017	493	6.90	137	2,140
J-815-036	680	9.02	57	2,159
J-815-253	660	0.00	66	2,160
J-815-155	678	1.37	58	2,163
J-815-256	566	0.00	118	2,180
J-815-074	614	1.06	85	2,193
J-815-238	615	4.11	85	2,196
J-815-038	614	2.79	85	2,205
J-815-023	529	0.00	131	2,231
J-815-056	529	0.00	131	2,245
J-815-057	536	0.00	128	2,255
J-815-232	667	0.00	63	2,269
J-815-070	531	17.09	121	2,271
J-815-058	531	17.55	130	2,285
J-815-097	719	0.00	40	2,294
J-815-251	665	0.00	63	2,329
J-815-233	667	0.00	62	2,329
J-815-197	588	0.00	109	2,334
J-815-255	589	1.52	108	2,335
J-815-196	590	0.00	108	2,336
J-815-195	595	1.59	106	2,342
J-815-259	608	0.00	102	2,380
J-815-260	639	0.00	90	2,409
J-815-169	718	0.00	41	2,417
J-815-170	718	1.56	41	2,420
J-815-075	675	0.00	59	2,473
J-815-182	568	0.00	112	2,473
J-815-223	687	0.00	54	2,479
J-815-207	634	0.00	7	2,482
J-815-234	688	9.18	54	2,484
J-815-224	685	0.96	55	2,485
J-815-270	684	1.25	55	2,487
J-815-157	677	0.00	59	2,487
J-815-235	676	0.00	59	2,487
J-815-156	677	0.00	58	2,487
J-815-217	678	0.00	58	2,488
J-815-220	678	0.79	58	2,488
J-815-218	678	0.00	58	2,488
J-815-219	678	0.00	58	2,488
J-815-189	678	0.00	58	2,488
J-815-188	678	0.00	58	2,488
J-815-035	677	0.75	58	2,490
J-815-034	676	1.18	59	2,498
J-815-163	672	0.00	61	2,507

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-815-165	672	0.00	61	2,507
J-815-166	672	0.00	61	2,507
J-815-164	671	0.91	61	2,509
J-815-167	670	2.31	61	2,509
J-815-126	651	0.00	70	2,517
J-815-162	653	2.91	69	2,519
J-815-125	630	0.00	79	2,528
J-815-160	627	0.00	80	2,528
J-815-161	627	0.00	81	2,528
J-815-267	622	0.00	82	2,528
J-815-124	629	0.00	80	2,528
J-815-123	628	0.00	80	2,528
J-815-159	628	1.59	80	2,529
J-815-129	626	0.00	81	2,529
J-815-059	552	1.06	119	2,546
J-815-060	554	0.00	118	2,554
J-815-248	556	0.00	117	2,560
J-815-181	556	6.32	117	2,560
J-815-249	558	0.00	116	2,565
J-815-250	556	1.11	117	2,589
J-815-184	581	6.92	106	2,699
J-815-076	263	0.00	240	2,733
J-815-127	530	0.00	123	3,218
J-815-128	529	0.00	123	3,219
J-815-119	388	0.00	184	3,276
J-815-065	379	0.00	188	3,279
J-815-066	377	0.00	189	3,280
J-815-122	307	0.00	220	3,320
J-815-121	306	0.00	220	3,321
J-815-120	306	0.00	220	3,322
J-815-113	305	0.00	221	3,323
J-815-112	262	0.07	240	3,446
J-815-077	262	0.00	240	3,447
J-815-078	261	0.00	240	3,447
J-815-079	261	0.00	241	3,447
J-815-081	261	0.00	240	3,447
J-815-080	219	0.00	259	3,548
J-815-239	219	0.00	260	3,548
J-815-240	210	0.00	263	3,553
Zone 835-A				
J-835-003	735	0.00	43	75
J-835-022	482	2.29	151	118
J-835-021	506	0.00	141	129
J-835-048	541	0.00	126	149
J-835-001	713	0.00	52	156
J-835-002	713	8.70	52	163
J-835-050	708	0.00	53	317
J-835-049	705	0.00	54	320

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-835-051	705	0.00	54	320
J-835-052	703	0.00	55	320
J-835-015	675	0.00	67	334
J-835-016	671	0.00	69	334
J-835-060	675	0.00	67	334
J-835-046	669	0.00	69	334
J-835-025	629	0.00	87	334
J-835-034	615	0.00	93	334
J-835-036	662	0.00	72	334
J-835-037	630	0.00	87	334
J-835-038	669	0.00	69	334
J-835-039	662	0.00	73	334
J-835-045	679	0.00	65	334
J-835-063	674	0.00	67	334
J-835-064	633	0.00	85	334
J-835-065	623	0.00	90	334
J-835-066	626	0.00	88	334
J-835-067	629	0.00	87	334
J-835-068	610	0.00	95	334
J-835-070	670	0.00	69	334
J-835-071	658	0.00	74	334
J-835-072	611	0.00	95	334
J-835-073	636	0.00	84	334
J-835-074	643	0.00	81	334
J-835-075	641	0.00	82	334
J-835-017	670	0.46	69	334
J-835-035	674	1.16	67	335
J-835-059	675	1.92	67	335
J-835-058	681	3.10	64	336
J-835-040	631	2.62	86	336
J-835-033	632	3.06	86	336
J-835-057	587	0.00	105	351
J-835-055	585	0.00	106	352
J-835-013	584	0.00	106	352
J-835-056	590	1.86	104	352
J-835-027	592	0.00	103	361
J-835-026	602	2.53	99	363
J-835-069	589	6.14	104	365
J-835-011	581	2.86	108	623
J-835-012	582	7.32	107	639
J-835-007	563	0.00	116	740
J-835-004	595	4.30	103	777
J-835-024	600	1.77	100	869
J-835-005	594	0.00	104	1,108
J-835-020	530	0.00	132	1,109
J-835-019	593	2.29	104	1,113
J-835-018	517	2.93	137	1,343
J-835-014	519	0.00	135	1,354

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-835-008	537	2.34	128	1,383
J-835-006	567	2.29	115	1,440
J-835-054	593	0.87	103	1,672
J-835-053	596	0.00	102	1,677
J-835-042	603	0.00	99	1,690
J-835-041	619	0.72	92	1,719
J-835-030	673	1.14	68	2,058
J-835-031	667	0.00	71	2,115
J-835-032	679	0.00	65	2,281
J-835-010	679	0.00	65	2,314
J-835-023	676	0.00	67	2,314
J-835-009	707	0.33	53	2,646
Zone 835-B				
J-835-047	724	0.00	48	69
J-835-043	720	0.00	50	756
J-835-061	721	0.00	49	756
J-835-044	705	1.58	56	757
J-835-062	723	0.00	49	759
Zone 880				
J-880-007	690	4.08	83	1,021
J-880-006	746	3.98	59	1,129
J-880-005	744	0.00	60	1,134
J-880-012	652	0.00	99	1,134
J-880-004	743	0.00	60	1,141
J-880-003	742	0.00	60	1,148
J-880-013	732	0.00	65	1,244
J-880-014	741	0.00	61	1,781
J-880-009	742	0.00	60	1,782
J-880-011	742	0.00	60	1,814
J-880-010	739	0.00	61	1,814
J-880-002	743	0.00	60	1,902
J-880-008	742	0.00	60	1,902
J-880-001	783	0.00	42	7,985
Zone 910				
J-910-019	726	0.00	47	52
J-910-044	686	9.00	84	64
J-910-020	727	0.00	70	86
J-910-043	720	8.94	71	224
J-910-042	721	0.00	70	237
J-910-041	719	0.00	71	279
J-910-070	733	0.00	33	316
J-910-056	808	6.12	39	692
J-910-034	711	1.18	75	700
J-910-082	694	0.00	82	751
J-910-038	742	2.19	61	764
J-910-029	724	0.00	48	766
J-910-037	711	0.98	75	818
J-910-036	720	0.81	71	828

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-910-033	720	2.08	71	829
J-910-065	732	0.00	33	874
J-910-030	726	0.00	71	895
J-910-017	729	0.00	70	914
J-910-018	727	0.00	70	914
J-910-016	753	7.34	59	1,069
J-910-035	733	0.00	65	1,084
J-910-014	753	9.74	59	1,132
J-910-008	742	0.70	66	1,142
J-910-006	814	3.32	35	1,154
J-910-007	810	12.98	36	1,154
J-910-071	723	0.00	70	1,178
J-910-069	723	0.00	70	1,185
J-910-032	724	4.09	69	1,189
J-910-021	789	5.92	47	1,229
J-910-009	790	2.53	47	1,240
J-910-039	734	4.17	67	1,256
J-910-010	791	1.42	47	1,256
J-910-005	796	0.00	42	1,274
J-910-013	796	0.00	42	1,274
J-910-083	739	3.30	63	1,279
J-910-048	736	0.00	64	1,284
J-910-081	733	0.61	65	1,285
J-910-046	671	10.17	92	1,291
J-910-012	773	0.00	62	1,301
J-910-011	779	0.00	60	1,301
J-910-057	783	0.00	58	1,311
J-910-053	767	0.00	61	1,396
J-910-004	773	3.50	50	1,483
J-910-072	776	0.00	49	1,498
J-910-024	779	1.14	55	1,535
J-910-022	775	1.81	57	1,576
J-910-023	775	5.37	58	1,580
J-910-031	775	2.48	47	1,852
J-910-045	778	0.00	46	1,942
J-910-084	779	0.00	45	2,015
J-910-025	748	1.70	72	2,060
J-910-049	789	2.49	41	2,109
J-910-080	789	0.00	41	2,127
J-910-078	789	0.00	41	2,199
J-910-077	790	0.00	41	2,254
J-910-058	760	3.89	68	2,561
J-910-059	761	0.31	68	2,767
J-910-086	787	0.00	42	3,238
J-910-087	787	4.06	42	3,430
J-910-055	788	0.00	42	3,517
J-910-054	788	0.87	41	3,543
J-910-060	734	0.00	81	5,259

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-910-064	733	0.00	81	5,266
J-910-063	732	0.61	82	5,948
J-910-074	790	0.00	41	6,478
J-910-027	810	0.00	32	6,712
J-910-073	790	0.00	40	6,870
J-910-062	692	0.00	100	13,005
J-910-047	795	0.00	38	13,063
J-910-061	727	0.00	84	14,133
Zone 960				
J-960-0087	673	0.00	76	750
J-960-0090	673	0.00	123	756
J-960-0125	525	0.00	140	988
J-960-0088	674	0.00	122	995
J-960-0079	532	3.91	137	1,071
J-960-0124	551	0.68	128	1,076
J-960-0129	814	0.00	62	1,137
J-960-0077	541	0.00	133	1,141
J-960-0076	540	2.43	133	1,146
J-960-0128	817	0.00	60	1,149
J-960-0127	820	6.01	59	1,156
J-960-0078	550	0.00	129	1,193
J-960-0108	551	0.00	128	1,196
J-960-0126	782	0.00	76	1,204
J-960-0106	845	0.00	48	1,316
J-960-0107	846	0.00	48	1,320
J-960-0123	844	0.87	49	1,320
J-960-0075	846	1.31	48	1,326
J-960-0028	639	1.66	90	1,370
J-960-0109	560	1.73	124	1,405
J-960-0030	768	0.00	82	1,431
J-960-0111	567	3.08	122	1,454
J-960-0074	841	0.00	50	1,474
J-960-0029	836	0.00	52	1,480
J-960-0073	837	0.00	52	1,480
J-960-0026	835	0.00	53	1,486
J-960-0027	609	0.33	103	1,583
J-960-0099	606	2.75	105	1,604
J-960-0011	774	3.80	79	1,677
J-960-0071	722	0.00	101	1,678
J-960-0013	791	0.00	72	1,724
J-960-0110	691	2.01	68	1,757
J-960-0014	772	0.00	80	1,833
J-960-0018	770	0.00	81	1,842
J-960-0019	771	0.00	81	1,842
J-960-0060	764	0.00	84	1,842
J-960-0120	665	0.00	126	1,987
J-960-0010	764	1.44	84	1,989
J-960-0119	665	0.00	126	1,991

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-960-0118	665	0.00	126	2,005
J-960-0121	666	0.00	126	2,008
J-960-0016	744	0.00	92	2,146
J-960-0046	704	0.00	110	2,146
J-960-0049	714	0.00	105	2,146
J-960-0017	732	0.28	98	2,146
J-960-0015	740	0.44	94	2,146
J-960-0050	728	0.74	99	2,147
J-960-0045	730	1.51	98	2,147
J-960-0047	729	1.66	99	2,148
J-960-0037	682	1.11	72	2,153
J-960-0086	680	0.68	72	2,160
J-960-0070	717	0.00	104	2,170
J-960-0048	726	0.00	100	2,170
J-960-0039	679	0.00	73	2,185
J-960-0036	680	1.46	73	2,187
J-960-0038	679	0.00	73	2,188
J-960-0057	674	0.00	75	2,188
J-960-0056	677	1.68	74	2,189
J-960-0131	626	0.98	96	2,242
J-960-0116	645	0.00	135	2,290
J-960-0033	751	1.51	89	2,413
J-960-0130	631	0.31	94	2,452
J-960-0103	631	0.52	94	2,452
J-960-0104	631	0.74	94	2,462
J-960-0100	630	0.48	94	2,469
J-960-0059	703	0.00	110	2,471
J-960-0145	691	2.05	115	2,477
J-960-0101	632	0.00	93	2,496
J-960-0102	635	0.00	92	2,511
J-960-0020	644	2.47	88	2,541
J-960-0147	692	0.59	115	2,542
J-960-0032	746	0.66	91	2,597
J-960-0085	728	1.68	99	2,611
J-960-0053	712	0.00	106	2,653
J-960-0051	712	0.00	106	2,678
J-960-0052	711	0.00	106	2,682
J-960-0054	711	1.33	107	2,683
J-960-0135	688	0.00	117	2,683
J-960-0133	702	0.00	110	2,683
J-960-0134	700	0.00	111	2,683
J-960-0055	704	0.85	110	2,684
J-960-0132	628	0.00	142	2,687
J-960-0042	623	0.00	144	2,687
J-960-0043	620	0.00	146	2,687
J-960-0044	625	0.00	144	2,687
J-960-0113	622	0.00	145	2,687
J-960-0105	626	1.14	143	2,688

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-960-0040	588	1.22	160	2,691
J-960-0069	694	0.55	114	2,706
J-960-0031	744	1.22	92	2,707
J-960-0117	636	0.00	139	2,747
J-960-0140	678	0.00	121	2,757
J-960-0139	689	0.33	116	2,757
J-960-0138	691	0.61	115	2,758
J-960-0007	675	0.00	122	2,845
J-960-0006	675	0.00	122	2,851
J-960-0004	675	0.00	122	2,855
J-960-0005	675	0.00	122	2,855
J-960-0012	677	0.00	121	2,967
J-960-0068	690	0.00	115	2,967
J-960-0141	678	0.00	121	2,967
J-960-0143	690	0.20	115	2,967
J-960-0144	690	0.92	116	2,968
J-960-0142	677	0.00	121	2,975
J-960-0122	643	7.17	136	3,074
J-960-0083	678	0.00	120	3,111
J-960-0146	679	0.00	120	3,111
J-960-0072	679	1.38	120	3,112
J-960-0082	681	0.00	119	3,134
J-960-0035	681	0.00	119	3,136
J-960-0034	709	0.74	107	3,224
J-960-0080	709	0.00	107	3,229
J-960-0081	710	0.00	107	3,229
J-960-0009	711	0.35	106	3,229
J-960-0008	720	0.35	103	3,230
J-960-0084	720	0.83	102	3,230
J-960-0112	709	0.00	107	3,232
J-960-0148	708	0.48	108	3,232
J-960-0058	705	1.68	109	3,234
J-960-0094	684	0.00	118	3,459
J-960-0095	683	7.95	118	3,460
J-960-0024	684	0.00	118	3,466
J-960-0025	682	0.00	119	3,466
J-960-0136	657	0.00	130	3,466
J-960-0137	659	0.00	129	3,466
J-960-0149	673	0.00	123	3,466
J-960-0092	683	0.00	118	3,472
J-960-0093	683	0.00	119	3,479
J-960-0065	683	0.00	118	3,734
J-960-0066	682	0.00	119	3,734
J-960-0067	681	0.00	119	3,734
J-960-0091	684	0.00	118	3,734
J-960-0023	708	4.35	108	3,738
J-960-0001	682	0.00	119	3,746
J-960-0155	683	0.00	119	3,785

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-960-0151	679	0.00	120	3,785
J-960-0152	680	0.00	120	3,785
J-960-0153	682	0.00	119	3,785
J-960-0154	682	0.00	119	3,785
J-960-0002	680	0.00	120	3,793
J-960-0003	680	0.00	120	3,842
J-960-0096	697	0.00	112	4,138
J-960-0097	713	0.00	105	4,294
J-960-0098	718	0.00	103	4,340
J-960-0150	765	0.00	83	4,670
J-960-0062	792	0.00	71	4,918
J-960-0064	865	0.00	40	5,309
J-960-0061	838	0.00	51	5,312
J-960-0063	841	0.00	50	5,318
Zone 1025				
J-1025-216	775	0.00	108	443
J-1025-215	775	0.00	108	495
J-1025-073	739	0.00	26	509
J-1025-074	751	0.00	118	509
J-1025-075	750	0.00	119	509
J-1025-078	783	0.00	104	509
J-1025-079	786	0.00	103	509
J-1025-080	797	0.00	98	509
J-1025-081	808	0.00	93	509
J-1025-082	818	0.00	89	509
J-1025-090	780	0.00	106	509
J-1025-091	897	0.00	55	509
J-1025-092	898	0.00	55	509
J-1025-093	899	0.00	54	509
J-1025-094	898	0.00	54	509
J-1025-095	902	0.00	53	509
J-1025-096	893	0.00	57	509
J-1025-097	863	0.00	70	509
J-1025-099	874	0.00	65	509
J-1025-100	819	0.00	89	509
J-1025-101	815	0.00	90	509
J-1025-102	896	0.00	55	509
J-1025-103	894	0.00	56	509
J-1025-124	741	0.00	122	509
J-1025-125	742	0.00	122	509
J-1025-126	744	0.00	121	509
J-1025-127	745	0.00	121	509
J-1025-162	928	0.00	42	509
J-1025-163	922	0.00	44	509
J-1025-164	901	0.00	53	509
J-1025-165	859	0.00	71	509
J-1025-167	838	0.00	80	509
J-1025-168	858	0.00	72	509

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1025-169	858	0.00	72	509
J-1025-171	835	0.00	82	509
J-1025-172	875	0.00	65	509
J-1025-173	874	0.00	65	509
J-1025-174	893	0.00	57	509
J-1025-175	895	0.00	56	509
J-1025-176	896	0.00	55	509
J-1025-177	801	0.00	97	509
J-1025-179	863	0.00	70	509
J-1025-180	865	0.00	69	509
J-1025-181	875	0.00	65	509
J-1025-182	874	0.00	65	509
J-1025-184	876	0.00	64	509
J-1025-185	897	0.00	55	509
J-1025-098	860	1.20	71	510
J-1025-076	780	1.40	106	510
J-1025-178	859	1.44	72	510
J-1025-077	778	1.92	107	511
J-1025-161	921	0.00	45	512
J-1025-147	918	0.00	46	513
J-1025-183	860	5.42	71	514
J-1025-166	802	8.35	96	517
J-1025-050	922	0.00	44	519
J-1025-170	856	10.66	73	520
J-1025-049	923	0.00	44	520
J-1025-142	923	0.00	44	521
J-1025-144	925	0.00	43	521
J-1025-145	928	0.00	42	521
J-1025-143	927	0.04	42	521
J-1025-146	928	0.00	42	521
J-1025-137	928	0.00	42	523
J-1025-138	929	0.00	41	523
J-1025-141	925	0.00	43	523
J-1025-139	928	0.00	42	525
J-1025-140	929	0.00	41	525
J-1025-063	924	0.00	43	538
J-1025-064	906	0.00	51	541
J-1025-053	877	0.00	64	546
J-1025-048	926	34.61	42	555
J-1025-051	839	0.00	80	556
J-1025-052	839	0.00	80	557
J-1025-160	840	0.00	80	557
J-1025-056	840	0.00	80	557
J-1025-057	841	0.00	80	558
J-1025-060	839	0.00	80	558
J-1025-059	823	0.00	87	564
J-1025-058	816	0.00	90	568
J-1025-054	808	0.00	94	575

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1025-055	787	0.00	103	584
J-1025-066	786	0.00	103	584
J-1025-068	788	0.00	102	585
J-1025-067	796	0.00	99	588
J-1025-069	811	0.00	92	595
J-1025-072	813	0.00	91	595
J-1025-071	815	0.00	91	596
J-1025-070	819	0.00	89	598
J-1025-086	819	0.00	89	598
J-1025-088	819	0.00	89	598
J-1025-087	819	0.00	89	598
J-1025-089	819	0.00	89	598
J-1025-148	824	0.92	87	611
J-1025-008	829	0.00	85	616
J-1025-001	829	0.00	85	617
J-1025-113	795	0.39	99	646
J-1025-002	797	3.89	99	648
J-1025-114	777	0.00	107	659
J-1025-009	703	0.00	139	660
J-1025-010	722	0.00	131	660
J-1025-011	683	0.00	148	660
J-1025-014	654	0.00	160	660
J-1025-015	647	0.00	163	660
J-1025-016	753	0.00	118	660
J-1025-017	741	0.00	123	660
J-1025-018	728	0.00	128	660
J-1025-043	639	0.00	167	660
J-1025-110	776	0.00	108	660
J-1025-111	678	0.00	150	660
J-1025-112	673	0.00	152	660
J-1025-115	778	0.00	107	660
J-1025-116	655	0.00	160	660
J-1025-117	661	0.00	158	660
J-1025-129	726	0.00	129	660
J-1025-136	777	0.00	107	660
J-1025-128	728	0.39	128	660
J-1025-047	644	1.38	165	661
J-1025-065	622	1.64	174	661
J-1025-044	631	2.32	170	662
J-1025-046	789	0.00	102	669
J-1025-045	771	0.00	110	702
J-1025-007	768	0.24	111	705
J-1025-250	771	1.99	110	714
J-1025-214	776	0.00	108	715
J-1025-201	772	0.57	109	715
J-1025-203	776	0.00	108	715
J-1025-213	770	0.00	110	715
J-1025-202	773	2.56	109	717

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1025-212	759	0.15	115	728
J-1025-219	754	0.00	117	733
J-1025-204	753	0.00	118	734
J-1025-205	752	0.00	118	734
J-1025-206	753	0.00	117	737
J-1025-207	754	0.00	117	740
J-1025-208	751	0.00	118	753
J-1025-217	749	0.00	119	762
J-1025-218	748	0.00	119	773
J-1025-211	760	0.00	114	854
J-1025-135	782	0.00	104	901
J-1025-209	770	0.00	109	942
J-1025-210	772	0.00	108	948
J-1025-134	783	0.00	103	963
J-1025-157	784	0.00	103	965
J-1025-133	781	0.00	104	965
J-1025-131	783	0.00	103	966
J-1025-132	784	0.00	103	967
J-1025-019	744	0.00	120	968
J-1025-020	747	0.00	119	968
J-1025-021	770	0.00	109	968
J-1025-022	784	0.00	103	968
J-1025-023	785	0.00	102	968
J-1025-149	738	0.00	123	968
J-1025-150	736	0.00	123	968
J-1025-151	733	0.00	30	968
J-1025-152	723	0.00	129	968
J-1025-153	736	0.00	123	968
J-1025-154	752	0.00	117	968
J-1025-155	754	0.00	116	968
J-1025-156	763	0.00	112	968
J-1025-158	717	0.00	132	968
J-1025-026	787	0.00	102	970
J-1025-159	712	3.65	134	972
J-1025-024	795	0.00	98	984
J-1025-025	809	0.00	92	1,010
J-1025-027	825	0.00	85	1,038
J-1025-028	858	0.00	70	1,073
J-1025-039	863	0.00	68	1,077
J-1025-038	872	0.00	64	1,085
J-1025-035	878	0.00	61	1,125
J-1025-029	863	0.00	68	1,132
J-1025-032	865	0.00	67	1,132
J-1025-033	884	0.00	59	1,132
J-1025-034	883	0.11	59	1,133
J-1025-031	868	0.46	66	1,133
J-1025-030	849	1.57	74	1,134
J-1025-037	889	0.00	57	1,138

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1025-036	892	0.00	55	1,142
J-1025-040	905	0.00	50	1,202
J-1025-041	913	0.00	46	1,229
J-1025-042	918	0.00	44	1,273
J-1025-118	926	0.46	40	1,273
J-1025-130	920	0.00	43	1,276
J-1025-119	930	1.11	38	1,438
Zone 1055				
J-1055-073	591	0.00	93	402
J-1055-072	594	0.00	92	484
J-1055-083	593	0.00	92	655
J-1055-084	595	0.00	214	748
J-1055-001	918	0.00	60	944
J-1055-085	596	0.00	214	949
J-1055-024	915	0.00	61	950
J-1055-093	594	0.00	92	950
J-1055-023	919	0.00	60	972
J-1055-010	929	0.00	55	1,175
J-1055-012	928	0.00	56	1,184
J-1055-094	598	0.00	213	1,212
J-1055-018	920	0.00	59	1,348
J-1055-011	917	0.00	60	1,348
J-1055-025	878	0.00	78	1,674
J-1055-026	875	0.00	79	1,674
J-1055-052	872	0.00	81	1,674
J-1055-053	895	0.00	71	1,674
J-1055-091	581	7.34	97	1,804
J-1055-090	560	0.00	106	1,835
J-1055-074	602	0.00	211	1,900
J-1055-078	600	0.00	212	1,900
J-1055-079	600	0.00	212	1,900
J-1055-075	590	0.00	216	1,908
J-1055-086	589	0.00	217	1,908
J-1055-092	590	0.00	216	1,919
J-1055-070	590	0.00	216	1,921
J-1055-071	576	0.00	223	1,928
J-1055-067	888	0.00	74	1,966
J-1055-066	890	0.00	73	2,122
J-1055-027	889	0.00	74	2,153
J-1055-028	885	0.00	75	2,225
J-1055-029	880	0.00	77	2,389
J-1055-055	880	0.00	77	2,425
J-1055-006	957	0.00	43	2,432
J-1055-002	951	0.00	45	2,447
J-1055-003	948	0.00	47	2,486
J-1055-004	935	0.00	53	2,522
J-1055-005	934	0.00	53	2,527
J-1055-037	929	0.00	55	2,542

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1055-017	930	5.77	55	2,546
J-1055-038	928	0.00	56	2,547
J-1055-054	879	0.66	78	2,576
J-1055-030	879	1.51	78	2,607
J-1055-088	628	0.00	193	2,614
J-1055-087	626	0.00	194	2,623
J-1055-022	626	0.00	194	2,632
J-1055-089	889	1.33	74	2,649
J-1055-039	913	0.00	63	2,684
J-1055-040	911	0.00	63	2,722
J-1055-041	911	1.46	63	2,728
J-1055-031	880	5.70	77	2,742
J-1055-042	915	0.00	62	2,780
J-1055-043	914	0.00	62	2,786
J-1055-044	912	0.00	63	2,799
J-1055-035	911	0.00	63	2,805
J-1055-036	909	0.00	64	2,816
J-1055-032	880	0.63	77	2,879
J-1055-045	909	0.24	64	2,904
J-1055-046	894	0.00	71	2,975
J-1055-069	886	0.00	74	3,026
J-1055-034	873	0.00	81	3,065
J-1055-051	880	0.00	77	3,102
J-1055-049	880	0.00	77	3,127
J-1055-047	880	0.00	77	3,132
J-1055-050	880	0.00	77	3,133
J-1055-048	880	0.00	77	3,136
J-1055-033	866	0.00	84	3,174
J-1055-021	662	0.00	176	3,221
J-1055-057	862	0.00	85	3,224
J-1055-062	875	0.00	80	3,231
J-1055-060	874	2.10	80	3,233
J-1055-056	861	0.00	86	3,240
J-1055-058	862	0.85	85	3,243
J-1055-059	859	0.00	87	3,246
J-1055-061	857	0.00	88	3,258
J-1055-068	868	0.00	83	3,298
J-1055-113	838	6.47	96	3,384
J-1055-114	835	0.00	98	3,398
J-1055-115	761	0.00	131	3,629
J-1055-103	755	0.00	133	3,675
J-1055-104	745	0.00	137	3,675
J-1055-019	753	0.00	134	3,679
J-1055-020	746	0.00	137	3,740
J-1055-102	819	0.00	106	3,740
J-1055-111	750	0.00	135	3,755
J-1055-101	813	0.00	108	3,799
J-1055-116	754	0.00	134	3,810

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1055-105	753	0.00	134	3,836
J-1055-106	752	0.00	135	3,840
J-1055-107	751	0.00	135	3,842
J-1055-118	813	0.00	108	3,842
J-1055-108	754	0.00	134	3,844
J-1055-100	813	0.00	108	3,847
J-1055-099	813	0.00	108	3,851
J-1055-098	715	0.00	151	3,869
J-1055-095	713	0.00	152	3,874
J-1055-096	713	0.00	152	3,877
J-1055-119	715	0.00	151	3,880
J-1055-120	717	0.00	150	3,880
J-1055-097	713	0.00	152	3,880
J-1055-112	711	0.00	153	3,885
J-1055-117	807	0.00	111	3,903
J-1055-110	806	0.00	111	3,908
J-1055-109	806	0.00	111	3,914
Zone 1090				
J-1090-023	722	0.00	158	173
J-1090-022	806	0.00	122	296
J-1090-033	931	2.86	68	408
J-1090-003	806	1.20	122	422
J-1090-030	945	0.00	62	548
J-1090-029	947	1.51	61	549
J-1090-027	942	0.00	63	549
J-1090-028	939	1.14	64	551
J-1090-034	677	3.71	178	557
J-1090-026	893	0.00	84	558
J-1090-031	892	1.79	84	558
J-1090-032	885	0.00	87	559
J-1090-024	886	0.00	87	559
J-1090-035	884	6.23	88	564
J-1090-025	891	6.53	85	564
J-1090-002	792	0.00	128	728
J-1090-039	879	8.52	90	828
J-1090-040	867	0.00	95	847
J-1090-041	768	0.00	138	998
J-1090-001	792	0.00	128	1,025
J-1090-043	655	0.00	188	1,217
J-1090-007	656	0.00	187	1,226
J-1090-008	707	0.00	165	1,351
J-1090-009	712	0.00	163	1,362
J-1090-010	722	0.00	158	1,385
J-1090-042	779	0.00	133	1,595
J-1090-011	783	0.00	132	1,614
J-1090-012	785	0.00	131	1,683
J-1090-013	817	0.00	117	1,956
J-1090-014	821	0.00	115	2,006

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1090-015	824	0.00	114	2,042
J-1090-018	826	0.00	113	2,080
J-1090-016	829	0.00	112	2,148
J-1090-017	831	1.29	111	2,193
J-1090-036	793	0.24	127	2,217
J-1090-037	792	0.00	128	2,217
J-1090-038	792	0.00	128	2,218
J-1090-005	792	0.00	128	2,219
J-1090-006	789	0.00	129	2,219
J-1090-004	825	0.00	114	2,223
J-1090-019	864	1.64	97	2,290
J-1090-046	992	0.00	41	2,936
J-1090-045	996	0.00	39	2,936
Zone 1265-1				
J-12651-101	1082	0.00	78	129
J-12651-100	1090	0.00	75	131
J-12651-087	1104	0.00	68	154
J-12651-019	1172	0.00	39	227
J-12651-106	1098	0.00	71	251
J-12651-105	1099	0.00	70	268
J-12651-020	1171	0.00	40	269
J-12651-102	1103	5.83	69	332
J-12651-010	1137	0.00	54	361
J-12651-103	1110	0.00	66	443
J-12651-008	1137	0.00	54	446
J-12651-022	1172	0.00	39	531
J-12651-024	1171	0.00	40	544
J-12651-184	1172	0.00	39	562
J-12651-086	1099	0.00	71	591
J-12651-083	1100	0.00	70	617
J-12651-104	1116	1.14	63	617
J-12651-302	#N/A	0.00	176	670
J-12651-301	#N/A	0.00	177	684
J-12651-084	1109	0.22	66	690
J-12651-110	984	0.00	120	803
J-12651-109	1050	2.21	92	805
J-12651-170	858	0.00	175	849
J-12651-169	858	0.00	175	871
J-12651-082	1098	0.15	71	891
J-12651-111	1046	2.01	94	912
J-12651-112	1048	0.00	93	916
J-12651-113	1044	1.38	94	917
J-12651-199	1000	5.09	113	991
J-12651-108	1079	0.00	79	1,033
J-12651-164	903	0.46	155	1,035
J-12651-107	1077	0.00	80	1,069
J-12651-130	958	0.00	132	1,086
J-12651-129	957	0.39	132	1,104

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-12651-027	952	0.52	134	1,104
J-12651-165	890	0.00	161	1,118
J-12651-167	842	0.00	182	1,122
J-12651-176	866	0.00	172	1,122
J-12651-096	863	0.00	173	1,122
J-12651-097	862	0.00	173	1,122
J-12651-098	861	0.00	174	1,122
J-12651-166	837	0.00	184	1,122
J-12651-171	857	0.00	176	1,122
J-12651-172	864	0.00	173	1,122
J-12651-175	863	0.00	173	1,122
J-12651-177	859	0.00	175	1,122
J-12651-179	837	0.00	184	1,122
J-12651-303	#N/A	0.00	176	1,122
J-12651-174	857	0.00	175	1,123
J-12651-180	835	0.00	185	1,123
J-12651-181	832	0.00	186	1,124
J-12651-032	841	0.00	182	1,139
J-12651-031	836	0.00	185	1,139
J-12651-033	836	0.00	185	1,139
J-12651-040	831	0.00	187	1,181
J-12651-041	833	0.00	186	1,183
J-12651-085	834	0.00	185	1,184
J-12651-151	809	0.00	196	1,184
J-12651-063	814	0.00	194	1,184
J-12651-064	819	0.00	192	1,184
J-12651-065	814	0.00	194	1,184
J-12651-066	814	0.00	194	1,184
J-12651-067	807	0.00	197	1,184
J-12651-068	807	0.00	197	1,184
J-12651-152	811	0.00	196	1,184
J-12651-157	833	0.00	186	1,184
J-12651-162	814	0.00	194	1,184
J-12651-153	835	0.00	185	1,185
J-12651-155	831	0.00	187	1,185
J-12651-156	830	0.00	187	1,185
J-12651-158	833	0.00	186	1,185
J-12651-160	834	0.00	185	1,185
J-12651-161	810	0.00	196	1,185
J-12651-154	835	0.00	185	1,185
J-12651-122	845	0.00	181	1,195
J-12651-095	853	0.00	177	1,220
J-12651-094	854	0.35	177	1,220
J-12651-124	854	0.00	177	1,221
J-12651-125	857	0.00	176	1,223
J-12651-039	860	0.59	174	1,225
J-12651-037	876	1.35	167	1,248
J-12651-036	883	0.00	164	1,260

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-12651-038	886	0.00	163	1,263
J-12651-035	891	0.28	161	1,267
J-12651-159	952	1.75	134	1,273
J-12651-034	901	0.00	156	1,279
J-12651-007	906	0.00	154	1,284
J-12651-012	913	0.00	151	1,291
J-12651-003	914	0.00	151	1,297
J-12651-017	1133	0.00	165	1,297
J-12651-004	909	0.13	153	1,304
J-12651-117	1133	0.00	56	1,341
J-12651-093	910	0.22	153	1,347
J-12651-127	907	0.00	154	1,348
J-12651-126	909	0.00	153	1,348
J-12651-128	909	0.00	153	1,349
J-12651-168	908	0.00	153	1,353
J-12651-163	912	0.50	152	1,359
J-12651-173	918	0.22	149	1,365
J-12651-009	1133	0.00	56	1,367
J-12651-014	1133	0.00	56	1,367
J-12651-013	1133	0.00	56	1,368
J-12651-116	1135	0.00	55	1,368
J-12651-016	1131	0.46	57	1,368
J-12651-015	1131	1.97	57	1,369
J-12651-132	928	0.00	144	1,376
J-12651-182	929	0.00	144	1,378
J-12651-178	930	0.00	144	1,378
J-12651-133	935	0.33	141	1,383
J-12651-028	947	0.00	137	1,394
J-12651-029	943	0.00	138	1,394
J-12651-030	947	0.00	137	1,394
J-12651-091	944	0.00	138	1,394
J-12651-092	943	0.00	138	1,394
J-12651-131	946	0.00	137	1,394
J-12651-142	946	0.31	137	1,394
J-12651-150	946	0.50	137	1,394
J-12651-137	945	0.00	137	1,396
J-12651-115	1128	0.00	58	1,396
J-12651-135	945	0.00	137	1,402
J-12651-136	945	0.00	137	1,402
J-12651-138	943	0.00	138	1,402
J-12651-140	942	0.00	139	1,402
J-12651-139	941	0.07	139	1,402
J-12651-114	1122	0.26	61	1,415
J-12651-002	954	0.24	134	1,449
J-12651-001	969	0.83	127	1,464
J-12651-186	1112	0.00	65	1,474
J-12651-143	964	0.33	129	1,488
J-12651-054	969	0.00	127	1,518

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-12651-055	972	0.00	126	1,523
J-12651-052	974	0.00	125	1,526
J-12651-051	975	0.00	124	1,530
J-12651-053	978	3.06	123	1,544
J-12651-099	997	0.11	115	1,561
J-12651-185	1105	0.00	68	1,568
J-12651-050	979	0.85	123	1,569
J-12651-080	1105	0.00	68	1,576
J-12651-049	979	0.68	122	1,581
J-12651-079	1106	0.00	68	1,589
J-12651-005	1103	0.00	69	1,591
J-12651-047	1001	1.20	113	1,591
J-12651-006	1099	0.00	71	1,593
J-12651-045	1018	0.00	106	1,596
J-12651-046	1019	0.00	105	1,596
J-12651-048	1019	0.26	105	1,597
J-12651-043	1028	0.00	101	1,597
J-12651-044	1019	1.20	105	1,597
J-12651-042	1034	1.03	99	1,598
J-12651-134	1072	1.11	82	1,598
J-12651-123	1043	1.84	95	1,599
J-12651-078	1105	0.00	68	1,599
J-12651-141	1067	0.00	85	1,599
J-12651-144	1050	0.94	92	1,612
J-12651-081	1098	0.39	71	1,623
J-12651-077	1110	0.00	66	1,640
J-12651-120	1073	0.00	82	1,646
J-12651-121	1074	0.00	81	1,646
J-12651-056	1077	0.00	80	1,646
J-12651-088	1075	0.00	81	1,646
J-12651-119	1072	0.17	82	1,646
J-12651-089	1096	0.00	72	1,664
J-12651-090	1094	0.00	73	1,664
J-12651-146	1095	0.00	73	1,664
J-12651-147	1094	0.00	73	1,664
J-12651-148	1091	0.00	74	1,664
J-12651-057	1087	0.28	76	1,664
J-12651-145	1093	1.51	73	1,679
J-12651-060	1099	0.35	71	1,748
J-12651-059	1101	0.00	70	1,760
J-12651-999	#N/A	0.00	69	1,763
J-12651-058	1102	0.02	69	1,763
J-12651-061	1102	0.00	69	1,766
J-12651-062	1106	0.15	67	1,814
J-12651-075	1105	0.00	68	1,834
J-12651-076	1105	0.00	68	1,834
J-12651-070	1106	0.00	68	1,836
J-12651-069	1107	0.00	67	1,837

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-12651-074	1107	0.00	67	1,837
J-12651-071	1107	0.00	67	1,874
J-12651-073	1108	3.15	67	1,890
Zone 1265-2A				
J-12652-022	851	0.00	45	281
J-12652-031	847	0.00	47	457
J-12652-015	732	0.00	97	595
J-12652-014	727	0.66	99	604
J-12652-012	739	0.00	94	685
J-12652-011	745	0.00	91	702
J-12652-035	853	0.00	44	726
J-12652-036	847	0.00	47	726
J-12652-010	758	1.70	86	739
J-12652-013	762	0.00	84	774
J-12652-025	829	0.00	55	776
J-12652-024	770	1.33	80	790
J-12652-023	778	0.96	77	802
J-12652-017	818	0.50	60	818
J-12652-005	785	0.90	74	842
J-12652-006	797	1.46	69	899
J-12652-018	830	0.00	54	953
J-12652-026	828	0.00	55	956
J-12652-027	827	0.00	55	958
J-12652-033	828	0.00	55	959
J-12652-040	820	0.00	59	959
J-12652-032	827	0.81	55	1,155
J-12652-030	846	0.00	47	1,332
Zone 1265-2B				
J-12652-047	1196	0.00	137	180
J-12652-059	1173	0.00	147	285
J-12652-061	1149	0.00	158	319
J-12652-052	1175	0.00	147	673
J-12652-058	1188	1.88	141	730
J-12652-043	1138	0.00	163	737
J-12652-060	1141	0.00	161	756
J-12652-051	1176	0.00	146	778
J-12652-057	1384	0.00	56	790
J-12652-056	1383	0.00	57	838
J-12652-042	1138	0.00	163	855
J-12652-062	1139	0.00	162	883
J-12652-041	1134	0.00	165	980
J-12652-045	1134	0.00	164	980
J-12652-046	1134	0.00	164	980
J-12652-048	1181	0.00	144	980
J-12652-049	1182	0.00	144	980
J-12652-050	1180	0.00	145	980
J-12652-064	1209	0.00	132	980
J-12652-071	1185	0.00	142	980

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-12652-072	1184	0.00	143	980
J-12652-063	1136	0.07	164	980
J-12652-044	1132	0.31	165	981
J-12652-068	1186	0.39	142	981
J-12652-065	1214	0.50	130	981
J-12652-070	1216	4.57	129	984
Zone 1265-2C				
J-12652-016	838	0.00	97	241
J-12652-009	835	0.00	98	241
J-12652-007	834	0.00	99	241
J-12652-002	841	0.00	96	242
J-12652-008	829	1.27	101	245
J-12652-034	818	0.72	106	267
J-12652-037	817	0.44	106	291
J-12652-039	844	0.00	95	464
J-12652-038	846	0.00	94	489
J-12652-020	850	0.00	92	532
J-12652-001	849	0.00	92	619
J-12652-004	850	0.00	92	642
J-12652-003	852	0.00	91	683
Zone 1435				
J-1435-075	1192	0.00	104	263
J-1435-068	1177	2.69	111	263
J-1435-049	1081	0.00	152	268
J-1435-065	1167	0.00	115	309
J-1435-048	1129	0.00	132	613
J-1435-069	1107	0.00	141	652
J-1435-007	1134	0.00	130	652
J-1435-032	1286	0.00	64	652
J-1435-033	1183	0.00	108	652
J-1435-035	1185	0.00	107	652
J-1435-038	1184	0.00	108	652
J-1435-039	1183	0.00	108	652
J-1435-040	1222	0.00	91	652
J-1435-041	1221	0.00	92	652
J-1435-044	1177	0.00	111	652
J-1435-045	1185	0.00	107	652
J-1435-046	1171	0.00	113	652
J-1435-047	1285	0.00	64	652
J-1435-054	1146	0.00	124	652
J-1435-055	1130	0.00	131	652
J-1435-056	1156	0.00	120	652
J-1435-057	1127	0.00	132	652
J-1435-058	1188	0.00	106	652
J-1435-059	1192	0.00	104	652
J-1435-060	1198	0.00	102	652
J-1435-061	1132	0.00	130	652
J-1435-063	1194	0.00	103	652

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1435-064	1185	0.00	107	652
J-1435-066	1145	0.00	125	652
J-1435-067	1183	0.00	108	652
J-1435-070	1265	0.00	73	652
J-1435-071	1234	0.00	86	652
J-1435-072	1225	0.00	90	652
J-1435-073	1172	0.00	113	652
J-1435-074	1179	0.00	110	652
J-1435-030	1289	0.00	62	652
J-1435-005	1108	0.07	141	652
J-1435-008	1146	0.07	124	652
J-1435-037	1187	0.15	107	652
J-1435-053	1148	0.20	123	652
J-1435-036	1194	0.22	103	652
J-1435-031	1284	0.31	64	652
J-1435-062	1177	0.39	111	652
J-1435-043	1174	0.57	112	652
J-1435-024	1290	0.52	62	652
J-1435-042	1205	0.74	99	652
J-1435-034	1170	1.38	114	653
J-1435-006	1128	1.55	132	653
J-1435-023	1368	2.21	28	653
J-1435-050	1113	0.00	139	684
J-1435-027	1183	0.00	108	684
J-1435-028	1180	0.00	110	684
J-1435-029	1132	0.00	130	684
J-1435-052	1122	1.00	135	685
J-1435-025	1307	1.40	55	685
J-1435-051	1184	2.64	108	686
J-1435-150	1245	3.80	81	687
Zone 1600				
J-1600-040	1374	0.94	96	93
J-1600-008	1382	0.00	93	115
J-1600-036	1227	3.04	160	148
J-1600-037	1231	0.00	158	202
J-1600-009	1388	0.00	90	251
J-1600-038	1233	0.00	157	546
J-1600-010	1381	0.00	93	556
J-1600-006	1376	0.44	95	559
J-1600-042	1469	5.11	55	648
J-1600-032	1388	0.00	90	689
J-1600-041	1431	0.00	71	698
J-1600-033	1387	0.00	90	700
J-1600-025	1387	0.00	91	708
J-1600-045	1369	1.97	98	715
J-1600-027	1381	0.00	93	725
J-1600-007	1376	0.00	95	738
J-1600-023	1363	0.00	101	738

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1600-024	1248	0.00	151	738
J-1600-026	1376	0.00	95	738
J-1600-059	1256	0.00	147	738
J-1600-030	1376	0.46	95	738
J-1600-028	1377	0.13	95	739
J-1600-050	1385	0.00	91	745
J-1600-034	1240	0.00	154	749
J-1600-035	1406	0.00	82	749
J-1600-039	1235	0.00	156	749
J-1600-029	1409	3.98	81	752
J-1600-003	1418	0.33	77	753
J-1600-001	1376	0.00	95	756
J-1600-004	1418	0.00	77	756
J-1600-005	1417	0.00	77	756
J-1600-054	1422	0.00	75	756
J-1600-056	1370	0.00	98	756
J-1600-002	1376	0.00	95	756
J-1600-047	1386	0.00	91	756
J-1600-048	1369	0.00	98	756
J-1600-049	1377	0.00	95	756
J-1600-051	1386	0.00	91	756
J-1600-052	1377	0.00	95	756
J-1600-055	1388	0.00	90	756
J-1600-043	1381	0.02	93	756
J-1600-031	1378	0.74	95	756
J-1600-044	1386	1.35	91	757
J-1600-100	1400	3.23	85	758
J-1600-053	1414	0.00	79	761
J-1600-018	1506	0.00	39	880
J-1600-046	1448	4.11	64	883
Zone 1890				
J-1890-026	1468	3.23	180	128
J-1890-020	1743	7.01	61	189
J-1890-019	1737	1.20	64	448
J-1890-014	1543	2.32	148	963
J-1890-003	1536	0.00	26	1,128
J-1890-015	1541	0.00	149	1,161
J-1890-016	1734	0.00	65	1,331
J-1890-021	1710	0.00	76	1,336
J-1890-022	1708	0.44	76	1,337
J-1890-017	1735	0.00	65	1,339
J-1890-007	1667	0.24	94	1,346
J-1890-023	1668	0.81	94	1,346
J-1890-009	1580	0.00	132	1,372
J-1890-018	1787	0.00	42	1,385
J-1890-010	1557	0.00	142	1,411
J-1890-012	1549	0.00	146	1,411
J-1890-011	1548	0.00	146	1,411

Appendix I: Cal Water Bear Gulch Water Supply and Facilities Master Plan
Results of Bear Gulch Fire Flow Simulation

Node ID	Elevation (ft)	Maximum Day Demand (gpm)	Static Pressure (psi)	Available Flow @ 20 psi (gpm)
J-1890-002	1556	0.00	142	1,411
J-1890-013	1553	0.00	144	1,411
J-1890-001	1553	1.44	144	1,413
J-1890-008	1537	0.00	151	1,440
J-1890-006	1540	1.84	149	1,445

Appendix J

Property Condition Report prepared by
Bear Gulch District

Public Version

California Water Service Company
Bear Gulch District

2006 Property Condition Report

April 2006

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 18	Station 19 - Ridgeway Tanks	Sta 15 - Woodside Knolls Tank
Fencing			
Fencing Description	None on site	Black Vinyl, wood, & Galvanized	Wood grape stake
General Condition	NA	Good	Poor
Fence Repairs	NA	NA	Coordinate with neighbor
Fence Replacement	NA	NA	possible
New Fence required	Need chain across driveway	NA	possible
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	NA	NA
Other Vegetation Concern	NA	Need to trim trees from tank	Need to trim trees from tank
General Comments	NA	Need to remove tree @ xfrmr	NA
Pavement			
General Condition	Poor with cracks and potholes	Good, two trenches to pave	Poor
Crack Seal	NA	NA	NA
Overlay	NA	NA	NA
Patch Pave	NA	Two 1' x 10' trenches	Paving needed around tank
Replace	Replace 10' x 110' AC driveway	NA	NA
Slurry	NA	NA	NA
Rock	Rock pump area approx 60'x 80'	NA	NA
Drainage issues	None	None	some, see tank
Slopes & Retaining Walls			
Steep slopes	NA	NA	NA
Retaining walls	NA	NA	NA
Repairs needed	NA	NA	NA
Slide activity noted	NA	NA	NA
Slope clean up needed	NA	Remove tree on berm	No
Geotech report needed	NA	No	No
Painting			
Pump condition	Poor	Poor	Poor
Piping condition	OK	Excellent	Poor
Building/shelter exterior cond	Poor	Excellent	Poor
Tank Exterior condition	NA	Excellent	Poor
Interior condition	NA	Excellent	NA
Recommendations	Paint pump, pipe, & enclosures	Paint pumps	Paint pump, pipe, & enclosures
Pumps & Piping			
General Condition	OK	OK	OK
Cleaning needed	Yes	Yes	Yes
Packing leaks noted	Yes	Yes	OK
Lubrication required	Likely	Likely	Likely
Vibration	NA	NA	NA
Heating issues	NA	NA	NA
Noise	NA	NA	NA
Controls			
General Condition	Old & not on SCADA	OK	Old & not on SCADA
RTU Type	NA	Old Style	NA
Panelboard issues	NA	Good	OK
Panelboard maintenance	Required	OK	Required

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 18	Station 19 - Ridgeway Tanks	Sta 15 - Woodside Knolls Tank
Buildings			
General condition	No building at site	No building at site	No building at site
Cleaning needed	NA	NA	NA
Repairs needed	NA	NA	NA
Roofs	NA	NA	NA
Drains	NA	NA	NA
Other Needs	NA	NA	NA
Tanks			
General condition	No Tanks at site	Good	OK
Seismic connections Y/N	NA	Yes	NO
Seismic connections tagged	NA	No, need tags	NA
Automatic Seismic valves	NA	NA	NA
Overflow condition	NA	OK	Needs retrofit
Vent condition	NA	OK	OK
Anticlimb condition	NA	OK	OK
Tank lip in good condition	NA	OK	Needs work
Other needs	NA	NA	Check with Jose on inspection
Pressure Tanks			
General Condition	No Pressure tank at site	Good	OK
Pressure tanks levels	NA	OK	OK
Site glass	NA	OK	Could use cleaning
Vaults			
General Condition	OK	OK	OK
Operational flowmeter	Not operational	Not operational	Not operational
Genset			
General condition	None	None	None
Do we have autostart?	NA	NA	NA
Tested?	NA	NA	NA
Hours	NA	NA	NA
Needs	NA	NA	NA
Misc			
Encroachment concerns	Wrote letter to RE agent	None	None
Surveying needs	Not at this time	None	None
Easement maintenance	Not at this time	None	None
Misc comments	CERP box is ugly	Need to remove masks on valve	Need new packing line installed
		can cover markers.	Paint pressure tank
			Clean around base of tank
			Paint PBC discharge white
			Replace CWS & trespass signs
			Clean tank roof
Future Plans			Eliminate station & rezone

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 23	Station 22 - Canada Tank	Station 24
Fencing			
Fencing Description	Chain link	Rely on neighbor's fence	None
General Condition	Good	Good	NA
Fence Repairs	Gate need repair or replacement	NA	NA
Fence Replacement	NA	NA	NA
New Fence required	NA	NA	Yes
Gardening Services			
Trimming	Trim Oleanders 1x year	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	Clean CB on access road 1x mo	NA
Other Vegetation Concern	NA	Trim trees around building	NA
General Comments	NA	NA	NA
Pavement			
General Condition	Good with cracks	Good with minor cracks	Good
Crack Seal	60'x50'	NA	NA
Overlay	60'x50'	After crack seal	NA
Patch Pave	Pave side 40'x9'	Raise 3 valves to grade	NA
Replace	NA	NA	NA
Slurry	NA	IN New paving area	NA
Rock	Add rock to right side of bldg	NA	NA
Drainage issues	grade overflow to drain & pave	None	None
Slopes & Retaining Walls			
Steep slopes	NA	Yes	Yes
Retaining walls	NA	None	None
Repairs needed	NA	No, slope holding well	Install rip-rap on slope
Slide activity noted	NA	Very minor	Not active at this time
Slope clean up needed	NA	Clean up debris from slope	NA
Geotech report needed	NA	No	No
Painting			
Pump condition	Poor	OK	OK
Piping condition	Poor	OK	OK
Building/shelter exterior cond	Painting required	Slightly chalky	Poor
Tank Exterior condition	NA	Good	NA
Interior condition	Painting / Epoxy req'd	Painting required	OK
Recommendations	Paint all interior	Paint all interior and bldg ext.	Paint pump, pipe, building
Pumps & Piping			
General Condition	OK	OK	OK
Cleaning needed	Yes	OK	OK
Packing leaks noted	Yes	OK	OK
Lubrication required	Likely	Likely	Likely
Vibration	NA	NA	NA
Heating issues	NA	NA	NA
Noise	Cheap style motor	Cheap style motor	NA
Controls			
General Condition	OK	OK, new starter order	OK
RTU Type	Old Style	Old Style	Old Style
Panelboard issues	OK	OK	OK
Panelboard maintenance	OK	Required	Required

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 23	Station 22 - Canada Tank	Station 24
Buildings			
General condition	Good	OK	OK
Cleaning needed	Yes	Yes	Fungicide & Pressure wash
Repairs needed	Fascia board	NA	NA
Roofs	Good	Poor condition, replace	Clean debris, remove barb wire
Drains	OK	OK	OK
Other Needs	Painting	NA	NA
Tanks			
General condition	Sump only	OK	No Tanks at site
Seismic connections Y/N	NA	Yes	NA
Seismic connections tagged	NA	No, need tags	NA
Automatic Seismic valves	NA	NA	NA
Overflow condition	OK	OK	NA
Vent condition	OK	OK	NA
Anticlimb condition	NA	OK	NA
Tank lip in good condition	NA	OK	NA
Other needs	NA	NA	NA
Pressure Tanks			
General Condition	No Pressure tank at site	OK	No Pressure tank at site
Pressure tanks levels	NA	OK	NA
Site glass	NA	OK	NA
Vaults			
General Condition	OK	Consider sump pump.	OK
Operational flowmeter	Unknown	None	None
Genset			
General condition	None	None	None
Do we have autostart?	NA	NA	NA
Tested?	NA	NA	NA
Hours	NA	NA	NA
Needs	NA	NA	NA
Misc			
Encroachment concerns	None	None	None
Surveying needs	None	None	Yes
Easement maintenance	None	Yes, clear to Marva Oaks, gate?	None
Misc comments	Get rid of old motor	Try cleaning door and louvers	Purchase dehumidifier
	Clean floor	Need More AC in building	Get better seal on door
	Annual maint on float valves	Spot paint P-tank bracing	
		Paint anti-climb	
		EMT -get sensing line in conduit	
Future Plans		Review PRV operation that	Replace above ground pipe
		keeps pumps running.	

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Sta 25 - Woodside Oaks Tank	Sta 31 - Summit Tank	Station 16
Fencing			
Fencing Description	None	Did not visit on tour in 2006	4 strand barb wire
General Condition	NA	because of impending	Poor
Fence Repairs	NA	demolition and reconstruction	Needed
Fence Replacement	NA	Do not need gardening.	NA
New Fence required	Yes		NA
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	NA	NA
Leaf Blowing	1x per month	NA	1x per month
Other Contract	NA	NA	
Other Vegetation Concern	Trim trees near tank		Trim dead area above pump
General Comments	NA		NA
Pavement			
General Condition	Rock only, Poor conditions		Dirt only, OK
Crack Seal	NA		NA
Overlay	NA		NA
Patch Pave	NA		NA
Replace	NA		NA
Slurry	NA		NA
Rock	150' x 12' Drive & around building		40' x 60' area at pump
Drainage issues	Need French drain behind tank		None
Slopes & Retaining Walls			
Steep slopes	Yes		None
Retaining walls	None		None
Repairs needed	NA		NA
Slide activity noted	NA		NA
Slope clean up needed	No		No
Geotech report needed	No		No
Painting			
Pump condition	OK		Poor
Piping condition	OK		OK
Building/shelter exterior cond	Poor		Poor
Tank Exterior condition	Poor		NA
Interior condition	Poor		Poor
Recommendations	Paint pump, pipe, build		Paint pump, shelter, panels
Pumps & Piping			
General Condition	OK		Poor
Cleaning needed	OK		Yes
Packing leaks noted	OK		No
Lubrication required	Likely		Yes, need pump evaluation
Vibration	NA		Yes
Heating issues	NA		Possible
Noise	NA		Yes
Controls			
General Condition	OK		OK
RTU Type	Old Style		Old Style
Panelboard issues	Needs cleaning		Needs cleaning
Panelboard maintenance	Required		Required

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Sta 25 - Woodside Oaks Tank	Sta 31 - Summit Tank	Station 16
Buildings			
General condition	OK		No building at site
Cleaning needed	Fungicide & Pressure wash		NA
Repairs needed	NA		NA
Roofs	Clean debris		NA
Drains	OK		NA
Other Needs	NA		NA
Tanks			
General condition	OK		No Tanks at site
Seismic connections Y/N	Yes		NA
Seismic connections tagged	No, need tags		NA
Automatic Seismic valves	NA		NA
Overflow condition	OK		NA
Vent condition	OK		NA
Anticlimb condition	OK		NA
Tank lip in good condition	OK		NA
Other needs	Check with Jose on inspection		NA
Pressure Tanks			
General Condition	No Pressure tank at site		No Pressure tank at site
Pressure tanks levels	NA		NA
Site glass	NA		NA
Vaults			
General Condition	OK		OK
Operational flowmeter	None		None
Genset			
General condition	None		None
Do we have autostart?	NA		NA
Tested?	NA		NA
Hours	NA		NA
Needs	NA		NA
Misc			
Encroachment concerns	None		None
Surveying needs	No		No
Easement maintenance	OK, maintain access easement		None
Misc comments	Purchase dehumidifier		Check valve numbers
	Get better seal on door		Paint fire hydrants
	Lower valve can near tank		Pick up barricade
Future Plans		Replacing tank in 2006	Enlarge station with future storage project

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Woodside Res	Station 3	Station 8
Fencing			
Fencing Description	Did not visit on tour in 2006	Rely on neighbor's fence	Wood Grape stake
General Condition	because of impending	Good	OK
Fence Repairs	demolition and reconstruction	NA	Add some slats
Fence Replacement	Do not need gardening.	NA	NA
New Fence required		NA	NA
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	NA	NA	2x per year
Leaf Blowing	NA	1x per month	1x per month
Other Contract	NA	NA	NA
Other Vegetation Concern		NA	Trim trees at wires
General Comments		NA	Trim trees over roof
Pavement			
General Condition		Could use wider area & steps	Rock only
Crack Seal		NA	NA
Overlay		NA	NA
Patch Pave		If new steps and access installed	NA
Replace		NA	NA
Slurry		NA	NA
Rock		Behind building	Dig out existing and re-rock
Drainage issues		None	slope to drain from building
Slopes & Retaining Walls			
Steep slopes		None	None
Retaining walls		None	Small 2' in front OK
Repairs needed		NA	NA
Slide activity noted		NA	NA
Slope clean up needed		No	No
Geotech report needed		No	No
Painting			
Pump condition		Poor	Poor
Piping condition		Poor	OK
Building/shelter exterior cond		Poor	Poor & Peeling
Tank Exterior condition		NA	NA
Interior condition		Poor	OK
Recommendations		Demolish & start over	Paint everything
Pumps & Piping			
General Condition		OK	Poor
Cleaning needed		Yes	Yes
Packing leaks noted		Extreme	Yes
Lubrication required		Likely	Likely
Vibration		NA	NA
Heating issues		NA	NA
Noise		NA	Some, have added baffling
Controls			
General Condition		Obsolete	Old
RTU Type		Old Style	Old Style
Panelboard issues		Needs cleaning	Needs cleaning
Panelboard maintenance		Required	Required

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Woodside Res	Station 3	Station 8
Buildings			
General condition		Poor	Poor
Cleaning needed		Yes	Yes
Repairs needed		Patch holes?	Need screening at pipes
Roofs		Poor	
Drains		NA	
Other Needs		Demolish & start over	Minor repair, caulk windows, paint
Tanks			
General condition		No Tanks at site	No Tanks at site
Seismic connections Y/N		NA	NA
Seismic connections tagged		NA	NA
Automatic Seismic valves		NA	NA
Overflow condition		NA	NA
Vent condition		NA	NA
Anticlimb condition		NA	NA
Tank lip in good condition		NA	NA
Other needs		NA	NA
Pressure Tanks			
General Condition		No Pressure tank at site	No Pressure tank at site
Pressure tanks levels		NA	NA
Site glass		NA	NA
Vaults			
General Condition		New	OK
Operational flowmeter		Yes	None
Genset			
General condition		None	None
Do we have autostart?		NA	NA
Tested?		NA	NA
Hours		NA	NA
Needs		NA	NA
Misc			
Encroachment concerns		None	None
Surveying needs		No	Yes
Easement maintenance		None	None
Misc comments			Rebuild site design in 2006 budge
			Remove WV barricades & wood
			Address sagging phone lines
Future Plans	Replacing tank in 2007	Consider complete rebuild with	Consider buying church lot
		variable speed pumps and	
		better control system	

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Station 6 Combsville Tank	Sta 7 Woodside Highlands Tank	Station 32 - Wayside Tank
Fencing			
Fencing Description	None	Chainlink front 4 strand barb else	Galvanized Chainlink
General Condition	NA	Poor	Good
Fence Repairs	NA	NA	Fix gate and area near gate
Fence Replacement	NA	Will address w/ landscape	NA
New Fence required	Yes	NA	NA
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	Weed wacking 2x per year	NA
Other Vegetation Concern	Trim trees above tank	Removed wood	Remove small redwood
General Comments	Remove fallen trees		Weed whacking
Pavement			
General Condition	AC good with some cracks	Poor	OK
Crack Seal	NA	NA	NA
Overlay	NA	NA	NA
Patch Pave	to raise catch basin area	NA	Repave a small portion of lot
Replace	NA	Yes	Needs new tank berm
Slurry	After French drain work	NA	NA
Rock	NA	NA	Discussed rocking portion
Drainage issues	high catch basin, slope	NA	Needs drainage berm repair
Slopes & Retaining Walls			
Steep slopes	Yes	No	Yes
Retaining walls	None	No	Yes
Repairs needed	French drain needed	No	No
Slide activity noted	Yes	No	No
Slope clean up needed	Yes	No	Some dirt behind tank
Geotech report needed	Have letter report	No	No
Painting			
Pump condition	Poor	Scheduled	NA
Piping condition	OK	Scheduled	Good
Building/shelter exterior cond	Good, needs wash	Scheduled	NA
Tank Exterior condition	Good Need algaecide	Scheduled	Good
Interior condition	OK, needs cleaning	Scheduled	NA
Recommendations	Clean	NA	Clean
Pumps & Piping			
General Condition	Old	Old	No pumps at site
Cleaning needed	Yes	Yes	NA
Packing leaks noted	Yes	Yes	NA
Lubrication required	Likely	Likely	NA
Vibration	No	No	NA
Heating issues	No	No	NA
Noise	No	Yes	NA
Controls			
General Condition	Old	OK	Good, recent upgrade
RTU Type	Old	Old Style	New style
Panelboard issues	NA	NA	NA
Panelboard maintenance	NA	Yes	No

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 6 Combsville Tank	Sta 7 Woodside Highlands Tank	Station 32 - Wayside Tank
Buildings			
General condition	Good	Shelters only	No building at site
Cleaning needed	Yes	None	NA
Repairs needed	OK	OK	NA
Roofs	Patch holes in roof	OK	NA
Drains	OK	OK	NA
Other Needs	NA	Need one replacement shelter	NA
Tanks			
General condition	Good	Redwood with fiberglass line	Good
Seismic connections Y/N	Yes	No	NA
Seismic connections tagged	Yes	NA	NA
Automatic Seismic valves	No	No	No
Overflow condition	Good	Needs retrofit	Needs retrofit
Vent condition	Needs cleaning	OK	Good
Anticlimb condition	Good	OK	Good
Tank lip in good condition	Good	OK	Needs work
Other needs	NA	Needs retrofit work	As noted
Pressure Tanks			
General Condition	No Pressure tank at site	No Pressure tank at site	No Pressure tank at site
Pressure tanks levels	NA	NA	NA
Site glass	NA	NA	NA
Vaults			
General Condition	OK	Old, cracked, need work	Flooded-solar sump pump?
Operational flowmeter	Does not work	Not operational	None
Genset			
General condition	None	None	None
Do we have autostart?	NA	NA	NA
Tested?	NA	NA	NA
Hours	NA	NA	NA
Needs	NA	NA	NA
Misc			
Encroachment concerns	None	None	None
Surveying needs	Yes	No	Yes, not urgent
Easement maintenance	None	No	No
Misc comments	t	Fix bollards at PG&E xformer	Need new trespassing sign
			Caps on radio support pipe
			Neighbor pump backflow issues
Future Plans		Need to abandon the 2" main	
		Add a high pressure hydrant	
		Seismic retrofit needed	

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Station 13	Station 30 - Portola Tank	Station 26
Fencing			
Fencing Description	None	Galvanized Chainlink	None
General Condition	NA	Good	NA
Fence Repairs	NA	Make better repair in cut area	NA
Fence Replacement	NA	NA	NA
New Fence required	No plans -scenic corridor	No	NA
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	NA	NA
Other Vegetation Concern	weed wack	Spray weeds before paint job	Keep Branches off roof
General Comments	remove Euc tree		
Pavement			
General Condition	Some AC, mostly rock	AC in poor condition	AC in poor condition
Crack Seal	NA	NA	Yes
Overlay	NA	NA	NA
Patch Pave	NA	Repave around tank	NA
Replace	NA	Repave smaller area for drainage	NA
Slurry	NA	NA	Yes
Rock	Needed	Rock remainder of property	NA
Drainage issues	None	Coordinate with paving	None noted
Slopes & Retaining Walls			
Steep slopes	No	Yes	No
Retaining walls	No	No	Yes
Repairs needed	No	No	Monitor joint movement
Slide activity noted	No	None	None
Slope clean up needed	No	Tank Apron/ ditches	NA
Geotech report needed	No	No	No
Painting			
Pump condition	Need paint	NA	Needed
Piping condition	Good	Scheduled, special color needed	Needed
Building/shelter exterior cond	Good	NA	Paint ext conc w/ 30
Tank Exterior condition	None	Scheduled	None
Interior condition	NA	NA	Paint int conc w/ 30
Recommendations	Clean and paint pumps	NA	NA
Pumps & Piping			
General Condition	Old	No pumps at site	OK
Cleaning needed	Yes	NA	Need cleaning before paint
Packing leaks noted	yes	NA	Yes
Lubrication required	Likely	NA	Likely
Vibration	No	NA	No
Heating issues	No	NA	No
Noise	No	NA	No
Controls			
General Condition	OK	OK	Good
RTU Type	Old style	Old Style	New Style
Panelboard issues	OK	OK	OK
Panelboard maintenance	No	No	No

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 13	Station 30 - Portola Tank	Station 26
Buildings			
General condition	Shelters only	No building at site	Concrete - good condition
Cleaning needed	Yes	NA	Yes
Repairs needed	repair small scrape	NA	No
Roofs	OK	NA	Good
Drains	OK	NA	Need to be cleared
Other Needs	Screening needed	NA	NA
Tanks			
General condition	No Tanks at site	Good	Sump only
Seismic connections Y/N	NA	No, needed	NA
Seismic connections tagged	NA	NA	NA
Automatic Seismic valves	NA	Yes, flow based	NA
Overflow condition	NA	Needs retrofit	OK
Vent condition	NA	OK	OK
Anticlimb condition	NA	OK	NA
Tank lip in good condition	NA	OK	NA
Other needs	NA	NA	NA
Pressure Tanks			
General Condition	No Pressure tank at site	No Pressure tank at site	No Pressure tank at site
Pressure tanks levels	NA	NA	NA
Site glass	NA	NA	NA
Vaults			
General Condition	need cleaning and rock	Paint with tank	Need replacement
Operational flowmeter	None	On SCADA?	none
Genset			
General condition	None	None	None
Do we have autostart?	NA	NA	NA
Tested?	NA	NA	NA
Hours	NA	NA	NA
Needs	NA	NA	NA
Misc			
Encroachment concerns	None	None	None
Surveying needs	Not at this time	None	None
Easement maintenance	No	Rock road outside station	No
Misc comments	Install permanent irrigation device		Remove obsolete box from inside
	Electrical pole in poor condition		Replace chain at drive
	Work with town to plant trees		
Future Plans	Can we eliminate & combine w/8		

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Sta17 - Alpine Hills Tank	Sta 21 - Arrowhead Tanks	Sta 27 - Westridge Tanks
Fencing			
Fencing Description	None	Chain link w/ wood slats	Minimal, black Chainlink at D/W
General Condition	NA	Good, slate in poor shape	OK
Fence Repairs	NA	Move slates from back to front	None
Fence Replacement	NA	No	None
New Fence required	NA	No	Yes
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	NA	NA
Other Vegetation Concern	Stake small trees	Spray weeds now	Remove dead trees
General Comments	Prune trees over tank		Complete landscaping
Pavement			
General Condition	AC with cracks	Some AC, mostly dirt	AC at approach, rock else
Crack Seal	Yes	NA	NA
Overlay	NA	NA	NA
Patch Pave	Replace AC in front of door	NA	NA
Replace	Tank berm needs replacement	Replace AC tank berms	NA
Slurry	NA	NA	Driveway only
Rock	NA	Needed	Need a bunch of rock
Drainage issues	Drain pipe needs extension	None	None
Slopes & Retaining Walls			
Steep slopes	Yes	No	No
Retaining walls	Yes	No	Yes
Repairs needed	No	No	No
Slide activity noted	No	No	No
Slope clean up needed	Clean area at base of r-wall	No	No
Geotech report needed	No	No	No
Painting			
Pump condition	Need paint	Needs painting	Needed
Piping condition	OK	OK	OK
Building/shelter exterior cond	OK	Consider painting block	New
Tank Exterior condition	OK	New paint	Good, graffiti problem
Interior condition	OK	Could use paint	OK
Recommendations	Clean and paint pumps	Clean and paint pump	Clean and paint pump
Pumps & Piping			
General Condition	OK	OK	OK
Cleaning needed	Yes	Needed	Yes
Packing leaks noted	No	No	No
Lubrication required	Likely	Likely	Likely
Vibration	No	No	No
Heating issues	No	No	No
Noise	No	No	No
Controls			
General Condition	OK	Good	New
RTU Type	New Style	New style	New Style
Panelboard issues	OK	OK	OK
Panelboard maintenance	No	No	No

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Sta17 - Alpine Hills Tank	Sta 21 - Arrowhead Tanks	Sta 27 - Westridge Tanks
Buildings			
General condition	Steel building	Good but ugly	Shelters only
Cleaning needed	Yes	No	None
Repairs needed	No	No	OK
Roofs	Clean pine needles	New roof needed	OK
Drains	Check	OK	OK
Other Needs	Check fan for ops	NA	NA
Tanks			
General condition	OK	Good	Good, graffiti problem
Seismic connections Y/N	No, needed	No, needed	Yes
Seismic connections tagged	NA	NA	No, needed
Automatic Seismic valves	No	No	No
Overflow condition	Needs retrofit	Needs retrofit	Good
Vent condition	OK	OK	Good
Anticlimb condition	OK	OK	Good
Tank lip in good condition	No, repairs needed	Needs replacement	Good
Other needs	NA	NA	NA
Pressure Tanks			
General Condition	OK	No Pressure tank at site	Good, paint chalky, clean & paint
Pressure tanks levels	OK	NA	Full
Site glass	OK	NA	OK
Vaults			
General Condition	Good	Chipped, replace top	OK
Operational flowmeter	None	None	None
Genset			
General condition	None	None	New
Do we have autostart?	NA	NA	Yes
Tested?	NA	NA	Yes, good
Hours	NA	NA	31.2 hours
Needs	NA	Consider one for this site	None
Misc			
Encroachment concerns	None	None	None
Surveying needs	None	None	None
Easement maintenance	Need to keep lines accessible	None	None
Misc comments	Remove obsolete box from inside	Remove obsolete box from inside	Fix drip system
		remove old fittings from inside	Can we eliminate old Panel?
		Label Panelboard breakers	
Future Plans	Seismic retrofit	Seismic retrofit	
		Future Genset	

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Station 20	Sta 28 Ladera Tank	Sta 29 Ormondale Tanks
Fencing			
Fencing Description	Black chainlink & wire mesh	Galvanized Chainlink	None
General Condition	Good	Good	NA
Fence Repairs	None	Fix barb wire	NA
Fence Replacement	None	NA	NA
New Fence required	Install black chain at front	No	Yes
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	NA	NA
Other Vegetation Concern	Remove fallen & dead trees	Prune deadwood from trees	Minor tree work
General Comments	Spray weeds	Remove trees at tank	
Pavement			
General Condition	Rock, good condition	AC, cracked	Poor, AC with cracks
Crack Seal	NA	NA	NA
Overlay	NA	NA	Hold off until retrofit work
Patch Pave	NA	Repave around tank	Hold off until retrofit work
Replace	NA	Repave smaller area for drainage	NA
Slurry	NA	NA	NA
Rock	NA	Rock remainder of property	NA
Drainage issues	None	Coordinate with retrofit	NA
Slopes & Retaining Walls			
Steep slopes	No	Yes	Yes
Retaining walls	Small one, OK	yes	Good condition
Repairs needed	No	No	No
Slide activity noted	No	No	No
Slope clean up needed	No	yes, around tank	No
Geotech report needed	No	No	No
Painting			
Pump condition	Needs paint	No pump	No pump
Piping condition	Needs paint	Good	Good
Building/shelter exterior cond	OK	None	None
Tank Exterior condition	OK	Good Need algaecide	Good
Interior condition	NA	None	None
Recommendations	Clean and paint pump	Clean	Clean roofs of tanks
Pumps & Piping			
General Condition	OK	No pumps at site	No pumps at site
Cleaning needed	Yes	NA	NA
Packing leaks noted	Yes	NA	NA
Lubrication required	Likely	NA	NA
Vibration	No	NA	NA
Heating issues	No	NA	NA
Noise	No	NA	NA
Controls			
General Condition	Rebuilt with Gen set	Minimal controls	Minimal, level to 14
RTU Type	Old Style	Old style	Old style
Panelboard issues	OK	OK	OK
Panelboard maintenance	Should be checked	OK	Check battaries, program?

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 20	Sta 28 Ladera Tank	Sta 29 Ormondale Tanks
Buildings			
General condition	Shelters only	No building at site	No building at site
Cleaning needed	Yes, rats	NA	NA
Repairs needed	No	NA	NA
Roofs	OK	NA	NA
Drains	OK	NA	NA
Other Needs	NA	NA	NA
Tanks			
General condition	No Tanks at site	Good	Good
Seismic connections Y/N	NA	No, needed	No, needed
Seismic connections tagged	NA	NA	NA
Automatic Seismic valves	NA	No	No
Overflow condition	NA	Needs retrofit	Needs retrofit
Vent condition	NA	OK	OK
Anticlimb condition	NA	OK	Good
Tank lip in good condition	NA	OK	Good
Other needs	NA	Needs retrofit work	
Pressure Tanks			
General Condition	Good	No Pressure tank at site	No Pressure tank at site
Pressure tanks levels	No air	NA	NA
Site glass	OK	NA	NA
Vaults			
General Condition	OK	None	OK
Operational flowmeter	None	None	None
Genset			
General condition	New	None	None
Do we have autostart?	Yes	NA	NA
Tested?	Yes, good	NA	NA
Hours	68.7 hours	NA	NA
Needs	Plug side holes to prevent rats	NA	NA
Misc			
Encroachment concerns	None	None	Yes
Surveying needs	None	None	Yes
Easement maintenance	No	No	No
Misc comments	Water in leak detection vault		Dig dirt away from redwood tank
	Need screens at pump shelter		
	Special compressor not working		
	Need valve marking		
Future Plans	Additional pump to 440 zone	Upgrade volume of tank	Replace and retrofit tanks

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Station 14	Sta 34 - Sunrise	Station 35
Fencing			
Fencing Description	None	New black chain link	New black chain link
General Condition	NA	Good	Good
Fence Repairs	NA	NA	NA
Fence Replacement	NA	NA	NA
New Fence required	Install wood in front	NA	NA
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	NA	1x per month
Other Contract	NA	NA	NA
Other Vegetation Concern	Grind out stumps	Remove small tree on wall	Wack or spray now
General Comments	Trim power line (PG&E?)		
Pavement			
General Condition	Poor AC	Rock only	Rock only
Crack Seal	NA	NA	NA
Overlay	NA	NA	NA
Patch Pave	NA	NA	NA
Replace	NA	NA	NA
Slurry	NA	NA	NA
Rock	Remove pavement and rock	Add more rock	Add more rock
Drainage issues	None	None	None
Slopes & Retaining Walls			
Steep slopes	No	No	No
Retaining walls	No	Yes	Yes
Repairs needed	No	No	No
Slide activity noted	No	No	No
Slope clean up needed	No	No	No
Geotech report needed	No	No	No
Painting			
Pump condition	Needs paint	No pump	OK
Piping condition	Needs paint	not visible	OK
Building/shelter exterior cond	Needs paint	NA	None
Tank Exterior condition	NA	Good, hatch needs painting	NA
Interior condition	Dirty	OK	NA
Recommendations	Apply aquaseal	Paint hatch	Paint & Label PBCs
Pumps & Piping			
General Condition	Poor	No pumps at site	Pump shelter & guards needed
Cleaning needed	yes	NA	yes
Packing leaks noted	yes	NA	yes
Lubrication required	likely	NA	likely
Vibration	No	NA	None
Heating issues	No	NA	None
Noise	No	NA	None
Controls			
General Condition	Old	Good	Good
RTU Type	Old style	New SCADA pak	New SCADA pak
Panelboard issues	OK	None	None
Panelboard maintenance		None	None

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Station 14	Sta 34 - Sunrise	Station 35
Buildings			
General condition	Below ground	No building at site	No building at site
Cleaning needed	yes	NA	NA
Repairs needed	no	NA	NA
Roofs	OK	NA	NA
Drains	OK	NA	NA
Other Needs	NA	NA	Add pump shelter
Tanks			
General condition	No Tanks at site	Good	No Tanks at site
Seismic connections Y/N	NA	No	NA
Seismic connections tagged	NA	No	NA
Automatic Seismic valves	NA	Yes, need to reviw ops	NA
Overflow condition	NA	Underground	NA
Vent condition	NA	Good	NA
Anticlimb condition	NA	NA	NA
Tank lip in good condition	NA	NA	NA
Other needs	NA	NA	NA
Pressure Tanks			
General Condition	No Pressure tank at site	No Pressure tank at site	No Pressure tank at site
Pressure tanks levels	NA	NA	NA
Site glass	NA	NA	NA
Vaults			
General Condition	OK	OK	OK
Operational flowmeter	None	Unknown	Unknown
Genset			
General condition	None	None	New
Do we have autostart?	NA	NA	No, look into adding
Tested?	NA	NA	Yes
Hours	NA	NA	197.2
Needs	NA	NA	
Misc			
Encroachment concerns	No	No	No
Surveying needs	Yes	No	No
Easement maintenance		No	No
Misc comments		Add logo and no trespassing	Add logo and no trespassing
			Lables for new station number
Future Plans			

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Sta 36 - Bonita	Sta 37 - Old Spanish	Sta 38 - Vista Verde
Fencing			
Fencing Description	New black chain link	None	New black chain link
General Condition	Good	NA	Good
Fence Repairs	NA	NA	NA
Fence Replacement	NA	NA	NA
New Fence required	Consider more extensive fence	Consider new driveway gate	Consider more extensive fence
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	NA	NA
Other Vegetation Concern	Wack or spray now	Scotch broom	Power line issues
General Comments	remove broom, thin trees		
Pavement			
General Condition	Dirt only	AC good and dirt	Rock only
Crack Seal	NA	NA	NA
Overlay	NA	Consider paving driveway	NA
Patch Pave	NA	NA	Behind and around tank
Replace	NA	NA	NA
Slurry	NA	NA	NA
Rock	NA	NA	Add some on driveway
Drainage issues	None	None	None
Slopes & Retaining Walls			
Steep slopes	Yes	YES!	Yes
Retaining walls	Yes	No	Yes
Repairs needed	No	No	No
Slide activity noted	No	Slide in past, OK at present	No
Slope clean up needed	Clean gutters	No	No
Geotech report needed	No	No	No
Painting			
Pump condition	Needs paint	No pump	Unpainted
Piping condition	Needs paint	Not visible	Needs paint
Building/shelter exterior cond	Paint panelboards	None	None
Tank Exterior condition	Good (special color)	Good	Good
Interior condition	NA	NA	NA
Recommendations	Paint all exposed metal	NA	Paint all exposed metal
Pumps & Piping			
General Condition	Submersible	No pumps at site	Good
Cleaning needed	No	NA	yes
Packing leaks noted	No	NA	no
Lubrication required	No	NA	likely
Vibration	No	NA	No
Heating issues	No	NA	No
Noise	No	NA	No
Controls			
General Condition	Good	Good	Good
RTU Type	New SCADA pak	New SCADA pak	New SCADA pak
Panelboard issues	None	None	None
Panelboard maintenance	None	None	None

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Sta 36 - Bonita	Sta 37 - Old Spanish	Sta 38 - Vista Verde
Buildings			
General condition	No building at site	No building at site	No building at site
Cleaning needed	NA	NA	NA
Repairs needed	NA	NA	NA
Roofs	NA	NA	NA
Drains	NA	NA	NA
Other Needs	NA	NA	NA
Tanks			
General condition	New bolted steel	New bolted steel	New bolted steel
Seismic connections Y/N	No	No	No
Seismic connections tagged	No	No	No
Automatic Seismic valves	Yes, need to reviw ops	Yes, need to reviw ops	Yes, need to reviw ops
Overflow condition	Underground	Underground	Underground
Vent condition	Good	Good	Good
Anticlimb condition	NA	NA	NA
Tank lip in good condition	NA	NA	NA
Other needs	NA	NA	NA
Pressure Tanks			
General Condition	No Pressure tank at site	No Pressure tank at site	No Pressure tank at site
Pressure tanks levels	NA	NA	NA
Site glass	NA	NA	NA
Vaults			
General Condition	OK	OK	OK
Operational flowmeter	Unknown	Unknown	Unknown
Genset			
General condition	Old, but started right up	None	Old but started right up
Do we have autostart?	No	NA	No
Tested?	Yes, quiet	NA	Yes
Hours	281.9	NA	379.4
Needs	Clean	NA	Clean
Misc			
Encroachment concerns	Some	No	No
Surveying needs	No	No	No
Easement maintenance	Walk with Tom Hubbard	No	No
Misc comments	Add logo and no trespassing	Add logo and no trespassing	Add logo and no trespassing
	Lables for new station number		Lables for new station number
			Fix PBC
			Remove stick of ductile
Future Plans		Replace PRV at station	
		Consider removing if problems.	

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Sta 39 - Pony Tracks	Sta 33 - Los Trancos	Operations Center Overall
Fencing			
Fencing Description	New black chain link	New black chain link	Chainlink
General Condition	Good	Good	Good
Fence Repairs	NA	Check/repain hinges	NA
Fence Replacement	NA	NA	Consider adding more at front
New Fence required	NA	NA	NA
Gardening Services			
Trimming	NA	NA	NA
Weed spraying	2x per year	2x per year	2x per year
Leaf Blowing	1x per month	1x per month	1x per month
Other Contract	NA	NA	Lawn mowing, shrub trimming
Other Vegetation Concern	Tree cutting needed		
General Comments	remove broom		
Pavement			
General Condition	Dirt only	Rock only	Poor
Crack Seal	NA	NA	As needed
Overlay	NA	NA	Yes
Patch Pave	NA	NA	Yes
Replace	NA	NA	Widen entrance road
Slurry	NA	NA	NA
Rock	Add on road and near tank	NA	NA
Drainage issues	None	None	Replace NPDES signs
Slopes & Retaining Walls			
Steep slopes	Yes	No	None
Retaining walls	No	No	None
Repairs needed	No	NA	NA
Slide activity noted	Yes, no recent movement	NA	NA
Slope clean up needed	No	NA	NA
Geotech report needed	No	NA	NA
Painting			
Pump condition	No pump	Unpainted	NA
Piping condition	Not visible	Needs paint	NA
Building/shelter exterior cond	None	None	New Good
Tank Exterior condition	Good	Good	NA
Interior condition	NA	NA	Some needs
Recommendations	NA	Paint all exposed metal	NA
Pumps & Piping			
General Condition	No pumps at site	Good	No pumps at site
Cleaning needed	NA	Yes	NA
Packing leaks noted	NA	no	NA
Lubrication required	NA	Likely	NA
Vibration	NA	No	NA
Heating issues	NA	No	NA
Noise	NA	No	NA
Controls			
General Condition	Good	Good	NA
RTU Type	New SCADA pak	New SCADA pak	NA
Panelboard issues	None	None	NA
Panelboard maintenance	None	None	NA

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Bear Gulch
Property Condition Report
2006

Facility	Sta 39 - Pony Tracks	Sta 33 - Los Trancos	Operations Center Overall
Buildings			Office
General condition	No building at site	Good, storage building	Good
Cleaning needed	NA	No	No
Repairs needed	NA	Patch small hole in side	No
Roofs	NA	Good	OK
Drains	NA	OK	OK
Other Needs	NA	NA	Need to enclose offices
Tanks			No Tanks at site
General condition	New bolted steel	New bolted steel	NA
Seismic connections Y/N	No	No	NA
Seismic connections tagged	No	No	NA
Automatic Seismic valves	Yes, need to reviw ops	No	NA
Overflow condition	Underground	Underground	NA
Vent condition	Good	Good	NA
Anticlimb condition	NA	NA	NA
Tank lip in good condition	NA	NA	NA
Other needs	NA	NA	NA
Pressure Tanks			No Pressure tank at site
General Condition	No Pressure tank at site	No Pressure tank at site	NA
Pressure tanks levels	NA	NA	NA
Site glass	NA	NA	
Vaults			NA
General Condition	OK	OK	NA
Operational flowmeter	Unknown	Unknown	
Genset			Small Ops genset
General condition	None	Old, obsolete?	No
Do we have autostart?	NA	No	No
Tested?	NA	Yes	NA
Hours	NA	1085.6	Clean, check
Needs	NA	Clean, check	
Misc			No
Encroachment concerns	No	No	No
Surveying needs	No	No	No
Easement maintenance	No	No	
Misc comments	Add logo and no trespassing	Add logo and no trespassing	
	Lables for new station number	Lables for new station number	
		Add valve to isolate PRV	
		Cut off mat at tank lip	
		Support pipe with wedgemount	
		Add guards to pumps	
Future Plans			New entrance road

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Storage Building near 4	Carport	Co. House #1 (Paul)
Fencing			
Fencing Description	NA	NA	Did not visit on tour in 2006
General Condition	NA	NA	
Fence Repairs	NA	NA	
Fence Replacement	NA	NA	
New Fence required	NA	NA	
Gardening Services			
Trimming	Included in Ops Center	Included in Ops Center	NA
Weed spraying	NA	NA	
Leaf Blowing	NA	NA	
Other Contract	NA	NA	
Other Vegetation Concern			
General Comments			
Pavement			
General Condition	NA	NA	
Crack Seal	NA	NA	
Overlay	NA	NA	
Patch Pave	NA	NA	
Replace	NA	NA	
Slurry	NA	NA	
Rock	NA	NA	
Drainage issues	NA	NA	
Slopes & Retaining Walls			
Steep slopes	NA	NA	
Retaining walls	NA	NA	
Repairs needed	NA	NA	
Slide activity noted	NA	NA	
Slope clean up needed	NA	NA	
Geotech report needed	NA	NA	
Painting			
Pump condition	NA	NA	
Piping condition	NA	NA	
Building/shelter exterior cond	Good	New	
Tank Exterior condition	NA	NA	
Interior condition	Good	New	
Recommendations	None	None	
Pumps & Piping			
General Condition	No pumps at site	No pumps at site	
Cleaning needed	NA	NA	
Packing leaks noted	NA	NA	
Lubrication required	NA	NA	
Vibration	NA	NA	
Heating issues	NA	NA	
Noise	NA	NA	
Controls			
General Condition	NA	NA	
RTU Type	NA	NA	
Panelboard issues	NA	NA	
Panelboard maintenance	NA	NA	

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Storage Building near 4	Carport	Co. House #1 (Paul)
Buildings	Storage	Carport	
General condition	Good	Good	
Cleaning needed	Yes, rat problems	No	
Repairs needed	No	No	
Roofs	OK	OK	
Drains	OK	New	
Other Needs	Discard boxes and straighten		
Tanks	No Tanks at site	No Tanks at site	
General condition	NA	NA	
Seismic connections Y/N	NA	NA	
Seismic connections tagged	NA	NA	
Automatic Seismic valves	NA	NA	
Overflow condition	NA	NA	
Vent condition	NA	NA	
Anticlimb condition	NA	NA	
Tank lip in good condition	NA	NA	
Other needs			
Pressure Tanks	No Pressure tank at site	No Pressure tank at site	
General Condition	NA	NA	
Pressure tanks levels	NA	NA	
Site glass			
Vaults	NA	NA	
General Condition	NA	NA	
Operational flowmeter			
Genset	None	None	
General condition	NA	NA	
Do we have autostart?	NA	NA	
Tested?	NA	NA	
Hours	NA	NA	
Needs			
Misc			
Encroachment concerns	No	No	
Surveying needs	No	No	
Easement maintenance	No	No	
Misc comments			
Future Plans		Consider expansion of carport	

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Co House #2 (Cary)	Station 4 - FIGH	Station 4 C
Fencing			
Fencing Description	Did not visit on tour in 2006	None (rely on front gate)	None (rely on front gate)
General Condition		NA	NA
Fence Repairs		Some redwood rail needed	Some redwood rail needed
Fence Replacement		NA	NA
New Fence required		NA	NA
Gardening Services			
Trimming	NA	Included in Ops Center	Included in Ops Center
Weed spraying		NA	NA
Leaf Blowing		NA	NA
Other Contract		NA	NA
Other Vegetation Concern			
General Comments		Trim trees over 4F Remove scotch broom	
Pavement			
General Condition		Good	Good
Crack Seal		Yes	Yes
Overlay		NA	NA
Patch Pave		NA	NA
Replace		NA	NA
Slurry		NA	NA
Rock		NA	NA
Drainage issues		Clean grass from catch basin	NA
Slopes & Retaining Walls			
Steep slopes		None	None
Retaining walls		None	None
Repairs needed		NA	NA
Slide activity noted		NA	NA
Slope clean up needed		NA	NA
Geotech report needed		NA	NA
Painting			
Pump condition		4-I needed	Paint needed
Piping condition		4-I needed	Paint needed
Building/shelter exterior cond		Good	Good
Tank Exterior condition		Good	NA
Interior condition		Good	Paint needed
Recommendations		Paint all bare metal	Clean and paint
Pumps & Piping			
General Condition		OK	OK
Cleaning needed		Yes	Yes
Packing leaks noted		Yes	Yes
Lubrication required		Likely	Likely
Vibration		No	No
Heating issues		No	No
Noise		No	No
Controls			
General Condition		OK	Old
RTU Type		New SCADA pak	Old syte
Panelboard issues		none	evaluate replacement
Panelboard maintenance		needs cleaning	needs cleaning

Public Version

Bear Gulch
Property Condition Report
2006

Facility	Co House #2 (Cary)	Station 4 - FIGH	Station 4 C
Buildings			
General condition		Good	OK, but old
Cleaning needed		No	Yes
Repairs needed		No	replace broken windows
Roofs		Good	OK
Drains		Good	OK
Other Needs		replace light bulbs	Epoxy floor
Tanks			
General condition		No Tanks at site	No Tanks at site
Seismic connections Y/N		NA	NA
Seismic connections tagged		NA	NA
Automatic Seismic valves		NA	NA
Overflow condition		NA	NA
Vent condition		NA	NA
Anticlimb condition		NA	NA
Tank lip in good condition		NA	NA
Other needs		NA	NA
Pressure Tanks			
General Condition		Both good	See 4-FIGH
Pressure tanks levels		discharge low, suction ok	
Site glass		Need cleaning	
Vaults			
General Condition		Needs cleaning & rock	NA
Operational flowmeter		Yes	NA
Genset			
General condition		None	None
Do we have autostart?		NA	NA
Tested?		NA	NA
Hours		NA	NA
Needs		NA	NA
Misc			
Encroachment concerns		No	No
Surveying needs		No	No
Easement maintenance		No	No
Misc comments		Pressure tanks need locks	Move charts to FO or SCADA
Future Plans		Add Gen set	
		Consider permanent PRV	
		Consider low head pump	
		Consdier C&H modifications	

Bear Gulch
Property Condition Report
2006

Public Version

Facility	Station 4-D	Sta 2 - Upflow clarifiers	Sta 2 - Filters, Chem. & Ops bld
Fencing			
Fencing Description	None (rely on front gate)	None (rely on front gate)	None (rely on front gate)
General Condition	NA	NA	NA
Fence Repairs	NA	NA	NA
Fence Replacement	NA	NA	NA
New Fence required	NA	NA	NA
Gardening Services			
Trimming	Included in Ops Center	Included in Ops Center	Included in Ops Center
Weed spraying	NA	NA	NA
Leaf Blowing	NA	NA	NA
Other Contract	NA	NA	NA
Other Vegetation Concern	Tree pruning needed		
General Comments			
Pavement			
General Condition	None	OK	OK
Crack Seal	NA	Yes	Yes
Overlay	NA	NA	NA
Patch Pave	NA	NA	Pave around plant
Replace	NA	NA	NA
Slurry	NA	NA	NA
Rock	NA	NA	NA
Drainage issues	NA	None	Fix standing water issue
Slopes & Retaining Walls			
Steep slopes	None	No	None
Retaining walls	None	Yes	None
Repairs needed	NA	No	NA
Slide activity noted	NA	Settlement of retaining wall	NA
Slope clean up needed	NA	No	NA
Geotech report needed	NA	Possibly	NA
Painting			
Pump condition	Paint needed	Paint mixer pump?	Backwash OK
Piping condition	Paint needed	Newly painted	Newly painted
Building/shelter exterior cond	New	NA	Newly painted
Tank Exterior condition	NA	Good, stainless steel	NA
Interior condition	Paint needed	NA	Need paint is some rooms
Recommendations	Hold off painting	OK	Paint walls as needed
Pumps & Piping			(Backwash pump)
General Condition	OK	New mixer	OK
Cleaning needed	Yes	yes	No
Packing leaks noted	No	No	No
Lubrication required	No	check precharge	Likely
Vibration	No	No	No
Heating issues	Some	No	No
Noise	Some	No	No
Controls			
General Condition	Manual	OK	Old
RTU Type	NA	at plant	NA
Panelboard issues	NA	NA	evalute replacement
Panelboard maintenance	NA	NA	needs cleaning

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Bear Gulch
Property Condition Report
2006

Facility	Station 4-D	Sta 2 - Upflow clarifiers	Sta 2 - Filters, Chem, & Ops bld
Buildings			
General condition	OK	No building at site	Good
Cleaning needed	Yes	NA	Some areas
Repairs needed	No	NA	
Roofs	No	NA	
Drains	No	NA	
Other Needs		NA	
Tanks			
General condition	No Tanks at site	No Tanks at site	No Tanks at site
Seismic connections Y/N	NA	NA	NA
Seismic connections tagged	NA	NA	NA
Automatic Seismic valves	NA	NA	NA
Overflow condition	NA	NA	NA
Vent condition	NA	NA	NA
Anticlimb condition	NA	NA	NA
Tank lip in good condition	NA	NA	NA
Other needs	NA	NA	NA
Pressure Tanks			
General Condition	See 4-FIGH	No Pressure tank at site	No Pressure tank at site
Pressure tanks levels		NA	NA
Site glass		NA	NA
Vaults			
General Condition	NA	Good -- adjust sump pump	OK
Operational flowmeter	NA	Blow out dirt & spider webs	Yes
Genset	Direct drive gasoline		
General condition	Old	None	None
Do we have autostart?	No	NA	NA
Tested?	No	NA	NA
Hours	NA	NA	NA
Needs	Bolt down battery box	NA	NA
Misc			
Encroachment concerns	No	No	No
Surveying needs	No	No	No
Easement maintenance	NO	No	No
Misc comments	Need new tuffshed	Clean up excess media on ground	Paint rusting stairs
		Fix air leak	Pipe turbidimeter to drain
		Discard plexiglass cover	Clean up hoses, elec cords
		Monitor wall settlement	Clean up graveyard, old garden
			Paint rails, boxes, air-pipe
			Intall SCADA restraint
Future Plans	Abandon with 4 gen-set?	Media replacement	Future station 2 gen-set
			Replace control valves
			Consider weather enclosure

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Facility	Sta 2 - Sump & blower building	Sta 2 - UV System	Sta 2 Lake Tanks
Fencing			
Fencing Description	None (rely on front gate)	None (rely on front gate)	None (rely on front gate)
General Condition	NA	NA	NA
Fence Repairs	NA	NA	NA
Fence Replacement	NA	NA	NA
New Fence required	NA	NA	NA
Gardening Services			
Trimming	Included in Ops Center	Included in Ops Center	Included in Ops Center
Weed spraying	NA	NA	NA
Leaf Blowing	NA	NA	NA
Other Contract	NA	NA	NA
Other Vegetation Concern			
General Comments			
Pavement			
General Condition	OK	OK	OK - Rock only
Crack Seal	Yes	Yes	NA
Overlay	NA	NA	NA
Patch Pave	NA	NA	Budget for tank berm AC
Replace	NA	NA	NA
Slurry	NA	NA	NA
Rock	NA	NA	NA
Drainage issues	None	None	None
Slopes & Retaining Walls			
Steep slopes	None	None	Yes
Retaining walls	None	None	No
Repairs needed	NA	NA	No
Slide activity noted	NA	NA	Some sluffing, monitor
Slope clean up needed	NA	NA	No
Geotech report needed	NA	NA	No
Painting			
Pump condition	OK	NA	No pump
Piping condition	OK	Paint all piping	New paint
Building/shelter exterior cond	Newly painted	Included with Ops building	None
Tank Exterior condition	NA	NA	New paint
Interior condition	OK	Newly painted	NA
Recommendations	Paint sample pump box	Paint all piping	NA
Pumps & Piping	(Sump pumps)		
General Condition	Good	New	No pumps at site
Cleaning needed	No	Some	NA
Packing leaks noted	No	NA	NA
Lubrication required	Likely	NA	NA
Vibration	No	NA	NA
Heating issues	No	NA	NA
Noise	No	NA	NA
Controls			
General Condition	OK	New	NA
RTU Type	at plant	New	NA
Panelboard issues	NA	None	NA
Panelboard maintenance	NA	None	NA

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Bear Gulch
Property Condition Report
2006

Facility	Sta 2 - Sump & blower building	Sta 2 - UV System	Sta 2 Lake Tanks
Buildings			
General condition	Good	Good	No building at site
Cleaning needed	Yes, finish floors	Yes, epoxy floors	NA
Repairs needed	sheet metal at openings	No	NA
Roofs	OK	OK	NA
Drains	OK	OK	NA
Other Needs			NA
Tanks			
General condition	No Tanks at site	No Tanks at site	Old, not to current code
Seismic connections Y/N	NA	NA	Yes
Seismic connections tagged	NA	NA	No, needed
Automatic Seismic valves	NA	NA	No
Overflow condition	NA	NA	OK
Vent condition	NA	NA	OK
Anticlimb condition	NA	NA	OK
Tank lip in good condition	NA	NA	OK
Other needs	NA	NA	bolted foundation, roofs
Pressure Tanks			
General Condition	No Pressure tank at site	No Pressure tank at site	No Pressure tank at site
Pressure tanks levels	NA	NA	NA
Site glass	NA	NA	NA
Vaults			
General Condition	OK	OK	OK
Operational flowmeter	NA	NA	NA
Genset			
General condition	None	None	None
Do we have autostart?	NA	NA	NA
Tested?	NA	NA	NA
Hours	NA	NA	NA
Needs	NA	NA	NA
Misc			
Encroachment concerns	No	No	No
Surveying needs	No	No	No
Easement maintenance	No	No	No
Misc comments	Fix leaking air realease	Sawcut floor for drain & reroute	Catch basin drainage issues
	New Window screen	Remove extra parts, tools, hose	
	Remove bolts in blower area		
	Remove sump pumps& shop vac		
	Service compressor/blower		
	Unistrut		
Future Plans			Replace with larger tank

Bear Gulch
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2006

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Facility	Sta 2 - Chloramination System	Sta 2 Chemical Systems	Sta 2 Settling ponds
Fencing			
Fencing Description	None (rely on front gate)	None (rely on front gate)	Did not visit on tour in 2006
General Condition	NA	NA	NA
Fence Repairs	NA	NA	NA
Fence Replacement	NA	NA	NA
New Fence required	NA	NA	NA
Gardening Services			
Trimming	Included in Ops Center	Included in Ops Center	Included in Ops Center
Weed spraying	NA	NA	NA
Leaf Blowing	NA	NA	NA
Other Contract	NA	NA	NA
Other Vegetation Concern			
General Comments			
Pavement			
General Condition	OK - Rock only	AC, good condition	
Crack Seal	NA	NA	
Overlay	NA	NA	
Patch Pave	NA	NA	
Replace	NA	NA	
Slurry	NA	NA	
Rock	NA	NA	
Drainage issues	Water weeping from old line	NA	
Slopes & Retaining Walls			
Steep slopes	None	None	
Retaining walls	None	None	
Repairs needed	NA	NA	
Slide activity noted	NA	NA	
Slope clean up needed	NA	NA	
Geotech report needed	NA	NA	
Painting			
Pump condition	No pump	OK	
Piping condition	New paint	OK	
Building/shelter exterior cond	New	NA	
Tank Exterior condition	NA	OK	
Interior condition	New	OK	
Recommendations	NA	NA	
Pumps & Piping			
General Condition	New	OK	
Cleaning needed	Clean building	No	
Packing leaks noted	NA	NA	
Lubrication required	NA	NA	
Vibration	NA	NA	
Heating issues	NA	NA	
Noise	NA	NA	
Controls			
General Condition	New	NA	
RTU Type	NA	NA	
Panelboard issues	NA	NA	
Panelboard maintenance	NA	NA	

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Bear Gulch
Property Condition Report
2006

Facility	Sta 2 - Chloramination System	Sta 2 Chemical Systems	Sta 2 Settling ponds
Buildings			
General condition	New	No building at site	
Cleaning needed	Clean & remove debris	NA	
Repairs needed	No	NA	
Roofs	OK	NA	
Drains	OK	NA	
Other Needs	NA	NA	
Tanks			
General condition	Stainless	Chemical tanks Good	
Seismic connections Y/N	OK	No, retrained	
Seismic connections tagged	NA	No	
Automatic Seismic valves	NA	NA	
Overflow condition	OK	OK	
Vent condition	OK	OK	
Anticlimb condition	NA	NA	
Tank lip in good condition	NA	NA	
Other needs	NA		
Pressure Tanks			
General Condition	No Pressure tank at site	No Pressure tank at site	
Pressure tanks levels	NA	NA	
Site glass	NA	NA	
Vaults			
General Condition	OK	OK	
Operational flowmeter	NA	NA	
Genset			
General condition	None	None	
Do we have autostart?	NA	NA	
Tested?	NA	NA	
Hours	NA	NA	
Needs	NA	NA	
Misc			
Encroachment concerns	No	No	
Surveying needs	No	No	
Easement maintenance	No	No	
Misc comments		Remove old lines in Cl2 room New Sheetrock/formica in CL2	
Future Plans		Upgrade lab facilities	

Bear Gulch
Property Condition Report
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Facility	Sta 2 Dam & apprurtenances	Sta 5 - Intermediate	Station 11
Fencing			
Fencing Description	Did not visit on tour in 2006	Chain link & 4 strand barb	Chain link
General Condition	See DSOD report for	Good	OK
Fence Repairs	2005 Operations	In progress	NA
Fence Replacement		NA	NA
New Fence required		NA	NA
Gardening Services			
Trimming		NA	NA
Weed spraying	Special equipment	2x per year	2x per year
Leaf Blowing		1x per month	1x per month
Other Contract		NA	NA
Other Vegetation Concern	Remove trees on dam	Clear underbrush along drive	
General Comments	remove weeds	Remove scotch broom	
Pavement			
General Condition		New	Rock only
Crack Seal		Needed	NA
Overlay		NA	NA
Patch Pave		Back of building	NA
Replace		NA	NA
Slurry		Needed	NA
Rock		NA	Could use more
Drainage issues		conduit issues	Poor drainage for packing
Slopes & Retaining Walls			
Steep slopes		yes	No
Retaining walls		yes	No
Repairs needed		no	No
Slide activity noted		no	No
Slope clean up needed		no	No
Geotech report needed		no	No
Painting			
Pump condition		New	Poor
Piping condition		New	Poor
Building/shelter exterior cond		New	Poor
Tank Exterior condition		Good	NA
Interior condition		New	NA
Recommendations		NA	Paint equipment
Pumps & Piping			
General Condition		New	Poor
Cleaning needed		Yes, wipe down	Yes, badly
Packing leaks noted		No	Yes
Lubrication required		No	Likely
Vibration		No	No
Heating issues		No	No
Noise		No	No
Controls			
General Condition		New	Old
RTU Type		New style	Old Style
Panelboard issues		None	Old
Panelboard maintenance		None	Yes

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Bear Gulch
Property Condition Report
2006

Facility	Sta 2 Dam & apprurtenances	Sta 5 - Intermediate	Station 11
Buildings			
General condition		New	No building at site
Cleaning needed		minor wipe down	NA
Repairs needed		No	NA
Roofs		Good	NA
Drains		Good	NA
Other Needs		Change air filters	NA
Tanks			
General condition		OK	No Tanks at site
Seismic connections Y/N		Yes	NA
Seismic connections tagged		No, needed	NA
Automatic Seismic valves		No	NA
Overflow condition		OK	NA
Vent condition		OK	NA
Anticlimb condition		OK	NA
Tank lip in good condition		9 OK, 8 poor	NA
Other needs		clean with algecide	NA
Pressure Tanks			
General Condition		New	OK
Pressure tanks levels		OK	Power wash, algecide
Site glass		OK	OK
Vaults			
General Condition		Good	OK
Operational flowmeter		Yes	No
Genset			
General condition		New	None
Do we have autostart?		Yes	NA
Tested?		Yes	NA
Hours		78.3	NA
Needs		wipe down, anchor battery	NA
Misc			
Encroachment concerns		No	None
Surveying needs		No	None
Easement maintenance		No	No
Misc comments		Get storage unit for gen set room.	
		Clean muddy floors	
		Tank 8 paint piping & EBBA	
		Weed tank berms	
		pick up ladder	
		Install blind flange on tank 6	
Future Plans		5 million gallon tank	New panelboard

Appendix K
Analyses of Individual Areas:

Woodside Highlands
Woodside Glens
Woodside Hills
Ladera
Downtown Menlo Park

Contents

Purpose and Overview **K-1**

K-1 Woodside Highlands Area **K-1-1**

K-2 Woodside Glens Area **K-2-1**

K-3 Woodside Hills Area **K-3-1**

K-4 Ladera Area **K-4-1**

K-5 Downtown Menlo Park Area **K-5-1**

Figures

Follows

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K-2-1 Woodside Glens Area K-2-1
K-3-1 Woodside Hills Area K-3-1
K-4-1 Ladera Area K-4-1
K-5-1 Downtown Menlo Park Area K-5-1

Appendix K
Analysis of Individual Areas

Purpose and Overview

The Water Supply & Facilities Master Plan for the Bear Gulch District evaluates and recommends improvements for the overall system. In addition, the following five individual areas were evaluated in more detail as part of the master plan:

- Woodside Highlands (Appendix K-1);
- Woodside Glens (Appendix K-2);
- Woodside Hills (Appendix K-3);
- Ladera (Appendix K-4); and
- Downtown Menlo Park (Appendix K-5).

Figure K-1 shows the location of these individual areas within the Bear Gulch District. This Appendix discusses each area separately, with respect to the following elements:

- Area Boundary
- Current Operating Conditions
- Local Constraints and Issues
- Performance Objectives
- Potential Improvements

The evaluation is based on the system-wide performance objectives established for the Bear Gulch District (Section 5 of the master plan report). Key concerns are improving service reliability during normal operations and emergency conditions, and pipeline replacement needs. In addition, local objectives include eliminating dead ends to improve hydraulics and water quality, facilitating maintenance efforts by eliminating difficult easements and backyard easements, and improving control systems.

Some potential improvements discussed herein are projects specifically included in the Master Plan recommendations (Section 9 of the master plan report). Others are projects that would be implemented as part of ongoing District replacement/rehabilitation efforts; and general budget placeholders are included in the master plan for such projects.

Specific projects and priorities for these areas will be identified by District staff for implementation of improvements based on overall District needs. As part of the design process, detailed predesign evaluations should be conducted to confirm the specific needs and requirements for each individual project.

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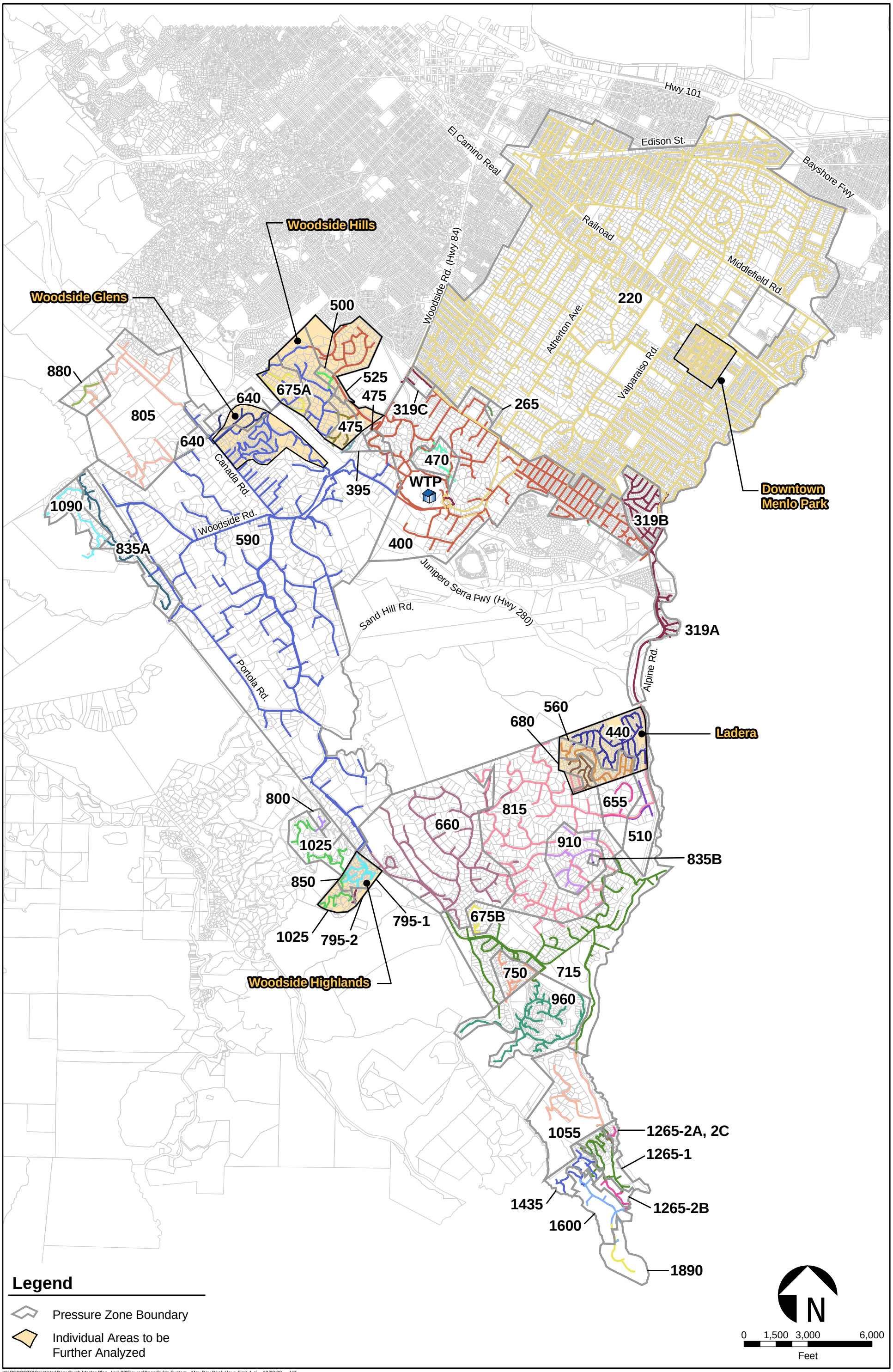

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CDM

Figure K-1
Individual Areas of Further Investigation within Bear Gulch District

Appendix K-1
Woodside Highlands Area

Area Boundary

The Woodside Highlands area of Portola Valley is shown on Figure K-1-1. The figure also shows the water system facilities serving the area.

The Woodside Highlands area is located off of Portola Road and is bounded by properties on Wayside Road, Russell Avenue, and Santa Maria Avenue. The area includes Zones 795-1, 795-2, 850, and the southern portion of 1025.

This evaluation does not include the Hayfields area or the Old La Honda main extension project area in the northern portion of zone 1025 that are fed from the Woodside Highlands area tanks and pump stations.

Current Operating Conditions

The Woodside Highlands area is essentially built-out, with a total average day demand of about 0.03 mgd for the entire area including zones 795-1, 795-2, 850, and a 1025 south of station 7. Due to hilly steep terrain, the small pressure zones serving the area are unlikely to ever be consolidated. The two 795 zones are physically separate and are thus identified as 795-1 and 795-2.

The Woodside Highlands area is supplied by pumping from lower zones. Pumping for this small area is very complex, as discussed below.

Pump station 5 at the Bear Gulch Reservoir supplies the water to the 590 zone which feeds the Woodside Highlands area. Under ideal operating conditions, the automatic valve located at pump station 8 on Portola Road opens to allow excess pressure (greater than 80 psi) from zone 590 to fill station 6 Coombsville tank (0.2 MG capacity) through an 8-inch line. When zone 590 pressure at the suction side of station 8 is between 50 and 80 psi, the valve remains closed, isolating zone 590 from Coombsville tank. When pressure is less than 50 psi, the valve opens allowing Coombville tank to supply zone 590 and maintain 50 psi in the zone. Coombsville tank fills when zone 590 pressure is above 80 psi, and drafts when pressure is less than 50 psi, or when pump station 6 is operating.

When zone 590 is stressed and cannot maintain enough pressure to fill Coombsville tank, then the normally closed valve at the redwood gate in station 8 is manually opened. This allows station 8 discharge to fill Coombsville tank. Station 8 discharge is in zone 660, which has 2.0 MG storage from two Arrowhead tanks, which backflow to fill Coombsville tank when the redwood gate valve is open. An altitude valve controls water level in Coombsville tank when the system is operated in this manner, which is primarily in summer. The gate is usually left open continuously for several months while demand remains high.

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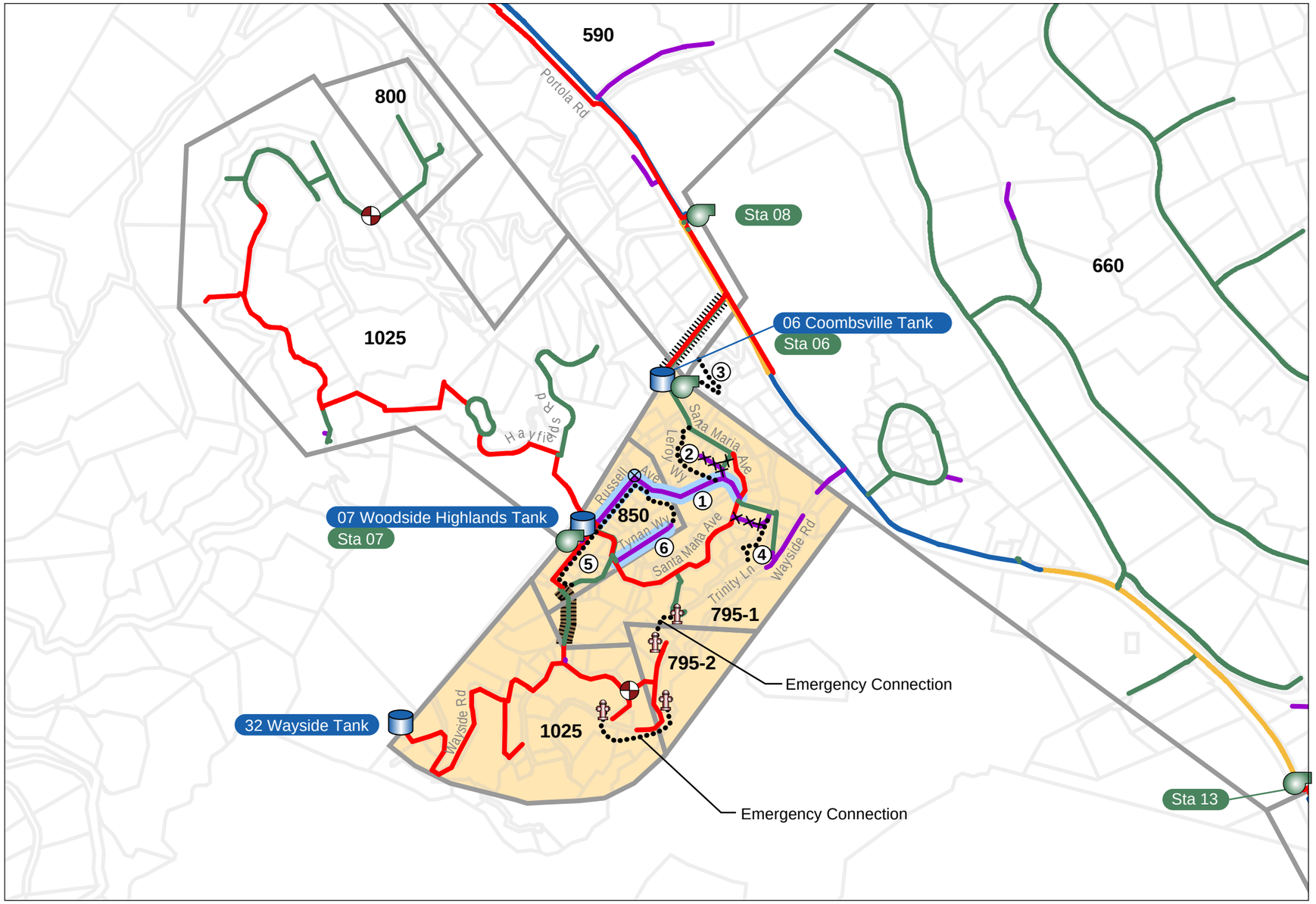

Legend

Diameter

- 1-5 inch
- 6 inch
- 8 inch
- 10-12 inch
- 14-18 inch
- 20-24 inch

- Tank(s)
- Pump Station Sta XX
- Pressure Reducing Valve
- Normally Closed Valve
- Fire Hydrant
- Pressure Zone Boundary
- Woodside Highlands Study Area
- Upsize Existing Pipeline
- Install New Pipeline
- Abandon Pipeline
- Problematic Easement
- Slide Area

Pipeline Improvements

Zone 795-1

1. Russell Ave, Sta 7 to Santa Maria Ave.
2. Leroy Way
3. Santa Maria Ave
4. Trinity Lane

Zone 850

5. Russell Ave, Tynan to Tynam
6. Tynam Way

N

0 750 1,500
Feet

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Figure K-1-1
Woodside Highlands Area

Pump station 6 delivers supply from Coombsville tank into zone 795-1. Customers in this pressure zone experience a fairly uniform hydraulic grade of approximately 795 feet. Six to 8-inch pipelines along Santa Maria Avenue convey supply from station 6 discharge to station 7 Woodside Highlands tank. The pump station is operated by SCADA controls based on water levels at Woodside Highlands tank (0.1 MG capacity).

Pump station 7 delivers water out of Woodside Highlands tank, along Russell Avenue, across a slide area, then west along Wayside Road to station 32 Wayside tank (0.25 MG capacity) serving the southern portion of zone 1025 at a fairly uniform hydraulic gradeline of approximately 1025 feet. Similar to station 6, pump station 7 is operated by SCADA based on water levels in Wayside Tank. Station 7 has two pumps. Pump B is intended for regular duty, while Pump C is intended for fire demand and will activate on low station discharge pressure. As a failsafe measure, this pump must be manually reset after fire flow operations. Only the part of zone 1025 that is between station 7 and Wayside tank is evaluated herein; the Hayfields and Old La Honda Road areas are not included.

Formerly, there was an 8-inch check valve at the top of a slide area between Wayside road and Russell Avenue that allowed flow from station 7 toward Wayside tank. Parallel to the check valve was a 2-inchbypass that limited flow from Wayside tank to the northern area of zone 1025 (Hayfields and Old La Honda areas) to approximately 200 gpm, in order to limit damage resulting from a failure of the slide area piping during a slide. Per District staff, the check valve at the slide location was recently removed, which allows Wayside Water to flow unimpeded to the northern portions of the 1025 zone to provide additional reliability. Prior to the check valve removal, the District observed low pressure from time to time in the Hayfields and Old La Honda Road areas during power outages.

From zone 1025, a 2-inch PRV in a vault at pump station 7 serves zone 850, which consists of homes on Russell Avenue and Tynan Way.

From zone 1025, a 4-inch PRV on Wayside Road near Horseshoe Way serves zone 795-2, which consists of a few blocks of customers along Wayside Road. This regulator reduces the hydraulic grade to 795 feet, thus matching the gradeline of station 6 discharge.

Local Constraints and Issues

The area has steep narrow roads with heavy vegetation. The area is fire-prone and has a large fuel load. The area has very limited access and several streets identified on the assessor's map are not viable public access. Several of the streets are in precarious locations that do not facilitate placement of water lines (such as lower Wayside Road). Drainage in the entire area is poor and flows from open hydrants and tank overflows can cause erosion and property damage.

Key local issues discussed with District staff include:

- The area has past and recent landslide activity that affects District operations. There are active slides located near station 6 and between station 7 and Wayside Tank.
- In several locations, water lines are located in easements in the rear of properties. A few areas have service lines connected to different streets with the private lines running across neighboring properties. There are concerns over the easement line in the slide area and over leaking easement lines (especially with Leroy Ave).
- Several mains are very old, in poor condition, and are of insufficient size.
- The area has a history of poor phone line communications, which in turn can lead to pumps staying on too long and overflowing the tanks. Manual backup controls for pumping in this area are also very unreliable.
- As a result of removing the check valve at the top of the slide area near Wayside Road, there is concern for uncontrolled losses from a failure of the slide area piping during a slide.

Performance Objectives

System-wide performance objectives have been established for the Bear Gulch District, as described in Section 5 of the master plan report. These performance objectives are applicable to the Woodside Highlands area.

Key concerns are improving service reliability during normal operations and emergency (fire) conditions, and pipeline replacement/rehabilitation needs. In addition, localized objectives include eliminating dead ends to improve hydraulics and water quality, facilitating maintenance efforts by eliminating difficult easements and backyard easements, and improving control systems. Existing Cal Water properties would be utilized as much as possible to avoid purchase of additional property.

Potential Improvements

Potential improvements to address the Woodside Highlands issues are discussed below. Some potential improvements are projects specifically included in the Master Plan recommendations (Section 9 of the master plan report). Others are projects that will be implemented as part of ongoing District replacement/rehabilitation efforts, and general budget placeholders are included in the master plan for such projects. Specific projects and priorities will be identified by District staff for implementation of improvements based on overall District needs. As part of the design process, detailed predesign evaluations should be conducted to confirm the specific needs and requirements for each individual project.

The Bear Gulch District Water Supply & Facilities Master Plan includes the following improvement projects within the Woodside Highlands area:

- Pump and motor at stations 6 and 7 are 39 years old, which is past Cal Water's expected service life of 34 years and should be evaluated for rehabilitation and/or replacement.

- Station 6 Coombsville tank is in good condition and 67 years old, which is older than Cal Water's expected service life of 48 years. Coombsville tank is one of four reservoirs in zone 590 that needs a combined capacity increase of 1.62 MG storage capacity. This tank should be evaluated for replacement with increased capacity.

- Both the Station 7 Woodside Highlands tank and the Station 32 Wayside tank require additional fire reserve capacity to meet the master plan performance criteria, as discussed below.
    - Station 7 Woodside Highlands tank, in zone 795-1, has 0.10 MG capacity and is short on fire flow capacity by 0.12 MG. Because it is at expected service life, in old condition, needs seismic retrofit, the tank should be evaluated for replacement with increased capacity.
    - Station 32 Wayside tank, in zone 1025, has 0.25 MG capacity and is short on fire flow capacity by 0.05 MG. Though it is in good condition and within Cal Water expected service life, the 40 year old tank should be evaluated for replacement with increased capacity.
    - As an option to replacing both existing tanks, one additional new tank of at least 0.17 MG (0.12 MG for Woodside Highlands plus 0.05 MG for Wayside) could meet the fire reserve deficiency for both zone 795-1 and 1025. Ideally, an additional tank would be located at Wayside station 32 where zone 1025 could access storage directly, and zone 795-1 could access it via a 4-inch bypass PRV at station 7. Another alternative would be to place the additional storage at station 7 Woodside Highlands tank. However, fire flows must be then be pumped into the 1025 zone from Woodside Highland tank, which would require a large fire pump and backup power at Station 7.

- Station 6 was recommended for back up power in the master plan because it met two critical pump station criteria (largest facility and sole source to multiple zones).

- Additional PRV capacity is needed to provide the master plan fire flows in zones 795-2 and 850. [Note: As part of the zone 850 PRV improvements, a relief PRV should be considered. Currently, the 2-inch PRV feeds zone 850 from zone 1025. If the current regulator fails open, pressures of approximately 150 PSI could occur in parts of the small 850 zone, which may lead to pipe and customer plumbing damage.]

- The Master Plan includes a budget placeholder for reinforcement of pipelines at critical slide locations. In the Woodside Highlands area, two pipelines (6-inch and

8-inch) have been identified at Santa Maria near Coombsville that provide transmission to Coombsville Reservoir. As described in Section 8.11.4 of the master plan, a bypass could be implemented consisting of a line isolation valve and a 12-inch diameter connection and manifold assembly, on either side of the defined hazard.

In addition, other localized improvements that the District could consider implementing to address specific local issues, as part of ongoing replacement/ rehabilitation programs, include:

- In zone 795-1, along Russell Avenue, from Santa Maria Avenue to station 7, upsize 1,300 feet of main to 8-inch. This would: 1) eliminate a 4-inch cast iron main in poor condition; 2) provide a parallel feed line to station 7 for half of the distance between station 6 and station 7; and 3) eliminate a dead end due to a normally closed valve on Russell Avenue. This location is labeled "1" on Figure K-1-1.

- In zone 795-1, install 700 feet of 8-inch main in Leroy Way, from Santa Maria Avenue to Russell Avenue. This main installation would: 1) eliminate a 6-inch cast iron main and a leaky 1-1/2-inch steel main in backyard easements; 2) eliminate one dead end; and 3) shorten the distance of non-looped piping between stations 6 and 7. This location is labeled "2" on Figure K-1-1.

- In 795-1 zone, install 700 LF of 8-inch main in Santa Maria Avenue, from Station 6 to 19 Santa Maria Avenue. This main installation would eliminate about 500 feet of 1-inch steel main in poor condition located in back yard easements. This location is labeled "3" on Figure K-1-1.

- There are two easements near the intersection of the east end of Russell Avenue and Santa Maria Avenue. The easement containing the 2-inch copper pipeline can be abandoned if a 2-inch line is extended 300 feet west from the existing 2-inch copper pipeline in Trinity Lane. If any fire hydrants are on the 2-inch line, it should be upsized to a minimum of 6-inches. This location is labeled "4" on Figure K-1-1.

- In zone 850, there is a dead end on the west side of Russell Avenue, and one on the west side of Tynan Way due to termination of the pipe. Along Russell Avenue between Tynan Way and Tynan Way, there is 700 feet of 1-, 2- and 4-inch diameter pipelines which are in poor condition. Installing 1,100 feet of new pipeline, at least 6-inches diameter, will eliminate the dead ends, create a looped network, and allow the small pipes to be abandoned. This location is labeled "5" on Figure K-1-1.

- In zone 850, a 450 foot 2-inch cast iron pipeline extends to the east side of Tynan Way and is a dead end pipeline. There is also a dead end at the 90 degree bend on Russell Avenue due to a normally closed valve. Installing 900 feet of new pipeline would eliminate the two dead ends, created a looped network, and eliminate the 2-inch pipeline. This location is labeled "6" on Figure K-1-1.

- Establish emergency jumper and booster connections to prepare for a large slide on the Wayside tank feed line. A potential site for jumping the 795-1 to the 795-2 zones is at 175 Trinity Lane. This connection was utilized by the District in the past to feed the homes on Trinity Lane during a water quality problem. A potential location to set the portable booster would be at 355 Wayside in conjunction with the Trinity jumper, the booster could then fill Wayside Tank.

- In place of the removed check valve at the top of the slide area between station 7 and Wayside tank, consider installing a valve with a sensor that will closes when detecting high flows from a main break due to slide.

- Implement control upgrades for station 6 and 7. The District is considering more innovative controls and backup controls for the pumping in this area.

- Evaluate replacement of unreliable phone lines with radio transmission towers, if line of sight between each station can be established.

Appendix K-2
Woodside Glens Area

Area Boundary

The Woodside Glens area is shown on Figure K-2-1. The figure also shows the water system facilities serving the area.

The Woodside Glens area is in the northern part of zone 590 and includes part of zone 640. It is bordered by Canada Road on the west, Laning Drive to the north, Interstate Highway 280 to the east and approximately Glenwood Avenue to the south.

The Woodside Glens evaluation also includes the 8-inch pipeline along Jane Road that continues south through an easement to Lindenbrook Court, as well the 8-inch pipeline that crosses Interstate highway 280 near Jane Road is included as well.

Current Operating Conditions

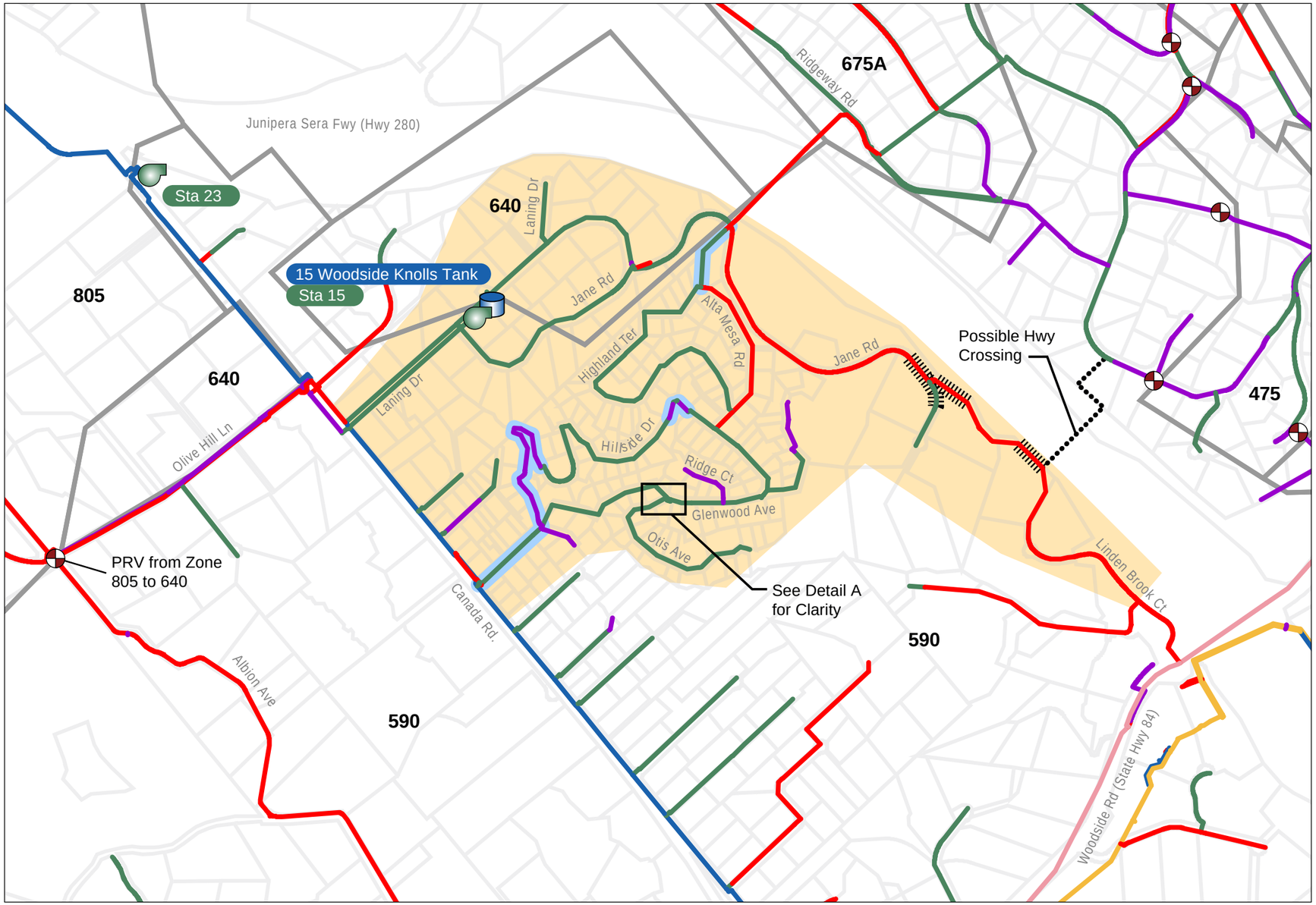
Woodside Glens encompasses parts of two zones, 590 and 640. The majority of the Woodside Glens area is in zone 590. Zone 640 is a small hydropneumatic zone. Buildout average day demand in the Woodside Glens area is a total of 0.19 mgd (0.16 mgd in the zone 590 portion and 0.03 mgd in the zone 640 portion).

Zone 590 is supplied via pump station 5 from zone 400. Zone 590 has three storage locations with a total of 2.2 MG capacity: 1.0 MG at station 19 Ridgeway tanks, east of Interstate highway 280; and 1.0 MG of ground level storage at station 16 Woodside reservoir, and 0.2 MG at Coombsville tank on the south side of zone 590. The four major transmission mains into the zone 590 portion of the Woodside Glens area are the 12-inch pipeline on Canada Road, the 8-inch on Lindenbrook Court/Jane Road, the 8-inch on Olive Hill Lane, and the 8-inch that crosses Interstate highway 280.

Station 5 pumps into zone 590 via transmission pipelines on Woodside Road. Two main routes branch off toward Ridgeway tanks from Woodside Road; an 8-inch line along Lindenbrook Court to Jane Road, and a 12-inch line on Canada Road. From Canada Road, transmission occurs mostly via a 6-inch line on Glenwood Avenue to an 8-inch line on Alta Mesa Road within Woodside Glens. Almost half of zone 590 storage is in Ridgeway tanks, which is connected to the rest of the zone by a single 8-inch pipeline crossing Interstate highway 280.

Zone 640 is supplied by two routes: 1) a 2-inch PRV from zone 805; and 2) a hydropneumatic pump station 15 from zone 590. From zone 590, station 23 pumps to zone 805 to fill station 22 Canada tank. Woodside Knolls tank (0.03 MG capacity) is located at the station 15 site and provides suction to the pump station 15. It is filled by an altitude valve from zone 590, and is at too low an elevation to serve zone 590.

Public Version



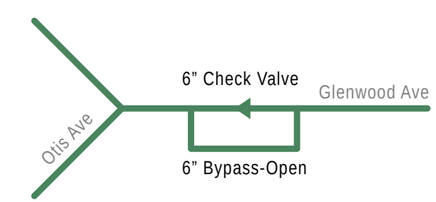
Legend

Diameter

- 1-5 inch
- 6 inch
- 8 inch
- 10-12 inch
- 14-18 inch
- 20-24 inch

- Tank(s)
- Pump Station Sta XX
- Pressure Reducing Valve
- Pressure Zone Boundary
- Woodside Glens Study Area
- Upsize Existing Pipeline
- Install New Pipeline
- Slide Area

Detail A



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Feet

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Figure K-2-1

Woodside Glens Area

During summer, supply to zone 640 is provided about equally from the PRV and from station 15. During winter when demands are lower, Woodside Knolls tank is drained and pump station 15 is taken out of service to avoid water quality problems due to the tank not cycling enough. During the winter, Zone 640 is fed entirely through the 2-inch PRV from zone 805.

Local Constraints and Issues

This area is very hilly with lots of vegetation and heavily wooded terrain (high fire risk). It has tight narrow winding roads in poor condition, which makes access difficult. Fire trucks have difficulty driving through the area.

The District prefers to dig into the streets only once for repair/replacement because of the difficult working conditions and major inconvenience to customers. Road work may block the only entrance to the area, which may require the District to provide shuttle services while under construction. Main construction is difficult due to serpentine rock conditions.

Key local issues discussed with District staff include:

- District staff would like to eliminate station 15, which serves zone 640, and/or consolidate with other zones. Station 15 is only needed during higher demand periods, and is taken out of service in the low demand winter months, when zone 640 is served solely by PRV from zone 805.
- A major concern is providing adequate fire flows, especially in locations with 4-inch and smaller mains. For example, pipelines as small as 1.5 inches are located along Hillside Drive near Glenwood Avenue.
- The 8-inch pipeline from Jane Road to Lindenbrook Court has slide issues. This pipeline is a major transmission line to station 19 Ridgeway tanks. If Jane Drive went out of service due to a slide, access of zone 590 portion of Woodside Glens to storage at Ridgeway tanks would be affected.
- There are some high ground elevation areas within the zone. The highest elevation area is the top of Laning Drive, where there have been customer complaints about low pressure.
- There was a formerly closed check valve at Glenwood Avenue and Otis Avenue that the District has been operating in open mode, and does not know what purpose it may have served.

Performance Objectives

System-wide performance objectives have been established for the Bear Gulch District, as described in Section 5 of the master plan report. These performance objectives are applicable to the Woodside Glens area. Key concerns are improving

service reliability during normal operations and emergency (fire) conditions, and pipeline replacement/rehabilitation needs.

Potential Improvements

Potential improvements to address the Woodside Glens issues are discussed below. Some potential improvements are projects specifically included in the Master Plan recommendations (Section 9 of the master plan report). Others are projects that will be implemented as part of ongoing District replacement/rehabilitation efforts, and general budget placeholders are included in the master plan for such projects. Specific projects and priorities will be identified by the District for implementation of improvements based on overall District needs. As part of the design process, detailed predesign evaluations should be conducted to confirm the specific needs and requirements for each individual project.

The Bear Gulch District Water Supply & Facilities Master Plan includes improvement projects within the Woodside Glens area related to pump station 15 (as discussed in Section 8. 11.2 of the master plan report). The District is considering taking station 15 permanently out of service for several reasons, including very low demands in winter, added operations and maintenance costs and facility age. Station 15 was constructed in 1953 and exceeds the expected service life.

The master plan includes the following option for taking pump station 15 out of service permanently:

- ***Eliminate station 15 and supply zone 640 solely by PRV from zone 805***.
    - The existing 2-inch PRV has adequate capacity to provide the buildout peak hour flow. However, an additional 6-inch PRV is required to provide the master plan fire flow plus maximum day demand.
    - The District noted that pipes near the PRV are fragile and that leaks are commonly created when valves are closed too quickly. As part of PRV improvements, replacement of poor condition pipelines in the area should also be evaluated. In particular, the existing 4-inch pipeline from the existing PRV to zone 640 (about 2,400 LF) should be replaced with a 12-inch pipeline to provide adequate capacity for fire flows.
    - Pump station 23 serving zone 805 would need 0.03 mgd additional capacity to meet zone 640 requirements.

If these improvements are made, Station 15 and the Woodside Knolls tank can be taken out of service. More detailed hydraulic evaluations should be done as part of predesign to identify specific pipeline improvements to undertake in conjunction with the PRV improvements, and to confirm pressures in the affected zones. The master plan model can be used for these detailed analyses.

Other options that the District could consider instead for service to zone 640 include:

- ***Rehabilitate station 15***. This station could remain in service and be rehabilitated. When the station is rehabilitated, replacement pump selection could consider pumping directly from zone 590, which has a higher hydraulic gradeline than the Woodside Knolls tank that currently provides suction to the pump station. If this is done, then the Woodside Knolls tank could be eliminated, assuming that the hydropneumatic tank has sufficient capacity.

- ***Relocate station 15 to station 23***. This option could be considered if space is available at station 23. The new pump would deliver supply directly from zone 590 to zone 640. This would consolidate facilities at one location, and would allow the District to eliminate the Woodside Knolls tank. The PRV from zone 805 could remain in service as backup. About 2,000 feet of new pipeline would be needed from station 23 along Canada Road to Olive Hill Lane.

- ***Rezone 640 to 675A and eliminate station 15***. Zone 675A, a small hydropneumatic zone located east of Interstate highway 280, is supplied by VFD pumps at station 19, Ridgeway. With this re-zoning, station 15 and the Woodside Knolls tank could be eliminated with the following improvements:

    - Additional pumping capacity in zone 675A – this zone already requires additional capacity to meet maximum day average hour plus fire flow, which is 2.46 mgd, not including zone 640. Existing pumps are deficient by 1.81 mgd for fire flow capacity in zone 675A. If zone 640 demands were included with 675A, pump capacity requirement would increase by 0.18 mgd, and increase pump deficiency to a total of 1.99 mgd, which is a small increase as fire flow capacity requirements are the same with zone 640.

    - About 1,000 feet of new 12-inch pipeline will be needed to connect zone 640 to zone 675A, including about 700 feet of jack and bore under Interstate highway 280 (parallel to the existing 590 pipeline in that alignment).

    - Re-zoning 640 to 675A would increase pressures at the high elevation services, but would not result in significantly higher pressures at the lower elevations in zone 640. Based on modeled elevations, static pressure in the lowest elevations of zone 640 would increase from 94 psi to 109 psi if it was rezoned to 675A.

In addition, other localized improvements that the District could consider implementing to address specific local issues, as part of ongoing replacement/ rehabilitation programs, include:

- The Master Plan includes a budget placeholder for reinforcement of pipelines at critical slide locations. The Jane Road pipeline should be prioritized for reinforcement at the slide area. As described in Section 8.11.4 of the master plan, a bypass could be implemented consisting of a line isolation valve and a 12-inch diameter connection and manifold assembly, on either side of the defined hazard.

- The Master Plan includes a budget placeholder for reinforcement of pipelines at creek crossings. Creek crossings would be reinforced by installing isolation valves and hydrants at either side of the crossing that would allow flexible bypass hoses to be used temporarily while damages are being permanently repaired. In the Woodside Glens area, two key pipelines (4-inch and 8-inch) cross Dry Creek at Olive Hill near Canada.

- Transmission capacity through Woodside Glens would improve reliability and fire flows. Figure K-2-1 shows the following proposed main replacements to improve transmission capacity from key supply points through the Woodside Glens system:

  - Replace 1,300 LF of pipeline less than 4-inch diameter in Hillside Drive with 8-inch pipeline. This includes 180 LF of 4-inch pipeline near Alta Mesa Road and Hillside Drive. Pipeline replacements, when needed in major loops should be 8-inch, instead of 6-inch, to provide additional fire flow reliability.

  - Replace 600 LF of 6-inch pipeline in Glenwood Avenue from the Canada Road supply point to Hillside Drive with 12-inch pipeline; and replace 450 LF of 6-inch pipeline in an easement from the Highway 280 & Jane Road supply point to Highland Terrace with 12-inch pipeline. These upgrades will significantly reduce headlosses when conveying high fire flows to zone 590 from key supply points into Woodside Glens, and will provide additional reliability for supply from either direction.

  - The existing system was developed prior to the fire flow standards established in the master plan. Cal Water is not required to undertake upgrades to the existing system to meet the new standards. However, Cal Water does use the information on the available fire flow when designing pipeline replacement projects. In general, if pipelines are replaced within the Woodside Glens area, it is recommended that a minimum 8-inch diameter be used for replacement to bolster fire flows. As a general guideline when planning for replacement projects, the required master plan fire flow amounts would likely not be met at hydrants served by: 1) small diameter dead-end pipes, generally less than 6-inch diameter; 2) 8-inch diameter dead-end pipes serving high ground elevation areas or very long dead-end segments; and 3) loops of 4-inch or smaller diameter pipes at the zone periphery located away from supply sources.

- The following projects have been identified by the District to replace leaky pipes:
  - 2400 LF of 6-inch steel and 4-inch cast iron in Olive Hill with 8-inch
  - 2500 LF of 6-inch steel in Lanning with 8-inch
  - 400 LF of 6-inch steel in Lanning Court with 6-inch
  - 300 LF of 2-inch cast iron in Ridge Court with 6-inch
- Another potential reliability improvement would be to provide a redundant crossing of Highway 280 into zone 590. If the single existing highway crossing went out of service, there would be no direct way for zone 590, including the Woodside Glens area, to access storage in station 19 Ridgeway tanks. Indirectly, Ridgeway storage could be passed through the PRV on Harcross into zone 400, which could be pumped into the main area of zone 590 via station 5. The only way to fill Ridgeway tanks would be via pump station 18, assuming it remains in service. An additional highway crossing transmission pipeline from Ridgeway tanks to zone 590 would provide additional reliability. The improvements would benefit all of zone 590, not just Woodside Glens.
  - A potential location for an additional crossing, as shown on Figure K-2-1, would be to install a pipeline from the easement off Lindenbrook Court, northeast under the highway, and connect to the zone 590 pipeline in Woodside Drive west of Kenmore Way. It would require a total of 1,200 feet of new 8-inch pipeline, with about half being jack and bore underneath the highway, and new easements on either side of the highway. Also about 1,600 feet of 4-inch pipelines in Woodside Drive, Ridgeway Road and Crest Road should be upsized to 8-inch pipe to handle transmission capabilities to and from Ridgeway tanks.
- As modeled, the check valve at Otis and Glenwood allows flow only westward on Glenwood Avenue toward Canada Road; and there is a parallel bypass valve that would allow flow in the opposite direction if open. In the past, historic records show that the parallel bypass was kept normally closed. However, the District has been operating the bypass in the open position, as it does not appear that the check valve serves any current purpose. This master plan evaluation concurs with the District's understanding that the check valve is not needed under current operations. With the bypass valve closed, flow toward the Ridgeway tanks is concentrated along Jane Road, which experiences high headlosses. With the bypass valve open (as currently operated), flow toward Ridgeway tanks is shared by pipelines in Jane Road and Canada Road, which reduces headlosses and increases pressures. Pressures near Jane Road and the Highway 280 crossing are about 10 psi higher under peak hour conditions with the valve open.

Appendix K-3
Woodside Hills Area

Area Boundary

The Woodside Hills area is shown on Figure K-3-1. The figure also shows the water system facilities serving the area.

Woodside Hills includes zones 395, 475A, 500, 525, 675A and small parts of zones 400 and 590. It consists of the Bear Gulch service area north of State Highway 84 (Woodside Road) and east of Interstate Highway 280. Las Pulgas Drive and Harcross Road define the northern boundary, while Fernside Street, parts of Woodside Drive, and High Road define the eastern boundary.

Current Operating Conditions

The Woodside Hills area is essentially built out, and comprises many small zones. Total average day demand in this area is 0.47 mgd at buildout. Zone 675A has about 0.14 mgd average day demand. The portions of the area in zones 400 and 590 have average day demands of about 0.14 mgd and 0.12 mgd, respectively. Zone 475A has about 0.04 mgd average day demand. Zones 395, 500, and 525 each have about 0.01 mgd average day demand.

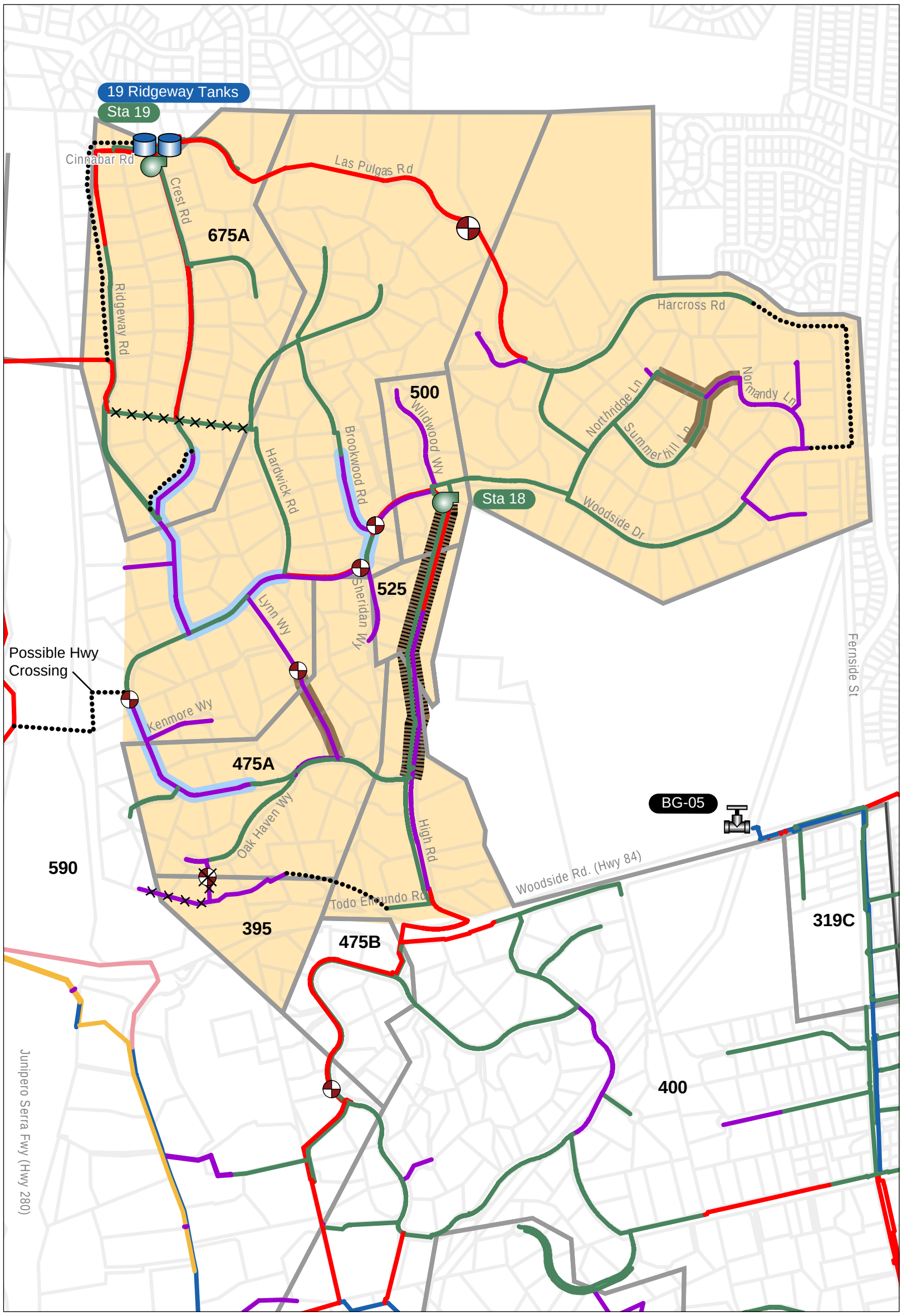
There are two pipelines that feed the Woodside Hills area. One is an 8-inch line that crosses Woodside Road at High Road in zone 400. The second is an 8-inch Interstate Highway 280 crossing in zone 590 near Jane Road. The 8-inch on High Road splits into a 4-inch and 6-inch pipeline connecting the northern section of zone 400.

Zone 400 is supplied by station 4 with storage in station 5 Intermediate tanks. The highest elevation area of zone 400 is in the Woodside Hills neighborhood northwest of state Highway 84. Supply to the northwest area of zone 400 occurs via two routes: by the parallel pipelines on High Road; and by a PRV from zone 590 on Las Pulgas Road. The PRV on Las Pulgas Road back feeds from zone 590 into zone 400.

Pump station 18, which also delivers supply from zone 400 to zone 590, is located at the north end of the easement with the parallel pipelines. Pump station 18 is occasionally used during summer high demand months to help fill Ridgeway tanks.

Zones 475A, 500, and 525 are very small zones supplied by PRVs from zone 590. Zone 395 is a very small zone supplied by a PRV from zone 475A.

Zone 675 is a hydropneumatic zone that is supplied from zone 590 via Ridgeway pump station 19, which has VFD pumps set at a constant 55 psi.



Legend

Diameter

- 1-5 inch
- 6 inch
- 8 inch
- 10-12 inch
- 14-18 inch
- 20-24 inch

- Tank(s)
- Turnout SFPUC
- Pump Station Sta XX
- Pressure Reducing Valve
- Pressure Zone Boundary
- Woodside Hills Study Area

- Upsize Existing Pipeline
- Install New Pipeline
- Abandon Pipeline
- Problematic Easement
- Slide Area

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Feet

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Figure K-3-1
Woodside Hills Area

Local Constraints and Issues

The area of zone 400 in Woodside Hills northwest of State Highway 84 has low pressures due to high elevations and undersized pipes. This area is fed by two undersized parallel pipelines, a 4-inch and a 6-inch pipeline along High Road, extending part way through an easement toward station 18. For the remainder of the easement nearest station 18, the parallel pipes are 6-inch and 8-inch in diameter.

In this northwest area of zone 400, the Bear Gulch District Water Supply & Facilities Master Plan evaluation observed low pressures during peak hour maximum day demand conditions due to high elevations and undersized transmission pipes.

Other key local issues discussed with District staff are summarized below:

- Eliminating/consolidating facilities, e.g., eliminating station 18 if possible.
- Combining small zones if possible, e.g., combining zones 500 and 525, and possibly 475, since all are at similar service elevations.
- Improving fire flows and circulation.
- Difficult easements. The worse easement locations are noted below:
    - High Road easement from station 18. The easement between High Road and station 18 is narrow, steep and inaccessible to trucks. Maintenance equipment and supplies must be carried into the easement. Access is very difficult and dangerous. If Station 18 were eliminated, as discussed above, it may be possible to also eliminate this easement.
    - Zone 400. The easement that connects pipelines in Summerhill Lane, Northridge Lane and Normandy Lane is inaccessible, leaky and has low flows. The easement between station 19 and Las Pulgas Road is overgrown along the unpaved road.
    - Zone 475A. The northern PRV into zone 475 from zone 590 on Lynn Way goes through an easement which is very difficult to access.
    - The 1,100 foot long easement from Ridgeway Road to Hardwick Road contains a 6-inch pipeline for zone 590. The easement, which cuts through zone 675A, is very difficult to access. This pipeline provides looped connections for the northern area of zone 590.

Performance Objectives

System-wide performance objectives have been established for the Bear Gulch District, as described in Section 5 of the master plan report. These performance objectives are applicable to the Woodside Hills area.

Key concerns are improving service reliability during normal operations and emergency (fire) conditions, and pipeline replacement/rehabilitation needs. In addition, localized objectives include eliminating dead ends to improve hydraulics and water quality, facilitating maintenance efforts by eliminating difficult easements, reducing maintenance by eliminating unnecessary facilities, and combining multiple small zones if possible.

Potential Improvements

Potential improvements to address the Woodside Highland issues are discussed below. Some potential improvements are projects specifically included in the Master Plan recommendations (Section 9 of the master plan report). Others are projects that will be implemented as part of ongoing District replacement/rehabilitation efforts, and general budget placeholders are included in the master plan for such projects. Specific projects and priorities will be identified by District staff for implementation of improvements based on overall District needs. As part of the design process, detailed predesign evaluations should be conducted to confirm the specific needs and requirements for each individual project.

Potential Elimination of Station 18

The Bear Gulch District Water Supply & Facilities Master Plan discusses pump station 18 (in Section 8. 11.2 of the master plan report). Station 18 is only used during summer high demand periods. It is 51 years old and in "okay" condition per the property condition report.

As discussed in Section 8.11.2 of the master plan report, one option would be to take Station 18 out of service and allow Station 5 to supply water to zone 590 without the occasional boost from station 18. Hydraulic analysis indicates that the 8-inch pipeline along Lindebrook Road and part of Jane Drive would need to be upsized if station 18 is removed from service and station 5 is used meet all zone demand. With the increased flow, the pipeline has headlosses of about 10 to 11 feet per 1000 feet. About 5,000 feet of this 8-inch pipeline, which helps convey water to Ridgeway tanks and to the north side of zone 400 in the Woodside Hills area across Highway 280, should be upsized to a 12-inch.

Another option for providing increased transmission capacity to help re-fill Ridgeway tanks during high demand periods would be implementation of the proposed transmission improvements through the Woodside Glens area, as discussed in Appendix K-2. If these Woodside Glens improvements are implemented, it may be possible to eliminate the Lindebrook Road & Jane Drive improvements by upsizing the Woodside Glens improvements to provide adequate capacity for re-filling the Ridgeway tanks. A more detailed hydraulic evaluation should be conducted as part of predesign studies.

There are reliability/redundancy considerations if station 18 and its associated easement on High Road were eliminated. Currently, there are only two supply points

into the Woodside Hills area of zone 590: an Interstate highway 280 crossing and from pump station 18 via the High Road easement pipeline. If pump station 18 were eliminated, only the single highway 280 feed to this area would remain.

Without station 18, if the single Highway 280 crossing were out of service, the Woodside Hills area would be reliant on available storage in the Ridgeway tanks, which could not be re-filled until the crossing is restored to service. Zone 475 could get lower pressure supply at the zone 400 gradeline via a check valve on High Road near the easement. The easement between High Road and pump station 18 must remain in service for the portion of zone 400 in Woodside Hills to continue receiving supply directly from the rest of zone 400 while the highway crossing is out of service. If the easement is eliminated, the northern part of zone 400 will also be dependent on available storage in the Ridgeway tanks.

To maintain the same level of reliability without pump station 18, a second highway crossing would have to be installed, possibly between Lindenbrook Court and Kenmore Way. The evaluation of the Woodside Glens area in Appendix K-2 also discusses the reliability benefits of a second highway crossing, since the existing pipeline easement between Lindenbrook Court and Jane Road is susceptible to slides. A second crossing would provide reliability benefits for all of zone 590.

A potential location for a second highway crossing, as shown on Figure K-3-1, would be to install a pipeline from the easement off Lindenbrook Court, northeast under the highway, and connect to the zone 590 pipeline in Woodside Drive west of Kenmore Way. It would require a total of 1,200 feet of new 8-inch pipeline, with about half being jack and bore underneath the highway, and new easements on either side of the highway. Also about 1,600 feet of 4-inch pipelines in Woodside Drive, Ridgeway Road and Crest Road should be upsized to 8-inch pipe to handle transmission capabilities to and from Ridgeway tanks. The improvements would provide reliability benefits to all of zone 590.

The easement from High Road should be eliminated only if pump station 18 is eliminated and a second highway crossing is installed for reliability. The northern part of zone 400 could be turned into a separate PRV zone fed by zone 590. In addition to the existing PRV on Las Pulgas Road, a second PRV could be located at the former station 18. This would provide two inflows into the northern 400 zone.

If station 18 and/or the easement remain in service, 2,000 feet of 4-inch cast iron main in High Road and the easement will eventually require replacement. Construction in this alignment will be difficult.

Potentially Combining Zones

The District plans to combine zone 395 into zone 400. PRV zone 395 served a block of customers off of Oakhaven Way. An old PG&E service will no longer be needed and

the PRV will be removed. About 800 feet of pipeline will be installed from Todo el Mundo Road in zone 400 extending westward to the existing zone 395 pipeline.

The master plan recommendations include PRV improvements to provide additional capacity for fire flows in the PRV zones including 395, 475A, 500 and 525. Implementation of the PRV improvements should consider potential zone combinations, as discussed below, in conjunction with related pipeline replacement projects.

Zones 500 and 525 could be combined into a single zone with grade line 525 feet. This would require installing 300 feet of pipeline on Woodside Drive to connect the two zones. Pressure in zone 500 would increase by 11 psi, to 93 psi in the lowest elevation of zone 500, which should be acceptable.

Zone 525 consists of customers along one block on Sheridan Way. Zone 475A could potentially be combined with zone 525 with 1,500 feet of new 8-inch pipeline to meet fire flow needs installed along Woodside Drive and Lynn Way. Woodside Drive between Brookwood Road and Sheridan Way has an 8-inch and 4-inch pipeline in zone 590. Due to relatively low elevations at the bottom of zone 475A, static pressures would increase up to 120 psi at the lowest elevations, which would require individual PRVs at customer services.

There are some general guidelines that the District could consider for operation of PRV zones with multiple PRV locations, in order to avoid "regulator bounce". The preferred operating mode would be to set one location as the primary PRV, while other locations are set at a lower grade line. For all normal operating conditions, the primary PRV should supply all flows into the zone, while the others do not operate. The other PRVs should be adjusted to a hydraulic grade line setting at least 5 feet lower than the primary PRV and set to open only during fire flows or maximum demand conditions. Operating a single PRV prevents pressure bounce which occurs when PRVs are set close enough to each other causing alternating irregular flows/pressures out of both PRVs. Each PRV should periodically be the primary PRV in order to maintain water quality and to exercise the valves.

Pipeline Replacement/Rehabilitation Improvements

As part of the District's ongoing pipeline replacement program, pipeline upsizing and some re-alignments would provide benefits in eliminating dead ends and easements, and in improving circulation and fire flows.

It is important to maintain looping in Summerhill Lane, Northridge Lane and Normandy Lane, as currently configured. One possible improvement is to eliminate the dead end at Harcross Road by installing 1,700 feet of new pipeline from the dead end to Fernside Street to Woodside Drive. This would also eliminate 400 feet of 2-inch dead end pipeline and associated easement off of Normandy Lane by providing

service connections from Fernside Street instead of from the easement off of Normandy Lane.

To increase looped piping in zone 590 near Ridgeway tanks, the following potential improvements should be considered:

- In order to eliminate 1,100 feet of easement between Ridgeway Road and Hardwick Road, the District is planning to upsize several areas of pipeline. About 550 feet of 4-inch pipeline on Crest road between Ridgeway Road and the current easement to Hardwick Road would be upsized to 8-inch. About 700 feet of 4-inch pipe on Brookwood Road and about 400 feet of 6-inch pipe on Woodside Drive would be upsized to 8-inch pipelines. This will strengthen looping in zone 590 to allow the easement to be eliminated.

- Install 1,700 feet of new pipeline along Ridgeway Road from the highway crossing to Cinnabar Road. Five hundred feet of easement and pipeline between Ridgeway Road and Crest Road would no longer be necessary. Reliability for Ridgeway storage access would increase by allowing two transmission pipelines into the tanks, instead of the current single transmission along Crest Road.

Four-inch pipelines and smaller in the area should be upsized to 6-inch or greater, per Cal Water replacement criterion. High priority improvements include:

- A total of 2,200 feet of 4-inch main would be upsized to 8-inch pipeline. The location includes 550 feet on Crest Road south of the easement, 850 feet on the south part of Ridgeway Road, and 800 feet on Woodside Road, west of Hardwick Road.

- 1,300 feet of 4-inch main along Woodside Road from Kenmore Way to Oakhaven Way

- 800 feet of 4-inch main on the south half of Brookwood and part of Woodside Road to Sheridan Way.

Appendix K-4
Ladera Area

Area Boundary

The Ladera area is shown on Figure K-4-1. The figure also shows the water system facilities serving the area.

The Ladera area is bordered by Alpine Road to the east, Stanford University property to the north, La Mesa Lane to the west, and approximately Westridge Drive to the south (Figure K-4-1). It consists of three zones: 680, 560 and 440.

Current Operating Conditions

The Ladera area is comprised of three very small zones: 680, 560 and 440). The area is essentially built out. The total average day demand at buildout for all zones is 0.16 mgd (0.01 mgd in zone 680; 0.02 mgd in zone 560; and 0.07 mgd in zone 440).

Station 20 currently pumps from zone 319A into zone 815. From zone 815, a PRV and altitude valve fills Station 28 Ladera tank, which is in zone 680. Storage for all the Ladera zones is provided in the Ladera tank.

From zone 680, several PRVs, ranging in size from 1.5 inches to 6 inches feed zone 560 from three locations. Zone 440 is supplied by PRV from two zones: from zone 560 via a 6-inch PRV on Durazno Way and from zone 815 via a 4-inch PRV on Alpine Road.

Local Constraints and Issues

For the Ladera area, key local issues discussed with District include:

- Improving the reliability of service to southern area, including Ladera area, from station 20.
- Eliminating difficult easements. Easements are often developed by adjacent property owners with landscapes and stone walls, and trees, all of which are difficult to replace. Easements are very narrow and difficult to access, being only 5 feet wide in some cases. Valves are difficult to locate. Zone 440 especially has many dead ends and easements.
- Eliminating dead ends if possible. There are many dead ends, and looping would improve hydraulics and water quality.
- Improving reliability of pipelines crossing slide areas. There are number of slide crossings in the Ladera area. These are steep hilly areas where mud slides or land slides cause pipeline damage.

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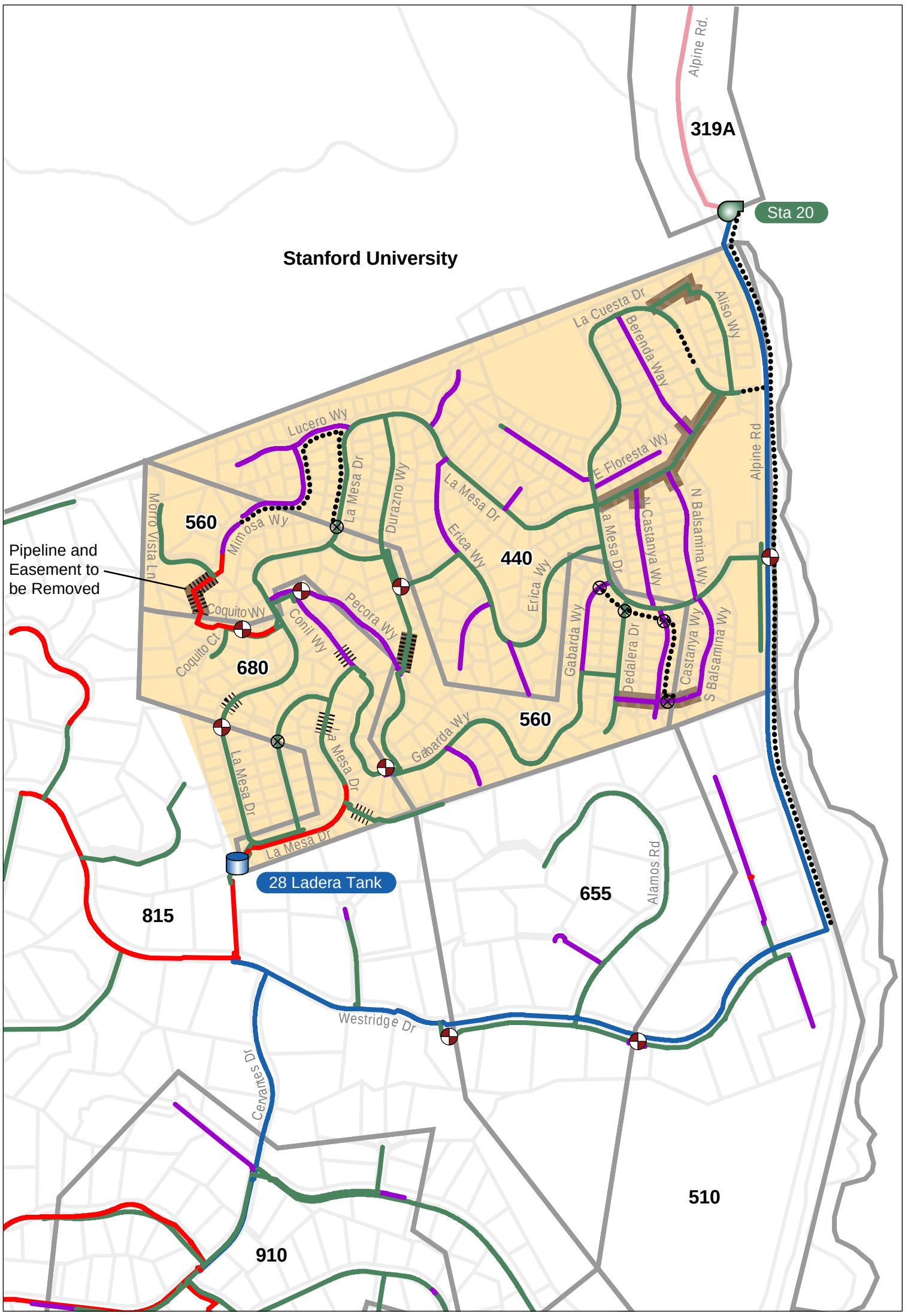

Legend

Diameter

- 1-5 inch
- 6 inch
- 8 inch
- 10-12 inch
- 14-18 inch
- 20-24 inch

- Tank(s)
- Pump Station Sta XX
- Pressure Reducing Valve
- Pressure Zone Boundary
- Ladera Area
- Normally Closed Valve

- Upsize Existing Pipeline
- Install New Pipeline
- Problematic Easement
- Slide Area

N

0 750 1,500
Feet

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Figure K-4-1
Ladera Area

- Improving PRV operations. Pressures downstream of the PRVs bounce around significantly, especially when settings are changed. When fire hydrants are opened, operational problems related to PRVs occur. PRV failure can cause the lower zone to experience high enough pressure to damage pipes or customer plumbing.

Performance Objectives

System-wide performance objectives have been established for the Bear Gulch District, as described in Section 5 of the master plan report. These performance objectives are applicable to the Ladera area.

Key concerns are reliability of pipelines in slide areas, eliminating dead ends to improve hydraulics and water quality, facilitating maintenance efforts by eliminating difficult easements, and reducing the number of PRV zones if possible.

Potential Improvements

Potential improvements to address Ladera issues are discussed below. Some potential improvements are projects specifically included in the Master Plan recommendations (Section 9 of the master plan report). Others are projects that will be implemented as part of ongoing District replacement/rehabilitation efforts, and general budget placeholders are included in the master plan for such projects. Specific projects and priorities will be identified by District staff for implementation of improvements based on overall District needs. As part of the design process, detailed predesign evaluations should be conducted to confirm the specific needs and requirements for each individual project.

The Bear Gulch District Water Supply & Facilities Master Plan includes the following improvement projects affecting the Ladera area, which are discussed in Section 8.11.2 of the report.

- Upsize pump station 20 to supply all of the southern part of Bear Gulch system in case pump station 8 is out of service. Buildout maximum day demand in the southern are is 3.8 mgd. The upsize would include four additional 550 gpm pumps and installing a 24-inch discharge transmission main along Alpine Road.

- Modify the pumping configuration at station 20 and have a set of low head pumps that would pump directly to zone 440, as well as the high head pumps to zone 815. Zone 440 would become a hydropneumatic zone (or would require VFD pumps). As a hydropneumatic zone, required pumping capacity should be provided to meet peak hour demand on the maximum day. It is assumed that fire storage would continue to be provided from zone 680 by gravity via the existing PRVs, which would become standby PRVs. It would not be cost-effective to provide fire pump capacity for zone 440 through the hydropneumatic station.

- Utilize the existing 12-inch pipeline in Alpine Road as a dedicated pipeline for zone 440, assuming that a new transmission pipeline is constructed for delivery of water to zone 815. Keep the existing PRVs from 560 and 815 as backups to the zone.

The possibility of combining zone 440 and 510 was also investigated, as discussed in Section 8.11.2. However, due to the large difference in pressures required between the two zones, it was not recommended.

In addition, other localized improvements to address specific local issues include:

- The Master Plan includes budget placeholders to provide additional PRV capacity for the master plan fire flows in zones 440 and 680.

- The Master Plan includes a budget placeholder for reinforcement of pipelines at critical slide locations. Six slide areas are shown on Figure K-4-1 that should be considered for reinforcement. These are steep hilly areas where mud slides or land slides cause pipeline damage. As described in Section 8.11.4 of the master plan, a bypass could be implemented consisting of a line isolation valve and a 12-inch diameter connection and manifold assembly, on either side of the defined hazard.

- Potential elimination of easements and deadends in zone 440 are discussed below:
    - Along La Cuesta Drive, 350 feet of 6-inch pipe should be installed near Aliso Way to complete a loop. It would not be possible to eliminate the private easement to Aliso Way without creating a long dead end.
    - Assuming the 12-inch main along Alpine is dedicated to zone 440, a new 200 foot long connection from La Cuesta Drive to Alpine would create looped pipelines on the east side of zone 440.
    - A 6-inch looped pipeline along the easement from North Balsamina Way to La Mesa Drive connects pipelines on North Balsamina Way and North Castanya Way. This easement runs through a field but is needed to maintain looped pipelines. This 6-inch is parallel to a 4-inch line on East Floresta Way. One option is to replace the 4-inch pipeline on East Floresta Way with 6-inch minimum and extend the lines on North Balsamina Way and North Castanya Way northward by 100 feet to East Floresta Way, which would require new short easements through existing properties if obtainable from the property owners. This would allow the 6-inch pipeline in the field easement to be eliminated; however, it would not be possible completely eliminate all easements through private property.
    - The zone 440 pipeline on South Balsamina Way is a dead end formed by a normally closed valve at South Castanya Way. When replacement occurs for the 4-inch pipeline in zone 560 along South Castanya Way, a new 600 foot long parallel line could be installed for zone 440. This would eliminate the dead end at South Balsamina Way and complete a loop for zone 440.

- The easement just east of East Florista Way, bisected by Berenda Way, and terminating at Aliso Way, is the second most troublesome easement for the District. The pipeline is shallow and interferes when the field is disked. Eliminating this pipeline would create multiple dead ends and reduce looped networking. Depending on the extent of pipeline and easement removed, up to three dead ends could be formed at Berenda Way, North Balsamina Way and North Castanya Way. Therefore, it is recommended to maintain this pipeline and easement. If the pipeline requires replacement, a deeper bury could be considered in the design.

- Potential elimination of easements and deadends in Zone 560 are discussed below:
  - From the end of Coquito Way, an 8-inch line goes through an easement to the intersection of Mimosa Way and Morro Vista Lane. This easement is in a steep slide area, dropping about 70 feet from Coquito Way to Mimosa Way. This easement can be eliminated by installing a parallel line along La Mesa Drive, Lucero Way and Mimosa Way. The parallel line would require 1,900 feet of new piping.
  - On the east side of zone 560, normally closed valves on La Mesa Drive create dead ends along Garbada Way, Dedalera Drive, and South Castanya Way. To eliminate dead ends, looping could be provided by installing piping on La Mesa Drive, parallel to existing zone 440 piping. The new parallel pipe would require 380 feet of new piping.
- Other considerations that may be appropriate for some locations include re-locating fire hydrants that are near deadends to be closer to larger capacity mains, and replacing pipelines in cross-country locations with better materials.
- Considerations for PRV operations are discussed below:
  - There are some general guidelines for operation of PRV zones with multiple PRV locations, in order to avoid "regulator bounce". The preferred operating mode would be to set one location as the primary PRV, while other locations are set at a lower grade line. For all normal operating conditions, the primary PRV should supply all flows into the zone, while the others do not operate. The other PRVs should be adjusted to a hydraulic grade line setting at least 5 feet lower than the primary PRV and set to open only during fire flows or maximum demand conditions. Operating a single PRV prevents pressure bounce which occurs when PRVs are set close enough to each other causing alternating irregular flows/pressures out of both PRVs. Each PRV should periodically be the primary PRV in order to maintain water quality and to exercise the valves.
  - In PRV supplied zones, relief regulators would limit high pressures in the lower zone, if a PRV were to fail open. This would protect mains and customer plumbing from excessively high pressures.

Appendix K-5
Downtown Menlo Park Area

Area Boundary

The Downtown Menlo Park area is shown on Figure K-5-1. The figure also shows the water system facilities serving the area.

The Downtown Menlo Park area is bordered by El Camino Real (State Highway 82) to the north, Oak Grove Avenue to the west, University Drive (State highway 109) to the south, and Roble Avenue to the east. The heart of the city's downtown commercial district is located along Santa Cruz Avenue between El Camino Real and University Drive.

Current Operating Conditions

The Downtown Menlo Park area is part of zone 220, which is the largest zone in the Bear Gulch system. This zone is supplied directly by seven SFPUC turnouts.

Five of the seven turnouts serve zone 220 via PRV: BG-01 at Bay Road and Marsh Road, BG-03 at El Camino Real and Middle Avenue, BG-04 at 5th Avenue and Glendale Avenue, BG-05 at Woodside Road and Bonsen Court, and BG-07 at the Bear Gulch Yard. PRVs downstream of the turnouts reduce the SFPUC gradeline from approximately 319 feet to 220 feet.

BG-02 at Atherton depot, located at Fair Oaks and Snowden Drive, has a butterfly valve that is opened only when other turnouts are not meeting system demands.

Turnout BG-05 serves zone 319C directly, in addition to zone 220 via PRV. Turnout BG-06 serves zone 319A directly, zone 815 via pump station 20, and zone 220 via PRV on the north side of zone 319A.

There is no existing storage in zone 220. Peaking currently occurs off the SFPUC supply system.

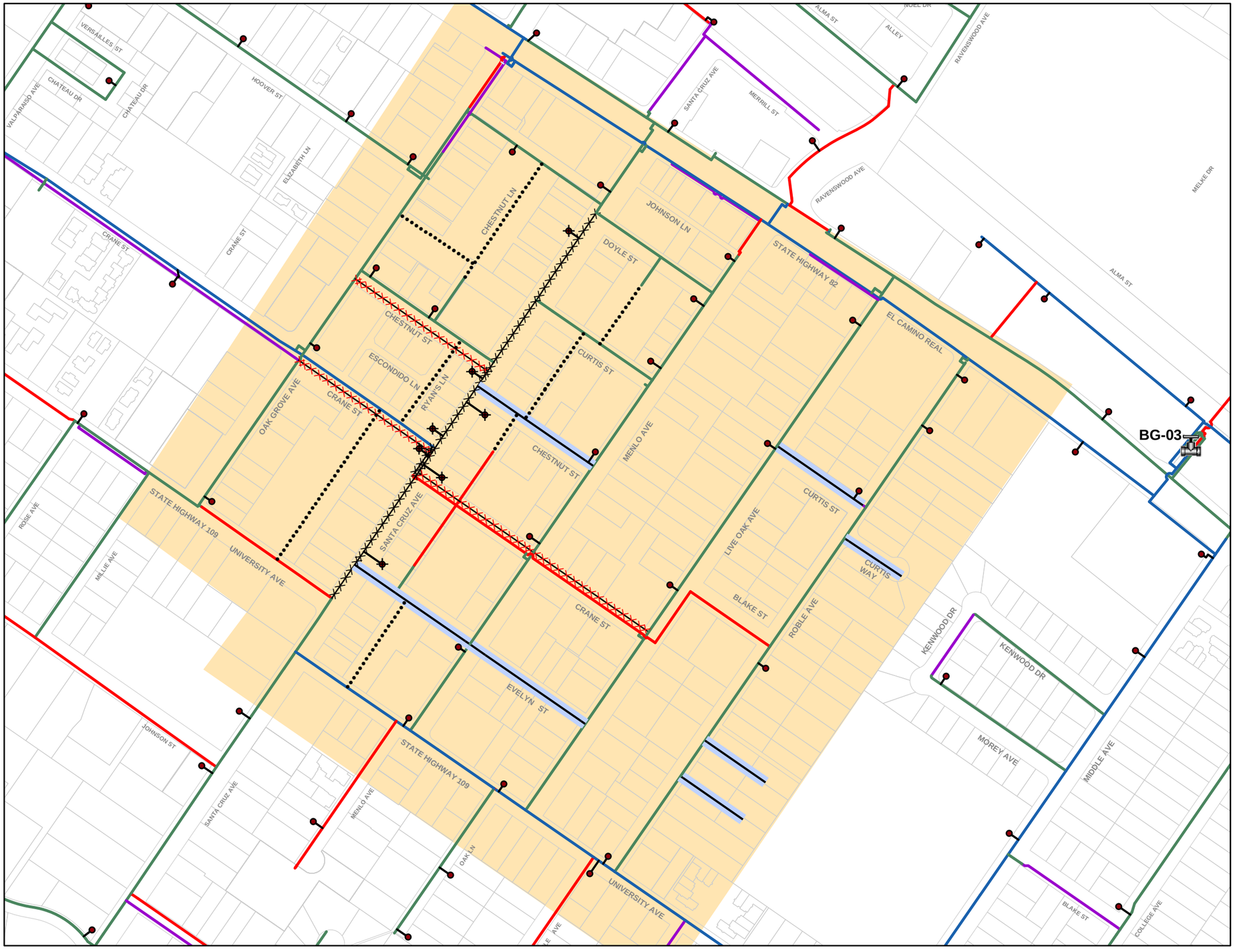
Due to recent pipeline replacements, there is a good transmission grid of 12-inch pipelines around the boundary of the downtown area in University Avenue, Crane Street, and El Camino Real.

Local Constraints and Issues

For the downtown Menlo Park area, key local issues discussed with District include:

- The City has a "pavement moratorium" on Santa Cruz Avenue in the downtown business district. No open cuts are allowed in the street so that disruptions to downtown businesses are minimized. Santa Cruz Avenue has asphalt streets with a tree-lined median and brick paved crosswalks.

Public Version



Legend

- Existing Hydrant
- Hydrant to be Relocated
- Turnout (BG-03)
- Menlo Park Downtown Area

Pipe Diameter

- 1" - 4"
- 6"
- 8"
- 10" - 12"
- 14" - 18"
- 20" - 24"

Improvements:

- Install New Pipeline
- Abandon Pipeline
- Upsize Existing Pipeline
- Transfer Service to Adjacent Line and Abandon Old 4 Inch

N

300 150 0 300

Feet

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Figure K-5-1

Downtown Menlo Park Area

- In the long term, the City wants to phase out utilities in Santa Cruz Avenue and prohibits new utilities from being installed. Instead, new pipelines are to be installed in alleys and parking lots behind the buildings along Santa Cruz Avenue, e.g., between University Avenue and Doyle Street. Even jack and bore under Santa Cruz at intersections to connect pipelines in cross streets would be difficult due to the dense commercial development and many existing utilities in the area.

- Similar to Santa Cruz Avenue, El Camino Real contains many utilities including fiber optics, high voltage lines, water, and sewer, which make it difficult to install pipelines that cross El Camino Real.

- Cast iron mains in the area have had explosive leaks and are problematic. The existing 6-inch cast iron pipeline along Santa Cruz Avenue will eventually need replacement.

- Many 4-inch pipelines have been replaced but the old pipes were left in service and capped off at the service connection because it is difficult to transfer services. Locations include Crane Street between Live Oak Avenue and Oak Grove Avenue; and Chestnut Street between Oak Grove Avenue and Santa Cruz Avenue. These locations are now starting to leak, since the 4-inch lines were not properly abandoned.

- The Fire Department has recently begun requiring higher fire flows for new businesses in the downtown, typically on the order of 3,000 to 4,000 gpm or higher. Adequate spacing of fire hydrants is also a concern for the Fire Department. Specific fire flow and hydrant requirements are established by the Fire Department.

- The pipeline in University Avenue was recently upgraded from an 8-inch to a 12-inch main. The City required new pavement for the entire street, not just the open cut section. City requirements for repaving and restoration greatly increase the cost of improvements in this area, e.g., for the University Avenue project, the pipeline installation itself was less than half the total cost.

Performance Objectives

System-wide performance objectives have been established for the Bear Gulch District, as described in Section 5 of the master plan report. These performance objectives are applicable to Menlo Park Downtown area.

Key concerns are providing adequate transmission capacity for fire flows, reconfiguring pipelines to supply the downtown commercial area without impacting Santa Cruz Avenue, abandoning pipelines properly to minimize leakage, providing adequately spaced fire hydrants to meet Fire Department requirements, and eliminating dead ends to improve hydraulics and water quality.

Potential Improvements

Potential improvements to address Menlo Park downtown issues are discussed below. Some potential improvements are projects that will be implemented as part of ongoing District replacement/rehabilitation efforts, and general budget placeholders are included in the master plan for such projects. Specific projects and priorities will be identified by District staff for implementation of improvements based on overall District needs. As part of the design process, detailed predesign evaluations should be conducted to confirm the specific needs and requirements for each individual project.

The Bear Gulch District Water Supply & Facilities Master Plan includes a number of pipeline improvement projects in zone 220, which will improve transmission capacity across the entire zone, including the downtown Menlo Park area. In addition, the Master Plan includes storage improvements to provide storage for zone 220 (for fire reserve, emergency reserve, and operational needs), instead of relying solely on the SFPUC supply system. These improvements will benefit the entire zone, including the downtown area.

Other localized improvements to address specific local issues are discussed below. Cal Water should closely coordinate all work in the downtown area with the City, and implement improvement projects in conjunction with other City projects such as the parking lot improvement plan.

Figure K-5-1 shows proposed improvements which would allow decommissioning of the pipeline in Santa Cruz Avenue, in order to avoid future disruption. In order to continue service to businesses along Santa Cruz Avenue, new pipe loops would be provided through parking lots behind the businesses.

With the proposed approach, the 6-inch existing main in the street will be abandoned in place and replaced by 8-inch minimum or 12-inch pipelines along the parking lots behind Santa Cruz Avenue. The Fire Department's specific fire flow requirements for new and/or existing businesses should be considered in sizing the new pipelines.

A pipeline in the east parking lot between Evelyn Street and Crane Street has already been installed (consisting of 100 feet of 6-inch and 200 feet of 8-inch pipe). An 8-inch line continues north of Crane Street for 150 feet in the east parking lot.

In general, the staging of the work would be to first complete new pipeline improvements, then install new service connections from the new pipes, and finally remove old services and abandon old lines. The work could proceed incrementally in segments, and in coordination with parking lot improvements and new business needs. The work could proceed in one block (or larger) segments. First the parallel parking lot pipeline loops on both sides of the street would be installed in the segment. Then services from existing pipeline in Santa Cruz Avenue can be transferred to the news lines in the parking lot. After transferring all services in the segment, that portion of the old pipeline in Santa Cruz Avenue can be taken out of

service. In total, approximately 1,500 feet of old pipe in Santa Cruz Avenue would be removed from service after installation of a total of approximately 3,000 feet of new replacement pipelines in parking lots on both sides of the street.

Some fire hydrants will need to be re-located and other new hydrants may be needed to provide proper coverage of the area. The Fire Department will set specific requirements for hydrant coverage. In general, hydrant spacing is typically on the order of 300 to 500 feet maximum spacing between hydrants. Each block on Santa Cruz Avenue is about 300 feet long, which would be about 1 hydrant per block.

Ideally, the pipeline in each cross street would cross Santa Cruz Avenue and create looped network around the downtown area. However, the west and east side of each cross street does not intersect Santa Cruz Avenue at the same location; instead there is a "dog-leg". A jack and bore connection across Santa Cruz Avenue may be possible at some locations, but would be difficult due to the crowded development and the large number of existing utilities. During predesign, each intersection location should be evaluated in detail, including field investigation, in order to determine the best configuration to maintain overall looping.

All remaining small diameter pipelines, as shown on Figure K-5-1 should be replaced with 8-inch mains at a minimum. Larger mains may be required on lines serving fire hydrants, depending on the specific Fire Department requirements. In the Downtown Menlo Park area, all cast iron pipes, regardless of size, should be evaluated for replacement as part of the District's ongoing pipeline replacement program, due to issues with leaks.

In addition, leaks have begun occurring in some 4-inch pipelines that were replaced but left in service and capped off at the service connections. Services should be transferred off these old 4-inch pipes, so the pipes can be properly abandoned. Streets that need services transferred include Crane and Chestnut, as shown on Figure K-5-1.The old 4-inch cast iron pipelines on Crane Street and the 4-inch transite pipeline on Chestnut Street should have all service connections transferred to the new parallel pipeline. Once transferred, the four-inch pipelines should be properly removed from service to avoid leaking.

Another potential consideration identified by the District is to install a new 12-inch main on the north side of El Camino Real. There is already an existing 12-inch on the south side. Having 12-inch mains on both sides would minimize disruption in this very busy street.