CITY OF ST. HELENA

MASTER WATER PLAN

Prepared For:

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October 2006

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SECTION 1 - INTRODUCTION

OBJECTIVE OF STUDY

The primary objective of the City of St. Helena Master Water Plan is to create a comprehensive document identifying estimated ultimate water demand, water supply sources and capacities, the capability of the existing treatment, transmission and distribution systems and providing recommendations for system improvements to the existing facilities to meet ultimate water demand.

The major tasks of this study are:

1. Determine Ultimate Water Demand
2. Determine Current Water Supply
3. Develop a Water System Hydraulic Model
4. Analyze current water treatment capability
5. Identify System Improvements
6. Develop Cost Estimates of Proposed Improvements

This study combines the findings and conclusions of various reports developed either as technical memorandums or engineering studies. These efforts were conducted either by Hanson Engineering, Albert A. Webb Associates or others; and the associated reports are referenced as required with copies provided in the technical appendices.

COMPUTER HYDRAULIC ANALYSIS

The computer hydraulic analysis model was developed using the H20NET ® software package; and the computer model is based upon the entire water supply and distribution network of the City of St. Helena system. The model was used to identify necessary improvements to the existing system as well as possible upgrades required on a longer term basis. Webb Associates analyzed the water system, utilizing the developed computer model for the following purposes:

1. To evaluate system for capabilities of meeting Maximum Day Demand plus fire flow
2. To review existing pump and booster stations
3. To make recommendations for pipeline upgrades
4. To develop a hydraulic model for analysis of future water supply improvement options such as increased capacity of the existing water treatment plant, a new Napa connection on Highway 29 or Silverado Trail or increased well production

5. To review the existing storage and pumping facilities as they relate to the system analysis and make recommendations as to their adequacy

Over twenty hydraulic runs were performed for different system conditions. Assumptions required for the model and run results at key conditions (Maximum Day, Peak Hour, Maximum Day with Fireflow and Tank Refill, etc.) are presented in the report. Additionally, a summary of all the hydraulic runs is provided. Hydraulic conditions for a future well field, Napa connection alternatives, and expanding fire flow service north along Highway 29 are also presented. Refer to the appropriate appendices for the hydraulic analysis and data, most of which are provided under separate cover.

SECTION 2 - WATER DEMAND

Recorded water demand has steadily increased since the 1960's when water demand averaged approximately 1,000 ac-ft/yr to recent years where annual demand is approximately 2,000 ac-ft/yr. Since water demand is directly impacted by the local hydrological conditions of Napa Valley and local water use ordinances and policies in effect at the time, significant annual variations have been experienced. Variations in annual demand from year to year have been as much as 300 ac-ft/year. Most recent data on actual water demand can be found in **Appendix A.**

The water demand projections are given in **Table 2-1.** This projected water demand used for the analysis was based upon the demands developed by James C. Hanson in Table 2-6 of the "1999 Master Water Plan" (**Appendix B**) and updated based on current water demand trends from 2003 Urban Water Management Plan Draft, March 2003 Draft report. Unaccounted system losses (estimated at 5%) are included in the projections.

Table 2-1 -- Water Demand Projections

	Year	Annual Water Demand (ac-ft/yr)	Average Day Water Demand (gpd)	Peak Monthly Demand (gpd)	Maximum Day (gpd)	Maximum Day (gpm)
	2005	2,084	1,860,000	3,285,000	4,928,000	3,422
	2010	2,111	1,846,000	3,326,000	4,989,000	3,465
	2015	2,138	1,909,000	3,369,000	5,054,000	3,510
	2020	2,164	1,932,000	3,411,000	5,117,000	3,553

Table 2-2 shows estimated Year 2005 Average Day, Maximum Day and Peak Hour Demand by Pressure Zone. The distribution system has 4 pressure zones with the 449′ pressure zone (Main) accounting for about 95% of the demand. Water demand for each of the three smaller outlying pressure zones was estimated based on the number of residential water services and pumping reported for each zone. The remaining demand was allocated to the Main Pressure zone. Peak Hour is estimated to be 1.5 times the Maximum Day Demand. Maximum fire flow for each zone is based on the highest classification within that zone. Maximum fire flow requirements are based on the 1990 Fire Insurance Classification prepared by ISO/Commercial Risk Services. The required duration for each zone was assumed as indicated.

Table 2-2
City of St. Helena
Water Demand by Pressure Zone, Year 2005

	Pressure Zone		Average Day (gpd)	Maximum Day (gpd)	Maximum Day (gpm)	Peak Hour (gpm)	Maximum Fire Demand[(1)]
YEAR 2005	1	449′ (Main)	1,771,000	4,684,000	3,253	4,880	3,500 gpm
	2	520′ (Spring Mountain)	70,000	192,000	133	200	750 gpm
	4	560′ (Madrone)	14,000	38,300	27	40	750 gpm
	3	664′ (Holmes)	5,000	13,700	10	15	750 gpm
	TOTAL		**1,860,000**	**4,928,000**	**3,422**[(2)]	**5,133**[(2)]	

(1) Durations are two hours; except for commercial in Main zone which is estimated at four (4) hours.
(2) Due to rounding individual numbers, the sum may not equal the total.

Water Demand from Year 2005 to Year 2020 has been projected to have an overall increase of 3.9% in accordance with the Table 2-1. **Table 2-3** gives Year 2020 Average Day, Maximum Day and Peak Hour Demand by Pressure Zone.

Table 2-3
City of St. Helena
Water Demand by Pressure Zone, Year 2020

	Pressure Zone		Average Day (gpd)	Maximum Day (gpd)	Maximum Day (gpm)	Peak Hour (gpm)	Maximum Fire Demand[1]
YEAR 2020	1	449′ (Main)	1,839,000	4,862,100	3,376	5,064	3,500 gpm
	2	520′ (Spring Mountain)	73,000	200,200	139	209	750 gpm
	4	560′ (Madrone)	14,800	40,500	28	42	750 gpm
	3	664′ (Holmes)	5,200	14,200	10	15	750 gpm
	TOTAL		**1,932,000**	**5,117,000**	**3,553**[2]	**5,330**[2]	

(1) Durations are two hours; except for commercial in Main zone which is estimate at four (4) hours.
(2) Due to rounding individual numbers, the sum may not equal the total.

SECTION 3 - WATER SUPPLY

INTRODUCTION

The City currently has two primary sources for potable water. Bell Canyon Reservoir is the major source of potable water, supplying roughly 80% of the annual demand augmented by local groundwater from the Stonebridge Wells supplying the balance. An additional supplemental emergency supply connection is available from the City of Napa.

BELL CANYON RESERVOIR AND LOUIS STRALLA WATER TREATMENT PLANT

The Bell Canyon Reservoir was built in 1959 and the Louis Stralla Water Treatment Plant (LSWTP) was originally constructed in 1980 and upgraded in 1994. Both facilities are owned and operated by the City. According to records provided, total water production for the calendar year 2002 at Bell Canyon Reservoir and LSWTP produced 1,942 ac-ft, approximately 84.8% of the total production for year 2002. Water production is reported on a weekly basis. Maximum reported water treatment plant production is 17.3 MG per week (or 2.5 MGD average for the maximum week) to meet daily demand. The water treatment plant capacity is rated at 4.3 MGD; however, the plant is currently operated at 3.4 MGD or less due to flow limitations in the inlet piping.

Recorded data indicate the quantity of water withdrawn from the Bell Canyon Reservoir for potable water has ranged from 1,086 to 1,942 ac-ft/year, with a thirteen year average of 1,500 ac-ft/year for the period of 1990 to 2002. Based on a safe yield analysis performed by James C. Hanson Consulting Engineer (**Appendix C**), the total safe yield for the Bell Canyon Reservoir is 1,575 ac-ft per year. When the required fish habitat release into Bell Creek is taken into account, the safe yield is reduced to 1,200 ac-ft per year for municipal potable water uses.

STONEBRIDGE WELLS

The City owns a well field known as the Stonebridge Wells located near the end of Pope Street next to Wappo Park. The existing system includes three wells (two of which are active) and a filtration facility, including filtration tanks, chlorination facilities and a backwash return system.

In 2002, the Stonebridge Wells produced 349 ac-ft or approximately 15.2% of the total production. Well #1 was installed in 1992 with a rated capacity of 425 gpm. Well #2 was installed in 1996 with a rated capacity of 225 gpm. The City operates a filter system for iron and manganese removal for both active wells and provides chlorination prior to introduction of ground water into the distribution system.

Weekly Water Report records show that typical production of the well system is between 1.9 and 2.4 MG per week (0.27 to 0.34 MGD average) but can be as high as 5.9 MG per week (0.84 MGD average) if the water treatment plant is not operated for an extended period.

According to a technical memorandum prepared by West Yost & Associates, entitled 'City of St. Helena Groundwater Evaluation and Possible New Well Location Study', March 21, 2005, additional groundwater may be available for municipal potable water uses. The report analyzed the anticipated geologic conditions underlying the City for any future potential wells. A copy of this report is provided in **Appendix D**. Based on existing City policy and ordinance, the well production is limited to 20% of the overall water demand in normal years. Based on a projection of 2,164 ac-ft/year demand in 2020, the maximum well production would be 433 ac-ft/year. If the existing Stonebridge Wells were operated at their current total capacity is 650 gpm for 7,800 hours per year, approximately 934 ac-ft of water would be produced or approximately 2.2 times the annual limit. Therefore, the existing Stonebridge Wells have enough capacity under normal operating conditions to meet the projected supply required.

LOWER RESERVOIR

The City owns and operates the Lower Reservoir on York Creek for non-potable irrigation and construction water requirements. Currently, water is diverted from York Creek and stored in the Lower Reservoir. Limited irrigation water is supplied by a single distribution pipeline in Spring Mountain Road. A connection for construction water is also available from this pipeline. Non-potable water deliveries have ranged from 14 to 19 ac-ft per year between 1996 and 2002.

WATER SUPPLY AND DEMAND COMPARISON

Based on potable water supplies currently available and anticipated demand projections, a potential shortfall of potable water supplies can be anticipated if the Bell Canyon is limited to 1,200 ac-ft/year. **Table 3-1** compares projected water supply sources and demand through 2020. Figure 3-1 graphically compares historical and projected water supply sources and demand through 2020.

EXISTING NAPA CONNECTION

The City also maintains a connection to the City of Napa on a standby basis with a maximum capacity of 1.55 cfs (700 gpm) up to a maximum of 100 MG (306.9 ac-ft) per year. The capacity is limited by agreement with the City of Napa. This metered connection point is located in Rutherford and is known as the Rutherford Connection. Water can be taken into the Main Zone from the Napa distribution system through the Rutherford Connection and pumped up to the main zone by the Rutherford Pump Station. During the years of 1990 through 2002, for nine out of the thirteen years, the City purchased no water from Napa. During the other four years, purchases ranged from 11 ac-ft to 299 ac-ft per year. Note that this connection is typically unavailable during the rainy season due to the flooding potential of the City's Rutherford Pump Station. The supply agreement could be amended or eliminated based on the agreement for additional water referenced in the following section.

ADDITIONAL WATER SUPPLY THROUGH NAPA

Based on a proposed agreement with the City of Napa, **Appendix E**, the City of St. Helena will purchase treated imported water from the City of Napa per the terms of the agreement in exchange for transferring the City of St. Helena's Kern County Water Entitlements to the City of Napa. The agreement contemplates three tiers of supply based on availability of water to Napa from imported sources. These are summarized below:

Tier A – 200 ac-ft/year during off-peak season between October 1 and April 30. The City of St. Helena must purchase this water at the then current outside city water rate established by the City of Napa

Tier B – 100 ac-ft/year during off-peak season between October 1 and April 30. The City of St. Helena must purchase this additional water at the then current outside city water rate established by the City of Napa if the State Water Project allotment is 30% or more as of April 1. An allotment of less than 30% would mean that Tier B water would not be available and St. Helena would not be obligated to purchase Tier B water

Tier C – 100 ac-ft/year between September 1 and May 31. The City of St. Helena would have the option to purchase additional water up to 100 ac-ft/year at the then current outside city water rate established by the City of Napa if the State Water Project allotment is 50% or more as of April 1 provided certain notification requirements are met.

As of February 2006, this proposed agreement has not been finalized and the terms may be amended to prior to final acceptance.

The proposed delivery point would be at the existing metered connection at Rutherford. Based on the proposed delivery schedules noted above, the Rutherford Pump Station must be operational during the period of October 1 through May 31. At an estimated flowrate of 1.55 cfs (based on the proposed maximum capacity of 1.0MGD for this connection), an annual delivery of 400 ac-ft would take approximately 4 ½ months of constant operation of the connection and Rutherford Pump Station. Significant upgrades to the Rutherford Pump Station are required for the City to utilize the proposed Napa water supply.

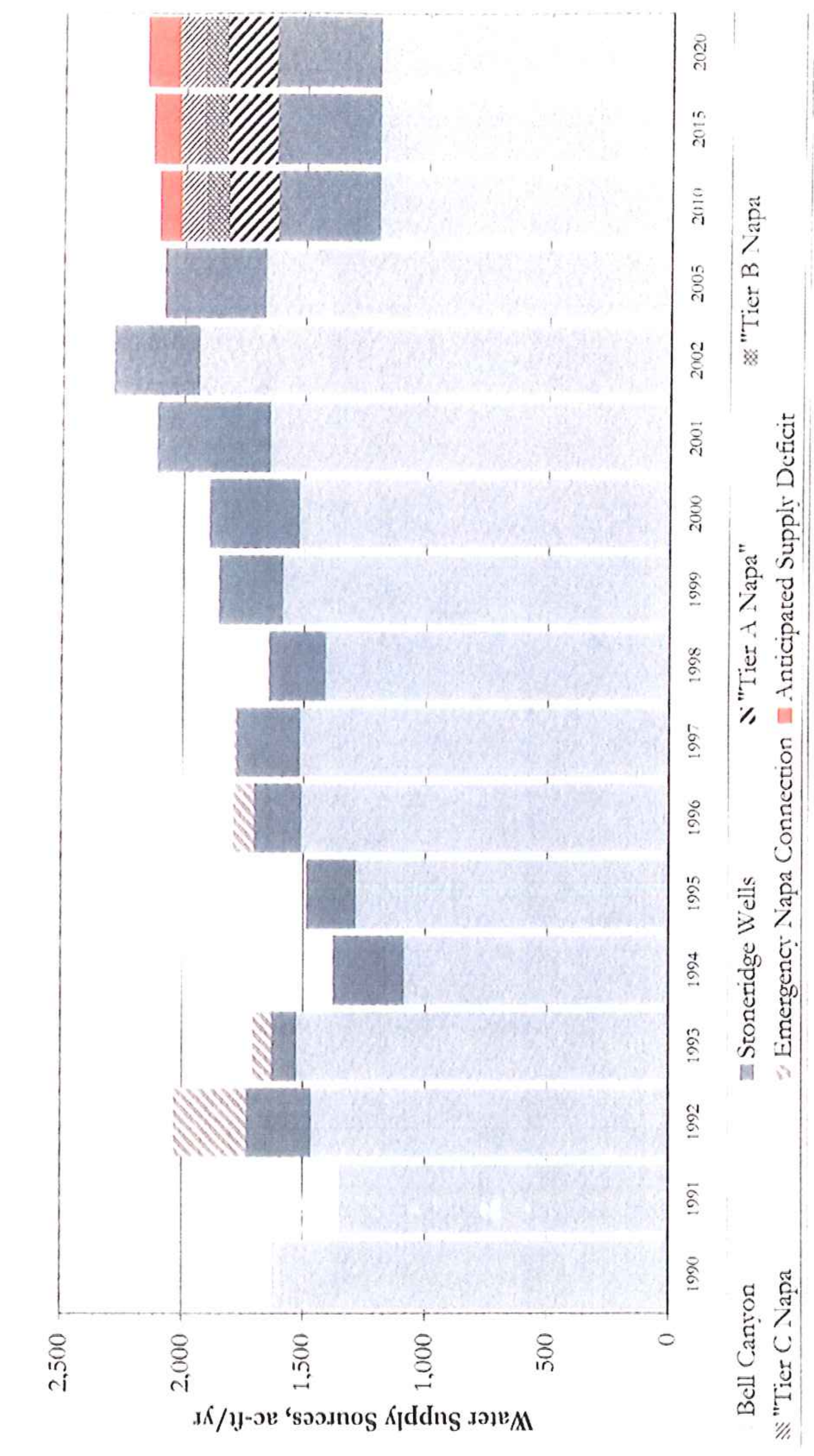
Since the Napa supply would be limited to only specific off-peak months, other significant operational changes and forecast planning for the water supply for winter vs. summer must be implemented to ensure that maximum use of the proposed Napa Tier A, B and C water, Stonebridge Wells and Bell Canyon water supplies.

Table 3-1
City of St. Helena
Projected Water Supply and Demand Comparison
ac-ft/year

Projected Supply Source	2002 (Actual)	2005	2010	2015	2020
Local Surface Water					
Bell Canyon	1,942	1,200 (1)	1,200 (1)	1,200 (1)	1,200 (1)
Bell Canyon Additional Withdraw	0	467 (2)	0	0	0
Upper/Lower Reservoir	0	0	0	0	0
Local Groundwater (3)	349	417(4)	422(4)	428(4)	433(4)
Imported Surface Water	0	0	0	0	0
Emergency Connection to Napa	0	0	0	0	0
Tier A - Napa	0	0	200	200	200
Tier B - Napa	0	0	100	100	100
Tier C - Napa	0	0	100	100	100
Total Supply	**2,290**	**2,084**	**2,022**	**2,028**	**2,033**
Actual / Projected Demand	2,290	2,084	2,111	2,138	2,164
Supply Excess (Shortfall)	**--**	**0**	**(89)**	**(110)**	**(131)**

(1) Available reservoir safe yield for potable water with required fish release.
(2) Estimated reservoir withdraws above safe yield to meet projected demand.
(3) From Existing Stonebridge Wells.
(4) Maximum Well Production limited to 20% of total demand

Figure 3-1
City of St. Helena
Water Supply vs. Demand
Historic and Projected



ULTIMATE MAXIMUM DAY DEMAND

Ultimate Maximum Day Demand is projected to be 5,117,000 gpd, which is most likely to occur during the months of June through September. The proposed Napa water supply would not be available during this period based on the terms of the proposed agreement. Maximum output of the Stonebridge Wells at 650 gpm is 936,000 gpd. Maximum output of LSWTP is 4,300,000 gpd, if upgraded and operated at its rated capacity. LSWTP maximum output is currently limited to 3,400,000 gpd. The total system supply is projected to be 5,236,000 gpd which exceeds Ultimate Maximum Day Demand by only 2.3%. Additional well capacity should be considered to ensure the City has enough water supply capacity for Ultimate Maximum Day Demand.

SECTION 4 - EXISTING WATER DISTRIBUTION SYSTEM

PRESSURE ZONES

The existing water system, shown on **Plate 1**, consists of reservoirs, pump stations, pipelines and source connections. Pipelines are identified as odd numbers, junctions as even numbers, pumps as 5000 series numbers, reservoirs as 7000 series numbers and valves as 9000 series numbers. The system consists of four pressure zones (449, 520, 560, and the 664-foot Zones). The 449, 560 and 664-foot Zones are based on the approximate mid-water elevations of various storage facilities for each zone. The 520-foot Zone is based on the hydraulic grade of the "Mean Discharge" pressure of the Spring Mountain Road Pump Station.

The 449-foot Zone (also known as P.Z. 1 or Main Zone) encompasses the majority of the distribution system. A 1.4 million-gallon storage reservoir provides the hydraulic grade for the zone. This reservoir is located adjacent to the Louis Stralla Water Treatment Plant (LSWTP) on the north side of the City limits. A second storage reservoir (2.7 million-gallon) was constructed for the 449-foot Zone in the late 1990's at the end of Spring Mountain Road near the Lower Reservoir. There are approximately 3,711 service connections in the 449-foot Zone. All of the commercial and industrial facilities and school sites served by the system are located within the 449-foot Zone. The other zones are limited to only residential connections.

The 520-foot Zone (also known as P.Z. 2 or Spring Mountain Zone) is located on the West Side of the City. This zone obtains its water supply from the 449-foot Zone through the Spring Mountain Road Pump Station, which has a maximum capacity of approximately 250 gpm. This flow rate is adequate to meet maximum day and Peak Hour Demand conditions for this pressure zone, but does not provide adequate fire flow capacity to the zone.

A swing check valve at the easterly end of the system in Scott Street provides a second connection from the 449 to 520-foot Zones. This connection provides additional water for fire protection when the 520-foot Zone pressure falls below the 449-foot Zone pressure during fire flow demand conditions. However, this connection is not adequate to meet minimum fire flow requirements throughout the 520-foot Zone, especially at the higher elevations.

The 664-foot Zone (also known as P.Z. 3 or Holmes Zone) is also located on the West Side of the City. This zone provides water to seven (7) residential service connections. The 664-foot Zone is connected to the 449-foot Zone through a 7.5-hp, 75-gpm pump[1] and the 60,000-gallon Holmes Storage Tank.

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[1] Estimated pump capacity based upon available records.

The 560-foot Zone (also known as P.Z. 4 or Madrone Zone) is located on the north side of the City and encompasses what is known as the Meadowood Service Area. There are forty-four (44) service connections in this zone. The Madrone Knoll Pump Station supplies water to the 560-foot Zone from the 449-foot Zone, with two 50-hp pumps[(1)]. Three 66,000-gallon redwood storage tanks, known as the Meadowood Tanks provide the hydraulic grade for the zone.

STORAGE FACILITIES

The City owned Bell Canyon Reservoir is located near the LSWTP. Water is drawn from the Bell Canyon Reservoir, treated for potable uses at the LSWTP, and pumped into the 1.4 MG reservoir located at the treatment plant. The City recently built a 2.7 MG welded steel storage reservoir at Lower Reservoir Site. Both welded steel reservoirs serve the 449-foot pressure zone. The high water level of the 2.7 MG storage reservoir is approximately 10 feet lower than the 1.4 MG reservoir. An altitude valve shuts off inflow to the 2.7 MG reservoir to prevent overflow. The Meadowood Tanks and the Holmes Tank provide storage for the 560 and 664-foot Zones respectively. See **Table 4-1** for a summary of the reservoirs and tanks and associated water levels.

Table 4-1
City of St. Helena
Existing Storage

Reservoir	Pressure Zone	Storage Capacity (MG)	Low Water Level Elevation (ft)	High Water Level Elevation (ft)
Treatment Plant Reservoir	449	1.4	437±	463 ±
2.7 MG Reservoir	449	2.7	428 ±	453 ±
Meadowood Tanks	560	0.20	550 ±	570 ±
Holmes Tank	664	0.06	654 ±	674 ±

The existing 1.4 MG reservoir at the treatment plant reportedly has some signs of interior coating failure and possible corrosion damage. Typically, re-coating the interior of a steel reservoir of this capacity takes the facility out of service for approximately two months. Since this facility is partially used for chlorine contact time, a CT analysis and interim plan must be developed in order to re-coat the interior of this reservoir.

Recommended improvements from the Master Water Plan Update, October 1987, were compared against actual improvements. The most critical improvement suggested, additional 2.7 MG of storage capacity in the 449-foot pressure zone, has been completed since the last master plan update.

[(1)] Actual Pump Capacity needs to be evaluated via pump testing.

A 16-inch diameter transmission line was installed at the same time to connect the new storage reservoir with the main lines within the distribution system near Main Street and Elmhurst Avenue. The actual location of the new storage reservoir was changed based on a February 1993 storage reservoir siting evaluation report prepared by Brelje & Race. In addition, an in-line booster pump station was constructed to boost the hydraulic grade in the 449-foot zone during high demand periods.

The City owns two additional open reservoirs (the Upper and Lower Reservoirs) which are currently utilized for non-potable water storage.

PUMPING STATIONS

There are five (5) pump stations within the water distribution system. **Table 4-2** shows a brief summary of the pump stations within the distribution system.

The In-Line Booster Pump Station, located near the Water Treatment Plant, contains two in-line pumps designed to increase the hydraulic grade in the 449 foot Zone in times of high demand or to refill the 2.7 MG reservoir.

The second pump station is the Spring Mountain Pump Station, which pumps water from the 449-foot Zone to the 520-foot Zone. A variable frequency drive (VFD) controls the speed of the pump to match pressure and demand since no water storage reservoir exists within the 520-foot Zone.

The third pump station is the Holmes Pump which pumps water from the 449-foot Zone to the Holmes Tank in the 664-foot Zone for local water service.

The fourth pump station is the Madrone Knoll Pump Station, which pumps water from the 449-foot Zone to the Meadowood Tanks for local service in the 560-foot Zone.

The fifth pump station is the Rutherford Pump Station, consisting of two manually controlled pumping units in parallel which pump water from the Napa System at the Rutherford Connection into the east end of the City's distribution system. The Rutherford Pump Station is utilized in conjunction with the Napa supplemental emergency connection. This pump station is typically not available in the rainy season because of the flooding potential at the pump station.

TABLE 4-2
City of St. Helena
Existing Pump Stations

Pump Station	Design Capacity (gpm)	Design TDH (ft)	Pump Units
In Line Booster	(1)	(1)	Two identical pumps in parallel, each with 20 hp electric motors
Spring Mountain	250 100	120 120	One pump with 7½ hp electric motor(2)
Holmes	75	(1)	One pump with 7½ hp electric motor
Madrone Knoll	850	240	Two identical pumps in parallel, each with 50 hp electric motors
Rutherford	700	195	Two identical pumps in parallel, each with 25 hp electric motors

PIPELINES

Pipelines which convey water throughout the system range from 1 ¼-inch to 24-inch in diameter are indicated on **Plate 2**.

The main transmission line from the treatment plant at Bell Canyon Reservoir to the distribution system consists of 24-inch diameter and 18-inch diameter pipelines. A 12-inch diameter line conveys water from the Rutherford Connection into the distribution system. A relatively new 16-inch line along Spring Mountain Road connects the new 2.7 MG tank with larger pipelines within the distribution system.

The pipelines located within the service area range from 1 ¼-inch to 14-inch diameter. Pipelines within the central portion of the City are well inter-tied by numerous loops and pipe size range from 4-inch diameter to 14-inch in diameter, with a few smaller lines on deadends. Several of the outlying areas have pipelines smaller than 4-inch diameter serving a small number of residential lots or commercial/retail facilities.

(1) Design Capacity and / or TDH are not known; hence they need to be verified.
(2) The horsepower of the second electric motor is estimated at 3 HP but needs to be verified

SECTION 5 - EXISTING WATER TREATMENT FACILITIES

The City owns and operates the Louis Stralla Water Treatment Plant and a filter system for the Stonebridge Wells. These facilities are used to treat local water supplies to potable water standards for use within the City's water service area.

LOUIS STRALLA WATER TREATMENT PLANT

Constructed in 1980 and later upgraded in 1994, the Louis Stralla Water Treatment Plant (LSWTP) treats local surface runoff collected in the Bell Canyon Reservoir for potable water use. LSWTP has a rated capacity of 4.3 MGD using conventional sand filtration with alum coagulant and chlorine disinfectant. The plant capacity is currently limited to 3.4 MGD due to the limitation of the capacity of the inlet piping.

Albert A. Webb Associates conducted a site tour and operational review of LSWTP in November 2004. The complete inspection report can be found in the Technical Memorandum dated January 25, 2005 in **Appendix F**. The critical findings are summarized and associated recommendations are given in Section 10.

STONEBRIDGE WELL FILTER SYSTEM

The City owns and operates a green sand pressure filter system to treat groundwater for iron and manganese removal from the Stonebridge Wells prior to introduction into the City's distribution system. The filter has two filter trains, a backwash collection and return system and a chlorination system.

The total capacity of the Stonebridge Wells is 650 gpm (0.94 MGD). Well No.1 and No. 2 have a rated capacity of 425 gpm and 225 gpm respectively.

Weekly Water Report records show that typical production of the well system is between 1.9 and 2.4 MG per week (0.27 to 0.34 MGD average) but can be as high as 5.9 MG per week (0.84 MGD average) if the water treatment plant is not operated for an extended period.

SECTION 6 - HYDRAULIC ANALYSIS

SUMMARY AND RESULTS

Various individual hydraulic runs were performed at critical conditions. These runs are summarized in the Hydraulic Run Summary Sheet (**Appendix G**). Detailed run input and output data for each junction, pipeline, tank and pump are given in the Detailed Hydraulic Results Report under separate cover.

Demand Allocation – Maximum Day Demand for Year 2005 was allocated to junctions (nodes) throughout the system. **Plate 3** shows the demand in gpm for each junction at Maximum Day year 2005. For any junction shown without demand, the demand was set to zero. All other demand scenarios used the same basic demand pattern. Individual demands were scaled based on the total demands indicated in **Table 2-1, Table 2-2** and **Table 2-3**. Detailed demand by node junction for each of the runs is given in the Detailed Hydraulic Results Report.

Design Criteria – Design criteria for each scenario is as follows:

- Minimum pressure under non-fireflow conditions -- 30 psi
- Minimum pressure under fireflow conditions -- 20 psi
- Maximum pipeline velocity -- 10 fps.

Pressures at nodes immediately adjacent to storage reservoirs are expected to be less than 20 psi and are excluded from these criteria. A specific list of nodes excluded is given in Detailed Hydraulic Results Report under Model Assumptions.

For hydraulic modeling purposes, only Years 2005 and 2020 data were used.

MAXIMUM DAY DEMAND

Total Maximum Day Demand for Year 2005 and Year 2020 are 3,422 gpm and 3,553 gpm respectively. With the existing system, all design criteria are met for both Year 2005 and 2020. Detailed run results are given in Run #3 and Run #5 in the Detailed Hydraulic Results Report.

PEAK HOUR DEMAND

Total Peak Hour Demand for Year 2005 and Year 2020 are 5,133 gpm and 5,330 gpm respectively. With the existing system, all design criteria are met for both Year 2005 and 2020. Velocity in the 2.7-

MG reservoir outlet (7.48 fps) is the highest velocity in the system. Detailed run results are given in Run #4 and Run #16 in the Detailed Hydraulic Results Report.

FIRE FLOW ANALYSIS

Design criteria is a minimum 20 psi residual pressure at the required flow rate and maximum velocity of 10 fps. Fireflow Analysis can be run in several formats using H2ONET®. In the first method, a specific node with its associated fire flow demand is selected and the model is run, calculating all system parameters for those conditions, including pressures, flows, velocities, etc. The second method analyzes fire flow at each node and reports available flow at 20 psi residual pressure as well as other key data. In this method, specific pipeline velocity data is not available. This method provides a summary of many individual fire flows analyses at various fire flow requirements at all nodes specified. Review of this summary data will indicate further detailed analysis using the first method.

FIRE FLOW AVAILABILITY CONTOURS

Fire flow is usually considered the most difficult condition to meet for a water distribution system. Typically, the fire authority having jurisdiction determines fire flow requirements based on land use. To facilitate this review and develop recommended improvements, fire flow availability contours were developed for the system. Some nodes are excluded from the analysis, due to their proximity to reservoirs or pump stations. In the Detailed Hydraulic Results Report, under Junction Information, the "Fireflow" column identifies which nodes are included or excluded from this analysis. Fireflow Availability at a residual pressure of 20 psi was calculated. From these data, a contour map of available fire flow from 500 to 3,500 gpm was developed (See **Plate 4**). The minimum standard fire flow was selected to be 500 gpm at 20-psi residual. Areas are easily identified (inside the red contour) which do not meet this standard. Typically, commercial zones require higher fire flows. In commercial areas where existing fire flow availability was below 2,000 gpm, pipeline improvements were identified, the model was updated and the analysis was repeated. The updated contour map for the proposed system is given in **Plate 5**. A list of those pipelines proposed to be upgraded and the associated proposed diameters are given in **Appendix H**.

CRITICAL NODES

Based on the contour map (**Plate 4**), fire hydrants near the school facilities on Grayson Avenue were identified as providing low residual pressures under fireflow conditions. Using criteria from the 1987 analysis, a fire flow of 2,500 gpm was applied to the fire hydrant at the school site, Node No. 1372. Minimum residual pressure of 20 psi is not met under these conditions. Pressure Contours were created showing a localized residual pressure problem, **Plate 6**. The existing pipelines in Grayson Avenue and Crane Avenue are 6-inch diameter, and are undersized for a demand of 2,500 gpm. Detailed run results are given in Run #7 in the Detailed Hydraulic Results Report.

In addition to flowrate and pressure criteria, the water distribution system should not have a maximum velocity exceeding 10 fps at Maximum Day Demand plus fireflow to avoid potential damage to pipelines. Several other pipelines in the vicinity of the school along Grayson Avenue and Crane Avenue should be upsized to meet the maximum velocity criteria. It is recommended to increase pipeline diameters from 6-inch to 10-inch[(1)] in Grayson Avenue from Main Street to Clark Avenue and from 6-inch to 8-inch in Clark Avenue from Birch Street to Vallejo Street. Pipelines diameters in the model were changed and the model run at the same conditions. Both minimum pressure and maximum velocity meet criteria. See **Plate 7** for updated pressure contours. In addition, fireflow of 2,500 gpm applied to another hydrant at the school site at the intersection of Grayson Avenue and Clark Avenue, Node 624.

TANK REFILL AT LOW DEMAND

Both of the City's larger capacity welded steel storage reservoirs are located in the Main Pressure zone. Under normal conditions, all water coming from the LSWTP enters the distribution system through the reservoir at the LSWTP. There is no direct reservoir fill pipeline to the 2.7 MG reservoir. Therefore, fill and draw conditions depend on hydraulic grade and demand within the system. At high demand conditions, water is withdrawn from the 2.7 MG reservoir. The 2.7 MG reservoir refills at low demand conditions or low reservoir water level. Typically the in-line booster pumps are used to refill the 2.7 MG reservoir more quickly. Comparison runs were performed at reservoir refill conditions for verifying in-line booster pump station operating scenarios. See **Table 6-1** for reservoir refill rates and times if the reservoir was dropped down to 14 ft and refilled back up to the maximum of 24 ft. Depending on the level of the 2.7 MG reservoir and the time allotted for refill, all three scenarios, when using the In-Line Booster Pumps, are capable of refilling the reservoir.

Table 6-1
City of St. Helena
Tank Refill Conditions - 2.7 MG Reservoir

In Line Booster Pump #1	In Line Booster Pump #2	Fill Rate (gpm)	Fill Rate (minutes/foot)	Total Fill Time From 14 to 24 ft (hours)
Off	Off	906	120	20
On	Off	1,768	62	10
Off	On	1,768	62	10
On	On	2,200	49	8

Without the Inline Booster Pumps, the refill rate drops to approximately 50%. Without the inline boosters, there is not enough hydraulic capacity to refill the 2.7MG reservoir during the night time hours if the reservoir was dropped during the day to turn over the water inside the tank. Thus the

[(1)] or 12-inch diameter if the City does not use 10-inch diameter pipelines in its system.

tendency is to keep the 2.7MG reservoir level high to maintain adequate system pressures and stored water supplies.

It should be noted that adequate turn over of the water within the 2.7 MG reservoir is critical to maintain appropriate water quality within the distribution system. Operational procedures and physical limitations of the system limit the ability for water system operators to adequately turn over the water in the 2.7 MG reservoir. With the existing configuration, since the refill rate is between 48 and 59 minutes per foot of reservoir and there are approximately eight night-time hours to refill the 2.7 MG reservoir when using the In-Line Booster pumps, the 2.7 MG reservoir level could be cycled between 8 and 10 feet per day to promote water turn over.

According Water Treatment Plant personnel, the In-Line Booster Pump Station is not typically used during the daytime period based on cost savings for time of use electrical metering avoiding higher on-peak electricity costs. Previous reports indicated that the pump station might be required to meet Maximum Day Demand plus fire flow and Peak Hour Demand. Under both scenarios, minimum system pressures are met, thus indicating that the In-Line Booster Pump Station is typically not required to operate during the day. If the 2.7 MG reservoir should fall below critical levels to meet minimum emergency and fireflow storage criteria, daytime operation of the pump station should be considered.

FUTURE WELL FIELD

Based on previous master plans, a future well field might be sited in the area south of the Napa River between the existing Stonebridge Wells and the City's sewage treatment plant. A proposed 12-inch diameter pipeline connecting to the main pipeline in Hwy 29 and three proposed 500 gpm wells were added to the model. At a total flow rate of 1,500 gpm and a well head elevation of 200 feet, a hydraulic grade at the well head might be expected to be 498 feet (129 psi discharge pressure) in order to move water back into the distribution system.

NAPA CONNECTIONS

Assuming that the maximum flowrate from the emergency connection is limited to 1.55 cfs or 700 gpm, the expected hydraulic grade at the Rutherford Pump Station discharge is 470 feet or 132 psi under Tank Refill Condition. The Rutherford Pump Station must be designed to meet this discharge pressure. The hydraulic grade will vary under other operating conditions such as Maximum Day or Peak Hour. Additional hydraulic runs will be necessary to develop the minimum and maximum system head curves for the Rutherford Pump Station during preliminary design and pump selection.

An alternate connection to Napa's system called the Hennesey Connection has been considered near the intersection of Silverado Trail and Hwy 128. Approximately 12,000 feet of new and upgraded 10-inch[1] pipeline would be required for this connection assuming the future pipeline crosses the Napa River at Zinfandel Lane. Under the same operating conditions as the Rutherford Connection,

[1] or 12-inch diameter if the City does not use 10-inch diameter pipelines in its system.

the Hennesey Connection would require a hydraulic grade of approximately 475 feet or 126 psi discharge pressure at a ground elevation of approximately 183 feet at the pump station for this connection.

EXTENDED PERIOD SIMULATION

An Extended Period Simulation (EPS) for a 24-hour Maximum Day was developed. Output data are available for junctions, pipelines, tanks and pumps at each hour. Operating conditions used regarding initial reservoir level demand curves and pump controls are given in the Detailed Hydraulic Results Report. Graphs of reservoir levels, demands and pump operations over the 24-hour period are also given in the Detailed Hydraulic Results Report. For the ultimate Maximum Day demand, the reservoir levels for the main pressure zone drop significantly during the day as demand approaches peak hour but are able to recover if the In-Line Booster Pumps are used to refill the 2.7 MG reservoir and water production at the LSWTP is maximized. Existing pumping capacity in the Holmes and Meadowood Zones can maintain tank levels under ultimate demand conditions.

Due to the flexibility of the control scenarios and large amount of data available, results of the EPS are can be reviewed interactively with the H2ONET® program in order to optimize the system operational performance at various demand scenarios. Output formats can also be customized for each specific use.

SECTION 7 - STORAGE REQUIREMENTS

Storage facilities are required to meet design demand for each pressure zone. These storage facilities are required to meet daily demand fluctuations, Peak Hour Demand, emergency conditions and maximum fire flow within each zone.

EQUALIZING STORAGE

Equalizing Storage provides storage to meet the daily minimum and maximum fluctuations in demand, allowing pumping facilities to be used near design conditions. It is recommended that twenty-five percent (25%) of the Maximum Day water demand be provided as storage within each pressure zone for peak hourly flucuations.

EMERGENCY STORAGE

Emergency storage would be needed to sustain the water demands during periods of emergency shutdown of the water supply facilities. A minimum of seventy-five percent (75%) of the Maximum Day water demand is recommended for emergency storage within each zone.

FIRE FLOW STORAGE

It is recommended that fire flow storage for each zone is provided for as storage within that pressure zone; and that fire flow storage is based on the maximum fire flow and duration required within each zone. Based on the fire flow requirements identified in the 1990 Hydrant Flow Data Summary prepared by IS Commercial Risk Services, Inc., (**Appendix H**) a maximum of 3,500 gpm fire flow is required in the 449 foot pressure zone. Fire flow Duration of 4 hours was used for the 449-foot pressure zone. For other pressure zones, existing services are residential and therefore 750-gpm fire flow with a two-hour duration was used.

RECOMMENDED IMPROVEMENTS

Using 2020 water demand, recommended storage required for each zone is given in **Table 7-1.**

Required storage and existing storage are compared in **Table 7-2.** Existing storage within the 449-foot needs to be increased 1.6 MG, primarily to meet additional emergency storage recommendations. The existing storage capacity within the 560-foot Zone will fulfill requirements through 2020. New storage for the 520-foot Zone is required and additional storage to fully meet fire flow requirements for 664-foot Zones are required. Alternatively if suitable storage sites are not available for either the 520-foot Zone and 664-foot Zone, the addition of a high capacity pump with a standby generator at the Spring Mountain and Holmes Pump Stations could be used to provide minimum fireflow from existing storage contained within the 449-foot Zone in lieu of the recommended storage.

Table 7-1
City of St. Helena
Storage Requirements for Year 2020

Pressure Zone	Peak Day (gpm)	Equalizing[1] (gallons)	Emergency[2] (gallons)	Fire Protection (gallons)	Total Storage (gallons)
449′	3,376	1,215,360	3,646,080	840,000	5,701,440
520′	139	50,040	150,120	90,000	290,160
560′	28	10,080	30,240	90,000	130,320
664′	10	3,600	10,800	90,000	104,400

(1) 25% of Maximum Day Demand.
(2) 75% of Maximum Day Demand.

Table 7-2
City of St. Helena
Recommended Storage Improvements

Pressure Zone	Storage Recommended (MG)	Existing Storage (MG)	Storage Improvements (MG)
449′	5.7	4.1	1.6
520′	0.290	None	0.290
560′	0.132	0.20	None
664′	0.104	0.06	0.044

OTHER STORAGE ISSUES

According to water operations staff, the existing 1.4 MG reservoir at LSWTP has some signs of corrosion and interior coating failure. Corrosion on steel reservoirs from interior coating failure is not uncommon and illustrates the need for periodic coating inspections. The failure can be relatively minor in non-critical areas to extensive coating failure leading to containment failure in the floor or tank shell. It is recommended that a consultant experienced in reservoir interior coatings inspect the interior coating of the 1.4 MG reservoir and develop a specification for the repair of the interior coating. This inspection should take place as soon as practical to allow time to prepare the repair specification, develop the required chlorine CT interim plan during the repair and schedule repair during off-peak demand periods.

The proximity of the inlet of the existing 2.7 MG storage to the outlet (15' apart) may lead to short circuiting of water within the reservoir. To better balance other operational needs such as system pressure, emergency storage and available fireflow with the need to mitigate THHM levels, the internal circulation within the tank should be evaluated to understand if there is short circuiting occurring between the inlet and outlets and causing dead spots within the tank. Changes to the tank can be constructed to reduce short circuiting and promote mixing by installing additional interior piping to separate the inlet and outlets and/or interior baffles to force circulation and improve first-in/first-out performance.

Tank 2

The 560-foot Zone has three existing 65,000 gallon redwood tanks. The tanks are adequate to meet storage system size recommendations. However, redwood tanks do not meet current American Water Works Association (A.W.W.A.) standards. A welded steel tank pursuant to A.W.W.A. standards should replace these tanks. To facilitate replacement within the same site and provide future flexibility for tank maintenance, two 100,000 gallon storage tanks should be constructed in phases to replace the three existing tanks.

Meadowood

The additional storage of 1.6 MG in the main pressure zone is recommended based on a higher ultimate demand in year 2020 than previously envisioned and a higher factor of safety for emergency storage requirements for municipal water systems. If the additional storage is located at LSWTP, the future transmission pipeline improvements are not necessary to meet maximum day requirements. However, if the additional storage cannot be located at LSWTP, then a reservoir siting study must be done to determine the hydraulic conditions, water quality considerations and potential transmission pipeline improvements needed for other proposed reservoir sites.

Tank 1/1A

SECTION 8 - PIPELINE RECOMMENDATIONS

PIPELINE IMPROVEMENTS

From the 1987 Master Water Plan Update, some of the most critical mainline replacement projects have been completed. Pipeline improvements have been completed based on immediate maintenance requirements or residential development within the City. All improvements have been incorporated into the new model based on the updated system map provided by the City. See **Table 8-1** for a detailed comparison of the status of the previously suggested improvements. Pipelines identified as inadequate for fire flow are listed in **Table 8-2.** A number of maintenance access problems and major leaks were identified in a report prepared by Robert Brownell, Water Foreman, City of St. Helena. Pipelines identified as current maintenance problems due to leaks or accessibility are listed in **Table 8-3.**

Maintaining and protecting easement rights is an issue widespread within the water industry. The City should take steps to protect and enforce its easement rights to allow for future repair or replacement of its facilities.

Much of the distribution system is beyond its life expectancy and has started to show increased maintenance costs. The City's experience is typical among public water systems. Many pipelines in service today have lasted well beyond their life expectancy while others fail much earlier. Many factors effect pipeline deterioration including soil type, groundwater, quality of installation, subsequent damage when other utilities are installed, pipe material, etc. Maintenance costs will continue to escalate as the system ages. A comprehensive program is recommended to address all the current pipeline replacement issues and incorporate new issues as they arise. Replacement of those pipelines identified in Tables 8-1, 8-2 and 8-3 should be prioritized by City staff. Significant capital expenditure will be necessary to fund these replacements. An implementation plan, including funding and schedule, should be developed. The program must include collection and review of leak repair data to supplement the replacement program with additional pipelines to be replaced. A longer term program should be implemented to replace aging pipelines prior to failures. Funding mechanisms through an appropriate water rate structure is typically used for these routine pipeline replacement programs.

Table 8-1
City of St. Helena
Mainline Replacement/Construction Status of 1987 Recommendations

Street Name	Approx. Length (linear feet)	Existing Size (Inches)	Proposed Size (Inches)	Status of Upgrade [1]	Notes
Madrona Street	2,800	4	12	Partial	1700′ of 8" complete
Highway 29	3,200	8	8	Not Done	
Highway 29	1,100	6	12	Not Done	
Highway 29	1,600	4	12	Not Done	
Highway 29	2,400	2	12	Not Done	
Hillview Place	1,900	4	8	Done	
Oak Avenue	1,700	4	8	Done	
Fulton Lane	1,100	4	8	Partial	700′ of 8" complete
Adam Street	3,000	4	8	Partial	1800′ of 8" complete
Hunt Avenue	600	4	8	Done	600′ of 6" complete
Edwards Street	800	4	8	Not Done	
Pope Street	1,300	4	8	Done	
Howell Mountain Road	3,800	2	8	Not Done	
Meadowood Lane	2,600	2	8	Not Done	

[1] as of January 2006

Table 8-2
City of St. Helena
Mainline Replacement/2005 Recommendations
Based on Fireflow Capability

Street Name	Approx Length (feet)	Existing Size (Inches)	Proposed Size (Inches)	Reason	Comments
Grayson Avenue	2,700	6	10[1]	Fireflow	At high school
Crane Avenue	1,250	6	8	Fireflow	At high school
North End of Fulton Avenue	500	2	8	Fireflow	Existing fire hydrant
Pine Street, north of Stockton Street	450	2 & 4	8	Fireflow	Existing fire hydrant in commercial zone
Vidovich Avenue	500	6	12	Fireflow	Existing fire hydrant in commercial zone
Charter Oak Avenue south of Main Street	700	2 & 4	12	Fireflow	Existing fire hydrant in commercial zone
North end of Charter Oak Avenue	800	2	12	Fireflow	Existing fire hydrant in commercial zone
Community Drive	600	2	8	Fireflow	Existing fire hydrant
Ingelwood Avenue	1,500	4	8	Fireflow	Existing fire hydrant
Kearney Street	900	4	8	Fireflow	Existing fire hydrant in commercial zone
Zindfindel Lane North of Hwy 29	1,450	4	8	Fireflow	Existing fire hydrant
West Zindfindel Lane	650	4	8	Fireflow	Existing fire hydrant
South End of Inglewood Avenue	300	2	8	Fireflow	Existing fire hydrant
South End of Vallejo Street	750	4	8	Fireflow	Existing fire hydrant
Mountain View Ave	900	4	8	Fireflow	Existing fire hydrant
Davis Lane	700	2	8	Fireflow	
West End of Palmer Drive	900	4	8	Fireflow	

[1] or 12-inch diameter if the City does not use 10-inch diameter pipeline in its system

Table 8-3
City of St. Helena
Mainline Replacement/2005 Recommendations

Street Name	Approx Length (feet)	Existing Size (Inches)	Proposed Size (Inches)	Reason	Comments
Pratt Ave, Elmhurst to Pratt Ave Bridge	5,000	14	16	Pipe Failures	Consider 16-inch PVC
Hwy 29, Galleron to south	3,000	12	12	Pipe Failures	Caltrans constructed improvements over pipeline
Hwy 29 at Vintage Avenue	300	6	8	Pipe Failure	Bore under railroad tracks and Hwy 29
Deer Park Road from Crystal Springs Road to Fawn Park Road	3,000	24	24	Pipe Failures	Main transmission pipeline from LSWTP
Silverado Trail at intersection of Pope and Howell Mountain Road	500	2	8	Existing pipe in stormdrain	Replace pipe within bridge and stormdrain, may require new crossing of Napa River

SECTION 9 - PUMP STATION RECOMMENDATIONS

SPRING MOUNTAIN PUMP STATION

The current station has one operational pump rated at 250 gpm which is used 24 hours per day, 7 days per week without a redundant pumping unit. Ultimate peak hour demand is estimated at 200 gpm. A redundant pumping unit of at least 200 gpm capacity is recommended. Depending on the availability of future storage for this zone, an additional large capacity pump capable of delivering fireflow requirements of at least 750 gpm with back up standby generator is also recommended. Due to the site restrictions of the existing site, the pump station may need to be relocated to provide enough space to install the additional pumping capacity. Actual operational controls, settings and field pump testing results should be reviewed to optimize pump efficiencies and power costs.

HOLMES PUMP STATION

The current station has one pump used approximately one hour per day under low demand conditions and twelve (12) hours per day under peak demand conditions. A redundant pumping unit of at least 10 gpm is recommended. Actual pumping capacity and TDH should be confirmed during an actual field pump test. Considering this is a very low volume, high TDH pumping application, the available pumps to meet the actual field conditions may need to be oversized compared to the maximum day demand criteria of 10 gpm. Consideration should be made to relocating the pump station to adequate space for the installation and future maintenance.

MADRONE KNOLL PUMP STATION

The pump curve contained in the City files does not match the reported pumping capacity of 425 gpm. Under typical conditions, the pumps would provide approximately 850 gpm according to the pump curve. This inconsistency should be further investigated. In addition, a reported pump capacity of 425 gpm for the expected demand for the 560-foot Zone appears to be oversized. A smaller pump could reduce stand-by charges for electrical service and improve system performance and/or pumping efficiency. It is recommended that the actual pump capacity and electrical costs should be reviewed against actual Maximum Day Demand to determine if pump replacement is warranted and cost effective. Actual pumping capacity and TDH should be confirmed by a pump test.

RUTHERFORD PUMP STATION

This pump station is utilized with the emergency Rutherford Connection to the Napa System. The pump station is reportedly in the flood plain and must be disconnected each rainy season to prevent potential flood damage to the electrical system. Discharge pressure is reportedly higher than operational personnel are comfortable with and therefore the pump station has not been run for a number of years. To ensure that the emergency connection to the Napa System at Rutherford is viable as a year round emergency connection and the pump station is available during the period of October 1 through May 31 when water could be purchased from the City of Napa per the proposed agreement, the Rutherford Pump Station location must be evaluated and changes to the station must be implemented to make it a permanent and fully functional facility.

IN-LINE BOOSTER

The pump station meets operational performance requirements to reservoir refill the 2.7 MG reservoir during off-peak hours. See Section 6 - Hydraulic Analysis for details of the analysis.

PUMP TESTING

Periodic pump tests allow a water purveyor to maintain its pump stations in peak operating condition and at maximum efficiency. Pump tests can identify required maintenance for a poor-performing pump long before catastrophic failure. Pump tests are usually performed by the local electrical utility or qualified pump-testing contractor. It is recommended that a pump test program be put in place for all City owned pumps including those installed in wells. Typical pump testing frequency is once per year.

SECTION 10 - WATER TREATMENT RECOMMENDATIONS

THHM/HAA5

The City has already taken steps to comply with recently adapted EPA Disinfection By Product (DBP) rules regarding THHM and HAA5 maximum contaminant levels (MCL's). Those steps include specific jar testing to optimize Total Organic Carbon (TOC), elimination of pre-treatment chlorination, relocating addition of chlorine to immediately upstream of the multimedia filtration and addition of sodium permanganate solution. These steps have reduced contaminant levels for the first year of required testing to less than the MCL's. The following actions are recommended to further reduce contaminant levels to ensure continued compliance with the MCL's set by the EPA.

1) Eliminate addition of chlorine prior to the multimedia filters.
2) Shock chlorinate multimedia filters periodically (weekly) to control any biological activity in the filters
3) Reduce chlorine residual leaving LSWTP to a minimum
4) Change operational procedures to force turn over of the 2.7MG reservoir
5) Consider a secondary chlorination station at 2.7MG reservoir to reduce chlorine residual leaving LSWTP and maintaining taste and odor within the distribution system.
6) Consider changes in 2.7MG reservoir to reduce short circuiting of water within the tank and promote tank turn over under all operating procedures.
7)

A long-term permanent solution is needed to reduce TOC levels and thereby reducing THHM and HAA5 maximum potential. It is recommended that the City considers Granular Activated Carbon (GAC) filters to its treatment process. This technology has been successfully implemented in similar applications.

LSWTP

On November 8 and 9, 2004, Brad Sackett and Brian Knoll of Albert A. Webb Associates performed a site inspection of the Louis Stralla Water Treatment Plant (LSWTP) and the Stoneridge Well Site and filter system. The complete inspection report is provided in **Appendix F** and the critical issues are summarized below.

1) **Upgrade capacity of smallest high service pump to 1,500 gpm to meet redundant pumping capacity requirements.** Currently, there are two 1,500 gpm pumps and one 500 gpm pump to pump water from the Clearwell to Tank #1 and the distribution system. With the largest pump out of service per DHS requirements, total high service pump capacity is 2,000 gpm or 2.88 MGD, under the required capacity of 4.3 MGD. The 500 gpm pump and associated switchgear should be replaced by a 1,500 gpm pump and upgraded switchgear. Since VFD control is already provided for the two existing 1,500 gpm pumps, new VFD control is not critical.
2) **Add additional standby generator capacity to allow operation of backwash and high service pumps at the same time.** According to Operations Staff, the existing generator capacity is too small to allow operation of the backwash pump at the same

time as the high service pumps. A power interruption during peak demand periods would limit treatment plant capacity.

3) **Upgrade capacity of inlet orifice plate and flow control valve to 4.3 MGD treatment plant capacity.** The current orifice plate and flow control valve limit the plant production to approximately 3.4 MGD. Increasing capacity of the inlet to match total plant capacity is required to meet Maximum Day demand if the Stonebridge Wells or the Napa connection are not available.
4) **Evaluate sludge handling capacity vs. anticipated operation of LSWTP based on safe yield of Bell Canyon Reservoir.** Because of changes in the chemical addition ratios required to meet new DBP rules, sludge production has increased and the existing sludge drying beds do not have enough capacity to adequately dry the increased sludge production created by increased TOC reduction requirements. The first drying bed does not have time to dry adequately before the second drying bed is full. Operators are forced to handle and dispose of wet sludge. This situation may be mitigated if less total water is drawn from the Bell Canyon Reservoir on an annual basis per the Water Supply plan proposed in Section 3. Actual sludge production and existing sludge handling capacity should be re-evaluated based the actual water supply plan implemented. Costs have been included in the cost estimates (Section 12) for an additional sludge drying bed.

The other recommendations contained within the inspection report are not required to meet regulatory requirements but are recommended to reduce the likelihood of equipment failure, reduce operating costs and are considered good practice.

STONEBRIDGE WELLS

The November 2004 inspection identified several critical actions to improve the performance of the well filtering and backwash return system for the Stonebridge Well site. These critical issues are summarized below.

1) Provide a flow meter and control system for backwash return to limit backwash return to no more than 10% of total flowrate into the filter system. There are no automatic controls or interlocks to prevent backwash return water from exceeding 10% of the instantaneous flow especially if either one or both wells are not operating. Excessive backwash return could compromise effluent water quality from the well filter system.
2) Replace backwash return pump with a smaller pump at a capacity of no more than 10% of the total flowrate into the filter system. Currently, a large capacity pump (200 gpm) is throttled back to approximately 20 gpm. Re-sizing the backwash return pump to match current operation will reduce the risk of exceeding the backwash return limit.
3) Provide a chlorine contact chamber for the backwash return. The original chlorine contact chamber for the backwash return water was incorporated into the increased filter capacity when the system was upgraded. Adequate chlorine contact time for the backwash return is needed to ensure proper filtering of the backwash return. A separate chlorine contact chamber sized for the maximum anticipated backwash return flowrate is recommended.

SECTION 11 - SUMMARY OF RECOMMENDED IMPROVEMENTS

STORAGE IMPROVEMENTS

Inspect interior coating of 1.4 MG tank at the storage treatment plant. Replace or repair the interior coating as required.

The inlet/outlet arrangement of the existing 2.7 MG storage should be reviewed regarding improvements for circulation, elimination of short circuiting between the inlet and outlet and preventing dead spots within the tank. Recommended improvements are 1) interior piping to separate the inlet and outlets or 2) interior baffles to improve circulation and first-in/first-out performance.

The existing storage facilities for the 560-foot Zone are adequate to meet storage system size recommendations. However, the redwood tanks do not meet the American Water Works Association (A.W.W.A.) standards. Two (2) welded steel tanks pursuant to A.W.W.A. standards should replace these tanks.

Additional storage of 1.6 MG in the main pressure zone is recommended based on the increased ultimate demand in year 2020. Additional storage located at LSWTP would not require additional transmission pipeline capacity. Additional storage located at other sites would require a specific site analysis and hydraulic modeling to size the required transmission pipelines.

As an alternative to the VFD pumping station and fireflow booster pump for the 520 foot zone, storage of 0.29MG is recommended.

Based on Year 2020 demand in 664 foot pressure zone, an additional 0.044MG (minimum) of storage capacity is recommended.

PIPELINE IMPROVEMENTS

Complete mainline replacements to improve distribution network and increase minimum pipe diameter to 8-inches as recommended in 1987 report. See Table 8-1

Replace various mainlines to improve fireflow capability. See Table 8-2

Replace various mainlines to eliminate existing high maintenance mainlines indicating high likelihood of future failures, or mainlines in inaccessible locations. See Table 8-3

Develop a program of annual mainline replacement program to replace aging mainlines prior to failures.

PUMP STATION IMPROVEMENTS

Spring Mountain Pump Station – add one 200 gpm pump for required redundancy, add one 750 gpm fire pump

Holmes Pump Station – add one 10 gpm pump for required redundancy.

Madrone Knoll Pump Station – perform field pump tests to determine field operating conditions and efficiencies.

Rutherford Pump Station – Relocate pump station out of the flood plain so the Rutherford Pump Station can be used during winter months for Tier A, B and C water from Napa; and provide pumps with appropriate hydraulic capability to pump 700 gpm from the Napa system.

Pump Testing – Initiate a program to routinely test (annually) all City owned pumps including well pumps for field operating conditions and efficiencies to identify inefficient or potentially failing pumps prior to a catastrophic failure.

WATER TREATMENT IMPROVEMENTS

Implement operational changes to reduce THHM/HAA5 levels.

Consider GAC filtration to reduce THHM/HAA5 maximum potential.

Upgrade smallest high service pump to 1,500 gpm, 75 hp.

Add additional standby generator capacity.

Upgrade inlet orifice plate and flow control valve to 4.3 MGD.

Expand sludge handling capability if required.

Prioritize operational improvement recommendations and develop an implementation schedule.

Provide flow meter and control system for backwash return system for the Stonebridge Well Filter Facility.

Replace backwash return pump with a smaller pump sized for the current operation for the Stonebridge Well Filter Facility.

Provide a chlorine contact chamber for the backwash return for the Stonebridge Well Filter Facility.

SECTION 12 - COST ESTIMATES

Cost Estimates have been prepared for project costs for various categories of improvements. These costs are summarized in **Table 12-1**. Additional details regarding the cost estimates are provided in **Table 12-2** through **Table 12-7**.

Table 12-1
City of St Helena
Master Water Plan
Project Cost Summary (1)

Category	Construction Costs	Project Cost (2)
Storage Facilities	$1,660,000	$2,330,000
Pipeline Improvements – Table 8-1	$1,743,000	$2,450,000
Pipeline Improvements – Table 8-2	$1,452,000	$2,040,000
Pipeline Improvements – Table 8-3	$1,957,000	$2,740,000
Pump Stations	$820,000	$1,150,000
Water Treatment	$874,000	$1,230,000
Total	$8,506,000	$11,940,000

(1) Indexed to January 2006 ENR-SF CCI of 8468.45.
(2) Project Costs are 1.4 time Construction Cost and include construction, construction contingencies, design engineering including plans and specifications, design and construction survey, geotechnical evaluation and report, nominal CEQA documentation, inspection and project management. Escalation, financing, interest during construction, legal, EIR/EIS, land acquisition and R-O-W agent costs are not included.

Table 12-2
City of St. Helena
Project Cost Estimates
Recommended New Reservoirs

Item	Construction Cost [1][2]
Additional 1.6 MG Storage for 499' Zone [3]	
1.6 MG Tank	$950,000
Site Work	$180,000
Increase Size of Holmes Tank [3]	
100,000 gallon Tank	$100,000
Site Work	$100,000
Replace Meadowood Tanks [3]	
Two 100,000 gallon welded steel tank	$240,000
Site Work	$90,000
Construction Cost Subtotal	**$1,660,000**
Total Project Costs [4]	**$2,324,000**
Use	**$2,330,000**

[1] Indexed to January 2006 ENR-SF CCI of 8,468.45

[2] Rounded to nearest $1,000

[3] Excludes site acquisition costs if required.

[4] Project cost is 1.4 times construction cost rounded to nearest $10,000. Project cost includes: construction costs, construction contingencies, design engineering including plans and specifications; design and construction surveying and mapping; geotechnical evaluation and report; engineering contract administration field inspection and basic environmental documentation. Costs are based on Engineering News. Record(ENR) Escalation, financing, interest during construction, legal, land, R-O-W agent, and environmental impact report costs are not included.

Table 12-3
City of St. Helena
Water Main Project Cost Estimates
for
Recommended Improvements from Table 8-1

Item	Quantity	Unit	Unit Cost [1]	Construction Cost [2]
8" Dia. Watermain [3]	12,000	L.F.	$72	$864,000
12" Dia. Watermain [3]	6,200	L.F.	$94	$583,000
Pavement removal, disposal and replacement	18,200	L.F.	$16	$296,000

Construction Cost Subtotal	**$1,743,000**
Total Project Cost [4]	**$2,440,200**
Use	**$2,450,000**

(1) Indexed to January 2006 ENR-SF CCI of 8,468.45

(2) Rounded to nearest $1,000

(3) Furnish and install; complete in place, including valves, appurtenance and connections, etc.

(4) Project cost is 1.4 times construction cost rounded to nearest $10,000. Project cost includes: construction costs, construction contingencies, design engineering including plans and specifications; design and construction surveying and mapping; geotechnical evaluation and report; engineering contract administration field inspection and basic environmental documentation. Costs are based on Engineering News. Record(ENR) Escalation, financing, interest during construction, legal, land, R-O-W agent, and environmental impact report costs are not included.

Table 12-4
City of St. Helena
Water Main Project Cost Estimates
for
Recommended Improvements from Table 8-2

Item	Quantity	Unit	Unit Cost [1]	Construction Cost [2]
8" Dia. Watermain [3]	10,850	L.F.	$72	$781,000
10" Dia. Watermain [2]	2,700	L.F.	$85	$230,000
12" Dia. Watermain [3]	2,000	L.F.	$94	$188,000
Pavement removal, disposal and replacement	15,550	L.F.	$16	$253,000

Construction Cost Subtotal	**$1,452,000**
Total Project Costs [4]	**$2,032,800**
Use	**$2,040,000**

(1) Indexed to January 2006 ENR-SF CCI of 8,468.45

(2) Rounded to nearest $1,000

(3) Furnish and install; complete in place, including valves, appurtenance and connections, etc.

(4) Project cost is 1.4 times construction cost rounded to nearest $10,000. Project cost includes: construction costs, construction contingencies, design engineering including plans and specifications; design and construction surveying and mapping; geotechnical evaluation and report; engineering contract administration field inspection and basic environmental documentation. Costs are based on Engineering News. Record(ENR) Escalation, financing, interest during construction, legal, land, R-O-W agent, and environmental impact report costs are not included.

Table 12-5
City of St. Helena
Water Main Project Cost Estimates
for
Recommended Improvements from Table 8-3

Item	Quantity	Unit	Unit Cost [1]	Construction Cost [2]
8" Dia. Watermain [3]	800	L.F.	$72	$58,000
12" Dia. Watermain [3]	3,000	L.F.	$94	$282,000
16" Dia. Watermain [3]	5,000	L.F.	$150	$750,000
24" Dia. Watermain [3]	3,000	L.F.	$225	$675,000
Pavement removal, disposal and replacement	11,800	L.F.	$16	$192,000

Construction Cost Subtotal	**$1,957,000**
Total Project Costs [4]	**$2,739,800**
Use	**$2,740,000**

[1] Indexed to January 2006 ENR-SF CCI of 8,468.45

[2] Rounded to nearest $1,000

[3] Furnish and install; complete in place, including valves, appurtenance and connections, etc.

[4] Project cost is 1.4 times construction cost rounded to nearest $10,000. Project cost includes: construction costs, construction contingencies, design engineering including plans and specifications; design and construction surveying and mapping; geotechnical evaluation and report; engineering contract administration field inspection and basic environmental documentation. Costs are based on Engineering News. Record(ENR) Escalation, financing, interest during construction, legal, land, R-O-W agent, and environmental impact report costs are not included.

Table 12-6
City of St. Helena
Project Cost Estimates
Recommended Pump Station Improvements

Item	Construction Cost [1][2]
Spring Mountain Pump Station [3]	
Add second 250 gpm 7.5 hp pump for redundancy	$60,000
Add 750 gpm 20 hp fire pump	$75,000
Holmes Pump Station [3]	
Add second 75 gpm 7.5 hp pump for redundancy	$60,000
Rutherford Pump Station (Relocate) [3]	
New 700 gpm, 25 hp pump and motor	$50,000
Unit Discharge piping and appurtenances	$35,000
New suction can and connections	$90,000
Electrical Work	$150,000
Pump Building	$180,000
Misc. Site Work	$120,000
Construction Cost Subtotal	**$820,000**
Total Project Costs [4]	**$1,148,000**
Use	**$1,150,000**

(1) Indexed to January 2006 ENR-SF CCI of 8,468.45

(2) Rounded to nearest $1,000

(3) Furnish and install; complete in place, appurtenance and connections, etc.

(4) Project cost is 1.4 times construction cost rounded to nearest $10,000. Project cost includes: construction costs, construction contingencies, design engineering including plans and specifications; design and construction surveying and mapping; geotechnical evaluation and report; engineering contract administration field inspection and basic environmental documentation. Costs are based on Engineering News. Record(ENR) Escalation, financing, interest during construction, legal, land, R-O-W agent, and environmental impact report costs are not included.

Table 12-7
City of St. Helena
Project Cost Estimates
Recommended Water Treatment Improvements

Item	Construction Cost (1)(2)
Air Compressor at Reservoir	
Replace aeration air compressor with oil free equipment	$15,000
Reservoir Effluent Meter	
Install mag meter at reservoir effluent. (Mag meter has already been	$9,000
Intake Tower	
Intake Tower Inspection (1)	$6,000
Permanganate Addition System	
New primary chemical feed pump	$4,000
Spare chemical feed pump (Assume install with primary)	$4,000
Telemetry wiring and control of chemical feed pump	$12,000
Sludge Bed Capacity (2)	
New concrete lined sludge drying bed with appropriate connection piping (Size: 185'x85' top and 85'x65' bottom, depth: 10')	$180,000
Optional Sludge drying equipment including sludge thickener, filter press, building, & appurtanences - Cost $900,000	
WTP Inlet Structure	
New inlet orifice plate for 4.0 MGD (diameter 18")	$4,000
New flow control valve for 4.0 MGD (diameter 18")	$20,000
High Service Pumps	
Replace smallest pump with a larger 1,500 gpm pumping unit. (75HP)	$24,000
Associated VFD motor controls and switch gear. (75HP)	$60,000
Pump Electrical Switch gear	
Construct adequate ventilation and/or air conditioning to maintain	$5,000
Pump Roof Access	
Re-model roof to allow roof access to the high service pumps for	$30,000
Standby Generator Capacity	
Additional standby generator, diesel powered, sizing to be determined	$120,000
Chemical Feed Pump Systems	
Spare alum chemical feed pump	$4,000
Spare chlorine feed pump	$3,000
Manifold piping for spare pumps to be installed.	$1,500

Continued next page

Table 12-7 - Continued
City of St. Helena
Project Cost Estimates
Recommended Water Treatment Improvements

Item	Construction Cost [1][2]
Tank #1	
Recoat interior of existing tank (capacity 1.4MG, Diameter 100', & Height 27')	$120,000
Construct new overflow outlet with air gap (retrofit existing outside overflow to include air gap, catch basin, and 100LF of drain piping)	$18,000
Temporary storage tanks during re-ling to comply with CT requirements.	$60,000
Well Treatment Facility	
New backwash return pump re-sizing	$3,000
Backwash return flow control and metering	$6,000
Chlorine contact chamber for backwash return, 1,000 gallon, pressure	$30,000
2.6 MG Tank	
New chlorination station at 2.6 MG tank outlet for secondary	$15,000
Modify tank reduce short circuiting of water	$50,000
Extend the inlet piping to the opposite side of the tank	$120,000
Construct internal baffles within the tank	
Construction Cost Subtotal	**$873,500**
Total Proiect Costs [4]	**$1,222,900**
Use	**$1,230,000**

[1] Indexed to January 2006 ENR-SF CCI of 8,468.45

[2] Rounded to nearest $1,000

[3] Excludes site acquisition costs if required.

[4] Project cost is 1.4 times construction cost rounded to nearest $10,000. Project cost includes: construction costs, construction contingencies, design engineering including plans and specifications; design and construction surveying and mapping; geotechnical evaluation and report; engineering contract administration; field inspection and basic environmental documentation. Costs are based on Engineering News. Record(ENR) Escalation, financing, interest during construction, legal, land, R-O-W agent, and environmental impact report costs are not included.

SECTION 13 - FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

FINDINGS

1. Based on the existing system for 449-foot Pressure Zone, the required 2,500 gpm fire flow at the school sites (node 1372 and 624) can not be met under Maximum Day Demand conditions.
2. Based upon recommended storage requirements, the 449-foot Zone is deficient in storage by 1.6M gallons and the 520-foot Zone is deficient by 296,000 gallons.
3. Existing pipelines in certain areas of the system are deficient in capacity to provide the required minimum fire flow of 750 gpm.
4. The existing distribution and transmission system can meet Peak Hour Flow Demand for year 2020 (5,330gpm).
5. The Spring Mountain Pump Station can supply Peak Hour Demand of 209 gpm for the 520-foot Zone, but cannot supply the required fire flow demand of 750 gpm.
6. The existing Redwood Meadowood Tanks do not meet A.W.W.A. standards.
7. There is only one adequate pumping unit at the both Spring Mountain and Holmes pump stations.
8. The existing Rutherford Pump Station is not operated due to concerns by operations personnel regarding discharge pressures and is not operated in the winter due to potential flood damage to the electrical system.
9. The required hydraulic grade on the discharge side of the Rutherford Connection/Pump Station at 700 gpm is 470 feet.
10. The required hydraulic grade on the discharge side of a future Hennesey Connection/Pump Station at 700 gpm is 475 feet.
11. The Louis Stralla Water Treatment Plant has a rated capacity of 4.3 MGD but is operated at a maximum of 3.4 MGD due to the limiting capacity of the inlet facilities.
12. First annual testing of THHM/HA5 levels indicates compliance with current MCL requirements.
13. Stonebridge Well backwash return system does not have controls to limit backwash return to 10% maximum of total flow.
14. Total projected water supply for 2020 is 2,033 ac-ft/yr.

CONCLUSIONS

1. The existing system is inadequate to deliver required fire flow to all commercial and industrial areas in the vicinity of the high school and to several existing fire hydrants located within residential areas.

2. The existing distribution and transmission system is capable of providing Maximum Day and Peak Hour Demand through the year 2020.

3. Existing storage capacity is below recommended levels in the 449-foot Zone and the 520-foot Zone.

4. The Madrone Knoll Pump Station pumping capacity appears to be significantly higher than system demand for the Meadowood service area.

5. The existing Rutherford Pump Station is not capable of delivering water from the Napa connection during the period of October 1 through May 31 when the proposed Tier A, B and C water is available.

6. The existing capacity of the LSWTP and Stonebridge Wells combined are not capable of providing Maximum Day demand for the year 2020.

7. Compliance with THHM/HA5 MCL's is marginal.

8. Stonebridge Well backwash return system could operate at higher than 10% backwash return ratio.

9. The proposed water supply for 2020 is 131 ac-ft/yr less than the projected demand of 2,164 ac-ft/yr. Supply deficits are currently filled by withdrawing water from Bell Canyon Reservoir above the safe yield.

RECOMMENDATIONS

The following system improvements are recommended:

1. Continue to replace deteriorating and undersized pipelines to meet minimum fireflow and system operational requirements. A comprehensive review of the easement, access and existing condition should be used to prioritize pipelines to be replaced.

2. Add 1.6M gallons storage tank in the 449-foot pressure zone to provide additional emergency storage to meet 2020 storage recommendations.

3. Add 40,000 gallons (minimum) storage in 664 foot pressure zone to meet fire flow requirements

4. Replace existing redwood Meadowood tanks with two 100,000-gallon welded steel tanks.

5. Add 296,000 gallons (minimum) storage within the 520-foot pressure zone to meet fire flow requirements or alternatively add a 750-gpm pump to the Spring Mountain Pump Station.

6. Add redundant pumping capacity to the Holmes Pump Station and Spring Mountain Pump Station. Pumps should be sized based on Year 2020 Peak Hour Demand scenario.

7. Perform periodic pump tests on each pump within the system and compare against manufacturer's pump curves and system operational data to determine recommended maintenance or replacement to maintain peak efficiencies.

8. Evaluate existing Madrone Knoll and Rutherford Pump Station installations for optimum efficiency and operational requirements.

9. Relocate or flood proof the Rutherford Pump Station so that it can be operated during winter months.

10. Implement operational changes to reduce THHM/HAA5 levels.

11. Evaluate GAC filtration to reduce THHM/HAA5 maximum potential.

12. Upgrade LSWTP to ensure the plant can operate at its rated capacity of 4.3 MGD.

13. Upgrade backwash return system at Stonebridge Well Filter Facility to limit backwash ratio to 10% of total flow and maximize chlorine contact of backwash return.

14. Continue to explore additional water supply sources.