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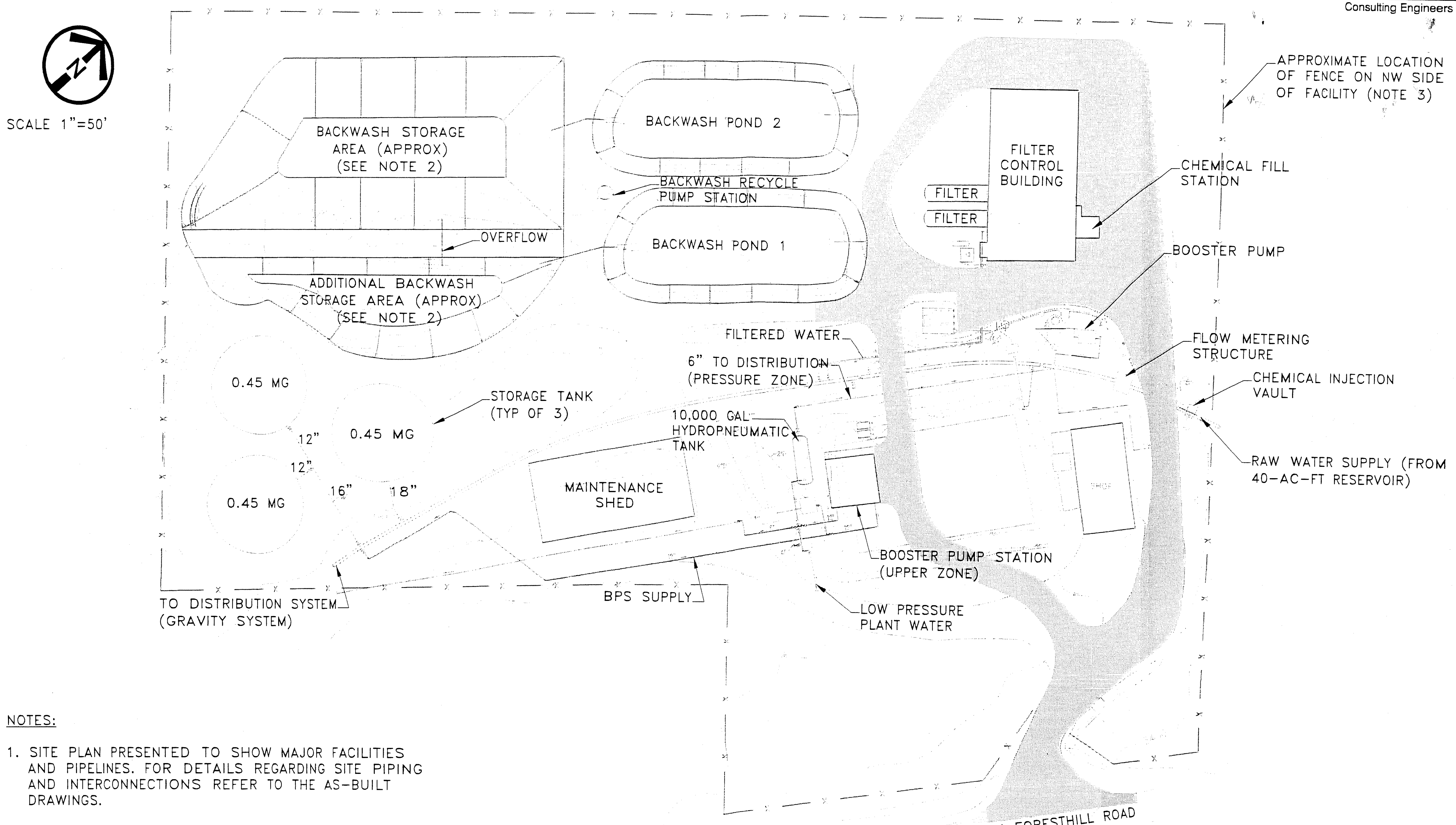

NOTES:

1. SITE PLAN PRESENTED TO SHOW MAJOR FACILITIES AND PIPELINES. FOR DETAILS REGARDING SITE PIPING AND INTERCONNECTIONS REFER TO THE AS-BUILT DRAWINGS.
2. ADDITIONAL BACKWASH STORAGE AREA IS APPROXIMATE.
3. NORTHERN BOUNDARY AND WIDTH OF PAVED AREA IS APPROXIMATE.

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FIGURE 5-2 EXISTING TREATMENT PLANT SITE PLAN

Table 5-1
Water Treatment Plant Design Criteria

Parameter	Value
Plant Flow (nominal) [a]	2,083 gpm (3.0 MGD)
Filter Rate	3.0 gpm/ft2
Filter Area (Total)	728 ft2
Filter Area per Cell	182 ft2
Filters	Two 2-cell, 9.5' Dia. x 39'4"
Backwash Rate (max)	18 gpm/ft2
Filter Rate for Backwash (max)	8.5 gpm/ft2
Backwash Supply Pump	3,200 gpm at 18.4' TDH
Backwash Return Pumps	140 gpm at 54' TDH
Surface Wash Pump	150 gpm at 250' TDH

[a] Capacity with both filters in service at maximum loading rate.

The filter media is a dual media type supported on a coarse sand and gravel base. The top media is anthracite coal while the second level of the dual media is finer grained filter sand. The media is selected to provide a course to fine grading. As the water moves through the media, larger impurities are removed in the upper layer of the filter bed. Finer particles are removed in the lower layer of the filter bed. The under drain system is supported by a gravel bed which provides structural support, and prevents the filter sand from migrating into the underdrain.

Filters are backwashed one at a time as required. When backwash is initiated, one cell is backwashed at a time. The filtered water from the three remaining cells serves as the backwash supply to the cell being backwashed in reverse direction to remove trapped solids. The multi-cell configuration and ability generate backwash supply water eliminates the need for backwash supply storage. The tops of the filter beds are agitated by the surface water system which breaks up any surface cakes. Operations staff may initiate backwashes manually based on effluent quality and/or pressure loss through the filters. Once initiated, automatic control valves actuate to accomplish the backwash. During a backwash cycle treated water is not being produced and the system is supplied from storage.

Spent backwash water is discharged to a series of backwash ponds which are used to store and treat the water to remove solids. The original intent of the design was to allow solids to settle out in the backwash ponds, and pump the clarified supernatant back to the treatment plant where it would mix with raw water and pass through the filters. The backwash recycle line is currently plumbed to return the supernatant directly in front of the filters. Operations staff has found that returning the backwash water directly in front of the filters negatively impacts the filter effluent quality.

To avoid impacting the effluent quality, the backwash storage basins have been expanded and provide enough capacity that the backwash water evaporates and percolates and there is no need to recycle the backwash water. No backwash water is discharged offsite.

A cationic polymer is used for coagulation/flocculation. The coagulant is injected into the 21-inch raw water pipeline from the 40-acre foot reservoir. No mixing devices are employed in the process. Floc form as the water mixes in the pipeline which increases the solids removal efficiency of the pressure filters. The existing treatment plant is considered a direct filtration plant by the CDPH.

Sodium hypochlorite is used as a disinfectant. District staff recently converted from chlorine gas to liquid to eliminate the hazards associated with chlorine gas. The sodium hypochlorite is pumped from a bulk storage tank to the injection point located just upstream of the filters. Ideally, chlorine is added after filtration to reduce the potential for the formation of trihalomethanes; however to increase the chlorine contact time to achieve adequate inactivation of Giardia the chlorine is added just upstream of the filters to receive contact time through the filters. Prechlorination prior to filtration does not create elevated trihalomethane concentrations in the water supply because the extremely low concentration of organics in the source water.

Hydrated lime is used to adjust pH. Hydrated lime is fed from a dry hopper into a small mixing tank where a concentrated lime slurry solution is rapidly mixed and discharged into the treated water pipeline just downstream of the filters.

The existing treatment facility produces excellent quality water. The facilities are maintained very well. Under the current plant piping configuration, maintaining adequate contact time for disinfection requires special operating and sampling procedures. District staff is currently working towards a solution to address that problem as discussed below.

5.1.3 Treated Water Storage and Chlorine Contact Time (CT)

Treated water is discharged from the filters and enters the distribution system. Three 430,000-gallon bolted steel tanks are located on the southwest corner of the treatment plant site providing about 1.3 Mgal of treated water storage. In their current configuration the tanks “ride the line” whereby the tanks are connected to the main transmission pipeline via branched tees with a lateral to the tank(s) as shown on Figure 5-2.

Treated water flows directly into the distribution system, or splits whereby some of the water enters the tanks, while the remaining water enters the distribution system. The proportionality depends on system demand. Under peak demand periods the majority of the water from the treatment plant bypasses the tanks altogether and enters the distribution system directly.

Treated water storage provides a number of functions including:

- Flow equalization
- Emergency storage
- Fire flow storage
- Residence time for chlorine contact time

The current tank configuration provides no effective storage that the CDPH credits toward the CT. The residence time is obtained through the filters, processes and transmission pipelines. In order to receive that credit, the chlorine residual must be measured at the first service in the system on a daily basis, which is cumbersome. That operational approach is complicated when the tanks are full and the treatment plant shuts down. The chlorine residual drops significantly when the water sits stagnant in the filters. As a result, the initial slug of water leaving the filters on start-up has a lower than normal amount of chlorine.

To avoid the dip in chlorine residual on start-up, operations staff attempts to adjust the plant flow rate to run continuously without shutting down. Achieving continuous operation is difficult without allowing significant drawdown of the tanks. Currently maximum day demands are near 2.5 MGD. In the event of a plant failure, operators must have the treatment plant back online within 12 hours or risk the distribution system running out of water, so allowing the tank levels to drop increases the potential risk of a water supply emergency in the event of a problem.

The chlorine contact time problem can be mitigated by reconfiguring the piping into the tanks and ensuring the water enters one or more of the tanks prior to entering the distribution system, and is discussed in more detail later in this section. Aside from the CT problem, operational storage within the system is currently adequate, but considered to be at the low end of normally accepted ranges especially given the remote location and rural nature of the District service area with threats of wildland fires that can drastically increase fire flow demands. Recommended storage improvements are discussed in Section 5.2.

5.1.4 Booster Pump Station

Treated water from the water treatment plant flows directly into the gravity distribution system that serves the lower elevation of the District. The booster pump station (BPS) is supplied directly from the 21-inch transmission main via a 12-inch suction pipeline, and serves the higher elevations of the system east of the treatment plant site, and provides auxiliary flow to lower portion of the system through a pressure reducing/pressure sustaining station across the street from Walter Way.

The pumping equipment and respective capacities are included in Table 5-2.

Table 5-2
Booster Pump Station

Pump	Quantity	Motor Size	Design Point
Low Capacity Pumps	2	25 HP	400 gpm @ 154’ TDH
High Capacity Pumps	2	75 HP	1,200 gpm @ 160’ TDH

The 25 HP pumps operate during normal conditions, and the larger 75 HP pumps are intended to provide fire flow. All four pumps are centrifugal type horizontal end suction units. Pumps are controlled automatically by a pressure transducer located in the building.

A 10,000 gallon hydropneumatic tank provides an air cushion and equalization to prevent the pumps from cycling rapidly. A 180 KW propane generator provides back-up power in the event of a power outage. The generator is sized to operate all the pumps. The generator automatically starts and an automatic transfer switch (ATS) automatically switches to the generator power.

5.2 TREATMENT PLANT IMPROVEMENTS

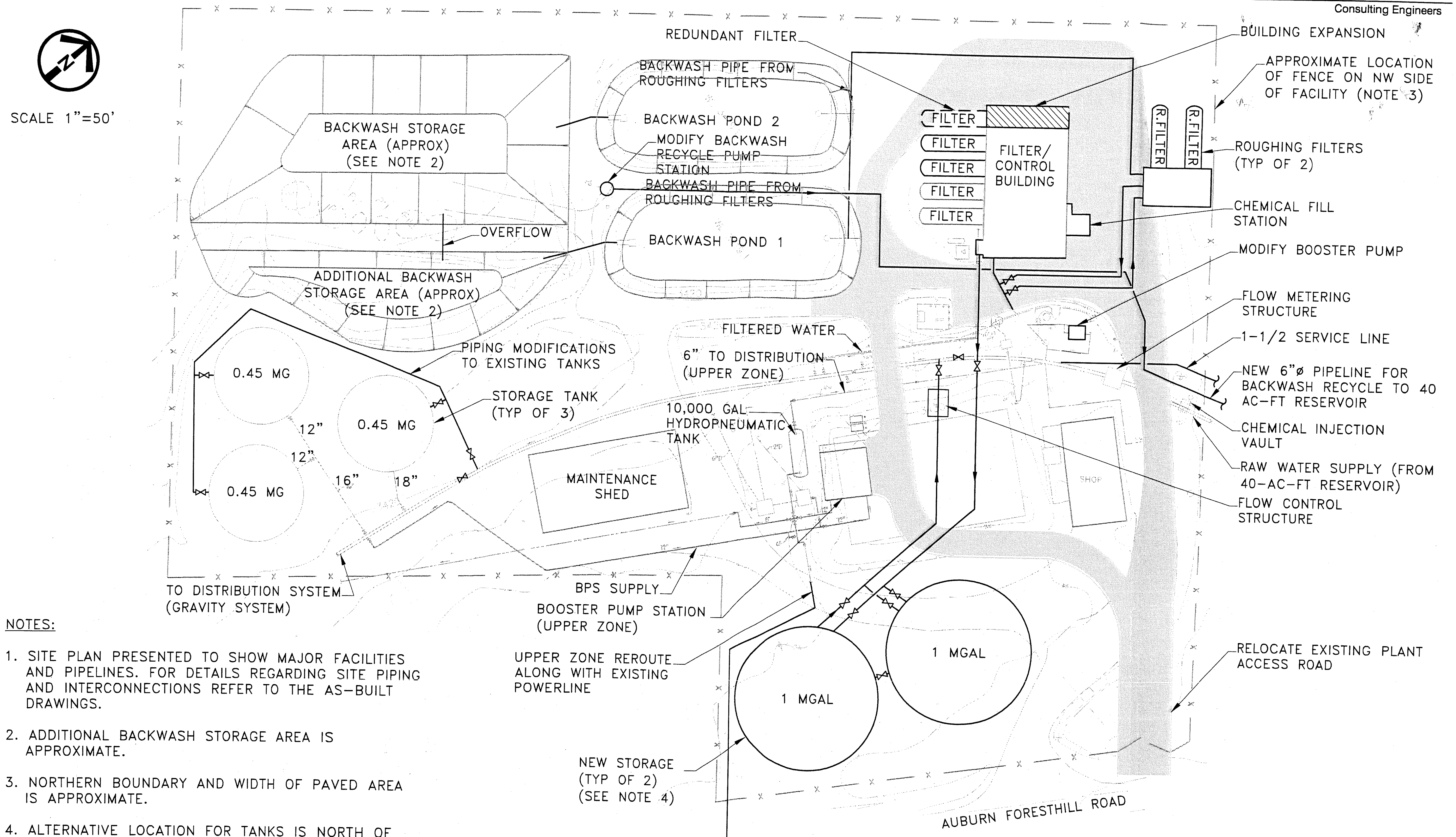
Improvements to the existing treatment facility are discussed in this section. The proposed treatment plant layout at the build-out condition is shown on Figure 5-3. The improvements will be constructed in phases as additional capacity is required. Improvement phasing is discussed in Section 5.4.

The improvements included herein are based on a planning level analysis used to determine the nature of improvements and planning level costs. Prior to implementing improvements, a preliminary engineering report must be completed to confirm the assumptions used to develop the improvements identified herein. As discussed below, a major assumption is that continued use of the pressure filters will be approved for future expansions, possibly with the addition of roughing filters. The Long-Term-2–Enhanced Surface Water Treatment Rule now applies to small systems, and requires that the raw water quality be analyzed for bacteriological contamination. Results of that test may require that more treatment be provided in the future.

Prior to implementing any of the suggested improvements included herein the District will comply with the California Environmental Quality Act (CEQA) and prepare the necessary documentation depending on the nature of the improvements. The District may also be subject to the National Environmental Protection Act (NEPA) and other Federal regulations depending on the nature of the project and funding sources. The determination of necessary documentation to comply with CEQA, and possibly NEPA, should occur during the predesign phase of the project when the specific nature of the improvements are known.

5.2.1 RAW WATER SUPPLY

The existing raw water supply facilities are adequate, function well and no improvements are recommended.



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2. ADDITIONAL BACKWASH STORAGE AREA IS APPROXIMATE.

3. NORTHERN BOUNDARY AND WIDTH OF PAVED AREA IS APPROXIMATE.

4. ALTERNATIVE LOCATION FOR TANKS IS NORTH OF EXISTING TANKS WITHIN BACKWASH STORAGE AREA. EVALUATION OF PREFERRED SITE TO OCCUR DURING PREDESIGN.

FIGURE 5-3 TREATMENT PLANT SITE PLAN BUILDOUT-6 MGD

5.2.2 Treatment Facilities

Improvements associated with increased plant capacity are discussed in this section. Planning level costs are provided for the improvements.

Filter Capacity. The original treatment plant was designed to accommodate two additional filters within the existing building, sized and configured similarly to the existing filters. Each filter provides a nominal capacity of 1.5 MGD at the approved loading rate. Future filter capacity expansions will be accomplished by adding additional filters and appurtenances.

With four filters in service the filter capacity will be 6 MGD. The projected maximum day demand is about 6.5 MGD, slightly higher than the capacity the treatment plant was originally designed for. The additional capacity needed could be provided by providing slightly larger filters with more capacity, or by adding a fifth filter in the future, which is considered the preferred alternative, as described below.

By adding the fifth filter, about 7.5 MGD additional filter capacity would be provided, but more importantly, there would be a redundant filter in available. The existing filters have operated extremely reliably since 1982; however, pressure filters occasionally fail. Typical failure points include:

- Problems in the under drain such as broken laterals,
- Failure of internal piping components,
- Failure of the internal baffle separating the cells, and
- General corrosion of the steel, including the shell.

These types of problems require that the filter be taken out of service, and depending on the location of the problem, media removed. While out of service the overall capacity of the treatment plant is reduced by 1.5 MGD. During the winter, when demands are low, this would not be a problem. However during peak demand periods, the demand would be higher than the available supply. Under today's demand, removing a filter from service would be problematic during the late spring, summer and fall.

Finally, under current drinking water regulations, a redundant treatment unit is required on new treatment plants. Although adding the redundant filter adds cost to the project, it is recommend and included in the project cost estimate, and would require an extension of the existing building. The redundant filter should be a high priority and provided as soon as funding is available.

Pretreatment. The existing water treatment plant is considered a direct filtration plant, which is an approved treatment method. Direct filtration includes coagulation and flocculation followed by filtration, and excludes sedimentation. Inline filtration is not an approved treatment process, and generally consists of the addition of coagulant immediately upstream of the filter units, with little or no time for coagulation and flocculation processes to occur. The designation between a direct and inline filtration is not always clear, and the District's system could be reclassified as an inline filtration process in the future. Reclassification to inline filtration would require major upgrades to the existing facility. Due to the high source water quality and long detention time provided in the 21-inch raw water pipeline between the 40-acre foot reservoir and treatment plant which provides time to allow flocculation to occur prior to filtration, reclassification to inline filtration is unlikely; however, pretreatment could be required.

Prior to the next treatment plant expansion, a Permit Amendment will be required from CDPH. During the amendment process, CDPH will evaluate the existing facilities in detail and there is a good possibility they will find that pretreatment will be necessary. The industry trend has become more conservative with new drinking water regulations being implemented since adoption of the 1996 Safe Drinking Water Act Amendment.

The addition of pretreatment processes at the District's treatment plant has been included in this Master Plan. Roughing filters would be installed just upstream of the existing filters. The roughing filters will be similar to the existing filters, except the media is coarser. The roughing filters will provide additional time for the coagulation process to progress and reduce the solids loading rate on the final (finishing) filters. Roughing filters are typically designed with a loading rate of approximately twice that of the finishing filters. Therefore one roughing filter of equal size would be able to pretreat water ahead of two finishing filters. A total of two roughing filters would be required to pretreat up to the anticipated capacity of an expanded treatment plant (approximately 6 MGD). A redundant roughing filter is not considered necessary, because they can be operated up to 10 gpm/ft^2, which is three times the loading rate of the final filters if necessary, and could provide over 5 MGD of capacity (based on 364 ft^2 – same size as existing filters). Prior to implementing the roughing filters a pilot study is necessary to assess performance.

A site plan is included in Figure 5-3 showing recommended improvements to the District's treatment plant. As shown, the new building and roughing filters would be installed to the east of the existing filter/control building, and oriented to allow continued access to the chemical fill station and the perimeter of the building. Additional space would be desirable, and could be achieved by encroaching on the parcel to the east, and adjacent to the existing treatment plant site; however the availability of that property is unknown.

The hydraulic head driving the water through the treatment plant derives from the differential pressure between the 40-acre foot reservoir and the treatment plant which is about 20-feet when the tanks are full and the reservoir is at its maximum elevation. With this amount of available head, the addition of roughing filters would likely require pumping. This is proposed to be accomplished with some relatively minor modifications to the existing backwash pump(s).

Backwash Recovery System. The backwash, filter to waste and instrument water must be contained on the site. Typically these streams are recycled back into the treatment system after some form of processing to remove excess solids. The current system is configured to return the backwash recycle stream directly in front of the filters and doing so negatively impacts the filter water quality. As mentioned previously, District Operators have expanded the backwash storage basins to a size capable of evaporating and percolating all of the water.

As the system demand and production of treated water increases, the volume of backwash water will also increase. The Backwash Recycling Rule requires that no more than 10-percent of the water applied to the filters is recycled water. Further, special monitoring and treatment requirements apply. To address these requirements, District staff plans to construct a pipeline up to the 40-acre foot reservoir which will convey and discharge the water into the basin.

There is approximately 13 MG of water in the reservoir which will provide dilution in excess of the 10 to 1 ratio required in the regulations. Operating in this way will simplify the controls of the backwash recycle pump station. For the purposes of this report about 1,500 feet of 6-inch diameter pipeline was assumed necessary to make the transmission of backwash water to the 40 acre-foot reservoir possible.

Treated Water Storage. Additional treated water storage at the site is needed to provided the required contact time for treatment, and provide reliability and equalization. Proposed criteria used to determine recommended storage facilities are included in Table 5-3. Storage volume for treatment is addressed below.

Table 5-3
Treated Water Storage Criteria

		Volume, Mgal	
Storage Component	**Criteria**	**Current**	**Build-Out**
Equalization	25% of MDD	0.58	1.6
Fire	2,000 gpm for 2 hours	0.24	0.24
Emergency	75% of MDD	1.7	5.0
Total	**---**	**2.5**	**6.8**

As shown in Table 5-3 a minimum volume of 2.5 Mgal of treated water storage is recommended under current conditions and would eventually be expanded to nearly 6.5 to 6.8 million gallons at full build-out. About one half of the storage could be provided at the treatment plant, and would help address the concerns with chlorine contact time that were discussed previously, while the remaining storage would be located within the distribution system.

Minimum storage included in Table 5-3 is based on standard design criteria within the industry with a priority placed on emergency storage which often is around 25% of maximum day demand (MDD) in a typical system. In addition, the Foresthill system warrants expanded storage for a number of reasons:

- The system is isolated, and mobilizing crews to address emergency situations can take time.
- Wild land fires are common in forested settings like the Foresthill Divide area. During a wild land fire, water demands within the District will increase significantly, and the duration will be substantially longer than the two hours typically associated with a structure fire.

- There are no interconnections with other systems for emergency supply.
- Portions of the transmission/distribution system is in extremely rough and remote country, and operates at high pressure. Locating a large leak can take time, during which the storage will be depleted if the treatment plant can not keep up. This has an added consequence in periods of critical water supply conditions whereby raw water yield may be affected as the treatment plant struggles to provide treated water to the system.
- The transmission/distribution system is currently constructed with little looping. Adding storage within the distribution system would provide redundancy against pipeline failures.

Provision of at least 75-percent of MDD emergency storage is recommend throughout the system. This includes storage in the distribution system and at the water treatment plant. The system storage will be added incrementally over time. Incremental expansion is necessary due to funding limitations as well as the need to maintain circulation through the tanks during low demand periods to avoid stagnant water and associated problems.

Onsite storage at the treatment plant is discussed in this section; distribution system storage is discussed in Section 6 of this report.

Siting storage tanks at the treatment plant site is difficult due to physical and operational constraints. The current storage tanks must remain online when the new tanks are being constructed; therefore locating the new tank(s) at that location is not possible. There is a large open area in the northwest portion of the site which is currently used for backwash storage. That location is about 10 to 15-feet lower in elevation than the existing tanks and constructing new storage in that location would require partially filling the area beneath the new tank(s).

A second location for additional storage tanks is near the plant entrance gate and is shown on Figure 5-3. The proposed site piping to and from the tanks is also shown. Two 1 Mgal storage tanks are recommended. By providing two tanks, they can be constructed in phases with the first occurring in the near future, while the second would be built as demands continue to increase. Two tanks also provide redundancy for major maintenance such as recoating where one can be removed from service without losing all the storage.

Ideally the new tanks could be constructed with the same maximum water surface elevation as the existing tanks. As planned that is not possible – the new tanks would need a diameter of approximately 78 feet and be filled to a normal operating level of 32 feet to provide a million gallons of storage each. The existing tanks have a maximum water elevation of about 24 feet. A hydraulic control valve would be needed to prevent the existing tanks from overflowing.

The additional elevation in the new tanks would reduce the available head to drive water through the plant, and as with the roughing filters, could require use of a pump. The existing backwash pump could be modified to allow operators to pump through the filters and fill the tanks.

Prior to selecting the location for the new tanks at the treatment plant site, a detailed hydraulic analysis, evaluation of soil conditions, and cost comparison should be completed to select the best alternative. The District is pluming the tank modification on the existing tank to provide an inlet for tanks located behind the existing tanks in the event that site is selected.

Chemical Feed Systems. Chemical feed system improvements needed to expand the system are discussed in general terms. As noted herein, relatively minor improvements are anticipated.

The chemical feed systems include:

- Cationic polymer for coagulation/flocculation
- Sodium hypochlorite for disinfection
- Lime for pH adjustment

Polymer Feed System. The polymer feed system is simple and consists of two chemical feed pumps, discharge piping and storage. The chemical is delivered in 250 gallon totes. As the demands increase, the chemical feed pumps may need to be replaced with larger units.

Chlorine Feed System. The chlorine feed system is similar to the polymer feed system and utilizes two pumps. The District converted the gaseous chlorine system to liquid sodium hypochlorite and installed a 2,300 gallon bulk storage tank, which will provide ample storage at projected build-out flows.

5.3 CAPITAL COST ESTIMATE

Planning level costs for the improvements discussed in this section are included below in Table 5-4. All costs included are based on 2007 cost levels. The estimates include a 30-percent contingency and a 25-percent allowance for engineering, administration and legal fees.

Table 5-4
Proposed Improvements[a]

	Improvements	Cost (x1,000)
Filtration Equipment		
A	Add additional filters, including face piping, media and manifolds – total of three additional filters including redundant unit	$1,250
	Expand/modify existing building to accommodate a fifth redundant filter unit	120
	Construct pretreatment building	250
	Install roughing filters (total of two units)	900
	Site piping modifications to accommodate roughing filters	75
	Modify existing backwash pump to increase capacity and design point to accommodate roughing filters and new tanks	150
	Sitework	100
	Electrical and controls (at approximately 30% of improvements)	850
	Sub-Total	**$3,695**
	Contingencies @ 30%	1,100
	Sub-Total	**$4,800**
	Engineering, Admin, Legal @ 25%	1,200
	Sub-Total Filtration Equipment	**$6,000**
Storage Facilities		
	Construct two 1 Mgal steel storage tanks	$2,000
	Site piping for new storage tank	110
	Hydraulic control structure (between new & existing tanks)	25
	Relocate access road and gate	30
	Modify inlet/out piping on existing tanks (work by District forces)	45
	Sub-Total	**$2,210**
	Contingencies @ 30%	660
	Sub-Total	**$2,870**
	Engineering, Admin, Legal @ 25%	720
	Sub-Total Storage Facilities	**$3,590**
Miscellaneous Improvements		
	Chemical feed modifications	20
	Backwash recycle pump station (6” pipeline and two new pumps)	140
	Sub-Total	**160**
	Contingencies @ 30%	50
	Sub-Total	**$210**
	Engineering, Admin, Legal @ 25%	50
	Sub-Total Miscellaneous Improvements	**$260**
	Total – Treatment Plant Improvements	**$9,850**

[a] June 2007 20 Cities ENR CCI = 7,984.

Section 6

Transmission, Distribution and Storage

The transmission, distribution system and associated treated water storage (distinct from raw water storage and treated water storage improvements at the District's treatment plant site) are discussed in this section. A description of the existing system is followed by recommended improvements to expand the system and correct existing deficiencies. Planning level cost estimates are provided for the improvements. Figures referenced in this section are included in the pocket at the back of this report.

6.1 EXISTING SYSTEM

The District's existing transmission and distribution system is described in this section. There is currently no storage within the transmission and distribution system.

6.1.1 TRANSMISSION PIPELINES

Transmission mains are the primary means of conveying water throughout the system. Transmission mains have distribution laterals emanating from the main, there are no services connected directly to the transmission pipelines. The District's current transmission and distribution system is shown on Figure 6-1 (see the inside back cover of this Master Plan). The transmission main begins at the water treatment plant and heads southwest, through a cross country route north of downtown Foresthill, until it begins to run adjacent and parallel to Foresthill Road.

The transmission main was constructed by the United States Bureau of Reclamation (USBR) as part of the Sugar Pine Reservoir Project in the early 1980s. The new transmission main paralleled the existing pipelines, some of which have been connected to the transmission main to create loops.

The entire transmission system is fed by gravity and there is no need for booster pumps stations to increase the system pressure along the transmission main. (As discussed below, a booster pump station located at the water treatment plant pressurizes the distribution system within the upper zone within downtown Foresthill.) As the elevation decreases away from the treatment plant, the pressure increases due to gravity head, and would exceed 520 psi (1,200 feet) at the end of the system near Bella Vista. These system pressures would require special pipeline materials and construction, and would present safety concerns.

The transmission main pressures are reduced through a series of pressure reducing stations. There are currently five pressure reducing stations (PRVs) located along its length with inlet pressures upwards of 200 pounds per square inch (psi). Outlet pressures are reduced down to 90 to 110 psi. Each of the PRVs are equipped with a pressure relief valve to protect the system. In the event of a PRV failure allowing full line pressure to occur, the relief valve opens and relieves the system pressure. The PRV stations are inspected weekly. The transmission main is constructed of asbestos concrete (AC) pipe, and is in good condition. Due to the high pressures involved special thickness classes were required to prevent failures and District staff must maintain an inventory of specialized repair materials suited to the unconventional pipe diameters. District staff report that problems with the PRVs and/or pipeline are infrequent and the system runs well.

The existing transmission pipeline was constructed with minimal looping. Looping creates interconnections which allow operators to divert flow around areas that must be isolated due to emergencies, or for heavy maintenance. Due to the linearity of the current system, water service is interrupted to all customers downstream of the isolation valve used to shut the water off.

District staff has operated the current system since its inception and are aware of the potential problems, and as discussed above, stock repair parts to minimize outages when necessary. A primary goal of future system expansions should be to create loops within the primary transmission system.

6.1.2 Distribution Pipelines

Distribution system pipelines are supplied directly from the transmission main. Distribution pipelines are typically smaller diameter and provide water service to customers via a service lateral and meter set.

Each distribution lateral connected to the District's transmission main is supplied through a PRV station. The PRVs serve to isolate and protect the transmission and distribution system mains from surges or over pressurization created within either system. There are currently 38 PRVs at distribution system laterals.

The distribution systems serve specific development within the pressure zone and include fire hydrants, services, air relive valves, etc. The District's distribution system consists of various types of pipe material including AC pipe, ductile iron and plastic. The system pressures vary greatly due to the undulating topography typical of the foothills. The overall distribution system is in good shape, which is evident based on the low percentage of unaccounted water as discussed in Section 3.

6.2 EXISTING TRANSMISSION/DISTRIBUTION SYSTEM EVALUATION

An evaluation of the existing system is provided in this section.

6.2.1 Hydraulic Model

A hydraulic model of the water transmission/distribution system for Foresthill was developed using Haestad's WaterCAD 7.0 modeling software. This model was used to analyze the existing system and to determine the improvements necessary to provide service within the existing service area boundary of the District.

Scenarios Analyzed

The water distribution system model developed for the District includes a matrix of existing and future build out scenarios; each containing four different demand conditions. The demand conditions analyzed in the water model were as follows:

- average day demands (ADD)
- maximum day demands (MDD)
- peak hour demands (PHD)
- maximum day demands coincident with fire flows (MDD+FF)

Input and Design Criteria

The basic input and design criteria used in the model are summarized below.

Distribution of Demands. The distribution system was divided into several zones based on the topography and existing PRV locations. The zones are delineated on the Figure 6-1. Each pressure zone was assigned a water demand based on the water demand projections within the zone, based on the current level of development.

The water demands were distributed throughout the model for current and build out conditions. The demand distribution for current conditions was based on the current level of demand, land uses, and whether or not the parcel was developed based on County Assessor's data. Future demands were distributed based on the projected demands and current land use designations throughout the District.

Model Node Elevations. USGS information, including topographic maps and existing electronic benchmark data were used to populate model nodes with elevations.

Demand Peaking Factor. Peaking factors used for modeling were developed in Section 3, and are as follows:

- Average day to Max day = 2.5
- Max day to Peak hour = 1.7

Unaccounted Water. Ten percent of the average water demand was considered as unaccounted water, as discussed in Section 3, and added to the ADD and MDD. These calculated demands were distributed evenly throughout the model.

Distribution System Pressure. The following pressure criteria for distribution system pressure were used in modeling.

1. A minimum pressure of 20 psi at all service connections during maximum day demand plus fire flow condition.

2. A minimal pressure of 40 psi during maximum day demand.

3. A minimum pressure of 30 psi during peak hour demand.

4. The static pressure at the lowest ground elevation of the zone nodes should not exceed 200 psi under all conditions.

Transmission/Distribution Piping. The pipes in this model were sized according to the following design criteria.

1. Pipe velocities should not exceed 8 fps under ADD, MDD and PHD conditions.
2. The "C" factors of old piping and new piping are 100 and 130, respectively.

Fire Flow Design Criteria for Undeveloped Area. The following criteria were used for fire flow analysis based on discussions with the Foresthill Fire Protection District.

1. Fire flow in residential areas of 1,000 gpm for 2 hours was used based on the International Fire Code (IFC) for one and two family dwellings having a fire area which does not exceed 3,600 square feet. Larger homes may be required to install fire sprinklers or other mitigation if flows greater than 1,000 gpm are required.
2. Fire flow in commercial areas of 2,000 gpm for 2 hours was used based on the International Fire Code (IFC) assuming an average commercial building size.

6.2.2 Existing System Modeling Results

Modeling results for the existing system are presented in this section. Results are presented for the "normal condition", which represents non-fire flow conditions and would be expected to occur on a daily basis. The "fire flow condition" represents the fire flow added to the maximum day demand flow.

Normal Conditions

Under normal conditions minimum the system pressures appear to be adequate. The system pressures and flow velocities satisfy the design criteria for ADD, MDD, and PHD, except in the following locations:

1. The velocity in the 6-inch main at Crestline Drive, between Mougnberry Lane and Cold Springs Drive (8.1 fps) slightly exceeds the design criteria under PHD, but is not considered to be a significant problem.
2. The pressures at the northern end of Eagle Ridge Drive and the 6-inch main at Monte Verde do not satisfy the minimum pressure criteria under ADD, MDD, and PHD.
3. Many of the pressure zones are fed by multiple PRVs. Many of the PRV stations are not active under normal conditions, and only operate under fire flow conditions or if areas are hydraulically isolated under due to maintenance or a main break. This practice is reasonable and provides redundancy in the system.

Fire Flow Condition

Under the maximum day plus fire flow condition, flows throughout the system are much higher than normal and velocities within the system are high. As a result, the system pressures are reduced as a result of the friction losses.

Based on the model results, a number of areas within the system do not meet the fire flow and/or minimum pressure criteria as shown on Figure 6-1.

Generally speaking, areas that fail to satisfy fire flows are summarized listed below.

1. Areas supplied by long 6-inch mains with no looping.
2. The system in the southwest suffers from inadequate fire flows due to the long distance from the storage tanks located at the WTP site.
3. Several locations within the District including Todd Valley, Gas Canyon, Monte Verde area, Isabel Lane, Old Mill Road, Thomson Street and Timberland Drive.

The deficiencies included above do not address the lack of redundancy and looping throughout the existing system, which is considered the most critical deficiency. Looping and improvements to correct existing deficiencies is included in Section 6-4.

6.2.3 Improvements to the Existing System

Improvements to the existing system are proposed to help the system meet the pressure and flow criteria. The proposed improvements to the existing system are shown in bold on Figure 6-2 included in the back of this Master Plan. The fire flows were not field verified through a model calibration, and District staff should verify, or provide input regarding the problem areas. The available fire flow after the improvements is shown on Figure 6-2. Not all fire flow deficiencies are fixed with these improvements.

The most critical distribution system pipeline modifications are listed here, with all recommended pipe modifications prioritized and listed in Table 6-1.

Table 6-1
Recommended Improvements for Existing Pipes

Item	Improvements	Remarks
a	Replace 6" distribution main with 8" main in Crestline Drive	To keep the velocity under the design criteria
b	Replace 6" distribution mains with 8" mains in Old Mill Street south of Foresthill Road	To satisfy the fire flow design criteria
c	Replace 4" distribution mains with 6" mains in Old Mill Street south of Foresthill Road	To satisfy the fire flow design criteria
d	Replace 6" distribution main with 8" main in Gas Canyon Court	To satisfy the fire flow design criteria STILL APPEARS TO BE DEFICIENT
e	6" distribution main connection between Thomas Street and Timber Land Drive	To satisfy the fire flow design criteria
f	Replace 6" distribution main with 8" main in Hard Rock Drive	To satisfy the fire flow design criteria VERIFY HARD ROCK DRIVE
g	Replace 6" distribution main with 8" main in Mayflower Road	To satisfy the fire flow design criteria
h	Replace 6" distribution main with 8" main in Moshiron Drive up to Pine Crest Drive	To satisfy the fire flow design criteria
i	Replace 6" distribution main with 8" main in Hosmer Mine Court	To satisfy the fire flow design criteria
j	Replace 6" distribution mains with 8" mains in Pine Crest Drive	To satisfy the fire flow design criteria
k	Replace 4" distribution mains with 6" mains in Pine Crest Drive	To satisfy the fire flow design criteria
l	6" distribution main connection between the ends of Eagle Ridge Drive and Ponderosa Way	To satisfy the fire flow design criteria
m	Replace 6" distribution mains with 8" mains in the northwest corner of Monte Verde area	To satisfy the fire flow design criteria

Pipelines smaller than 6 inches were not analyzed as part of this report. Any 2-inch and 4-inch diameter distribution mains are recommended to be replaced with at least 6-inch mains to increase available fire flow.

A few existing PRV settings were changed within the distribution system to satisfy the design criteria within the hydraulic model. The existing and new settings of the modified PRVs are summarized in Table 6-2. It is understood that operations staff adjusts the PRV setting frequently depending on seasonal demands. Prior to making adjustments indicated further analysis is recommend to ensure that over pressurization does not occur with in the system. Table 6-2 is provided as guidance only.

Table 6-2
Existing and Proposed PRV Controls

PRV Location	Existing Control		Proposed Control		Remarks
	Status	Pressure Setting (Psi)	Status [a]	Pressure Setting (Psi)	
PRS 3	Active	90	Active	45	To match the downstream HGL to the proposed tank
PRS 5	Active	100	Active	125	To improve the available fire flow
Thomas Street 2	Active	80	Active	105	To combine two or more PRVs to form a pressure zone
Gas Canyon	Active	90	Active	105	To extend a pressure zone to combine with another pressure zone
Greenridge	Active	45	Active	65	The setting was too off from the other PRVs that supply to that zone
Little Oak	Active	80	Active	30	To prevent this PRV from becoming the sole supply for a pressure zone in Todd Valley
Pre-School	Active	130	Inactive	-	To make use of both proposed tanks in the Southwest area
Eagle Ridge	Active	130	Active	150	To satisfy the pressure criteria / to improve the available fire flow in that zone
Monte Verde	Active	120	Active	130	To satisfy the pressure criteria / to improve the available fire flow in Monte Verde area
McKeon Ponderosa	Active	90	Inactive	-	No need to be active to stay in a pressure zone with the adjacent nodes
Old Mill	Active	60	Active	80	The setting was too off from the other PRVs that supply to that zone
Blaylocks	Active	60	Inactive	-	No need to be active to stay in a pressure zone with the adjacent nodes

(a) Inactive valves were not needed for pressure reducing during all model scenarios.

6.3 TRANSMISSION PIPELINES AND STORAGE SYSTEM BUILD-OUT

The expanded transmission system presented herein has been developed to provide service for future development, provide looping/parallel pipelines to increase redundancy, and includes additional treated water storage within the system through build-out. Future improvements consider use of existing facilities where possible to reduce project costs. Where possible the proposed pipeline alignments are along existing roads, or in the vicinity of future roadways currently planned by Placer County.

Improvements have been developed to a facilities planning level. Detailed engineering studies are needed prior to implementing the improvements to confirm assumptions, verify elevations and system hydraulics, consider alignment route alternatives, etc.

Prior to implementing any of the suggested improvements included herein the District will comply with the California Environmental Quality Act (CEQA) and prepare the necessary documentation depending on the nature of the improvements. The District may also be subject to the National Environmental Protection Act (NEPA) and other Federal regulations depending on the nature of the project and funding sources. The determination of necessary documentation to comply with CEQA, and possibly NEPA, should occur during the predesign phase of the project when the specific nature of the improvements are known including transmission main alignments and storage tank locations within the system.

Distribution systems associated with specific developments are not addressed in this report. The “onsite” pipelines and appurtenances to serve individual developments will be designed by the developers to District standards. The layout of those facilities will be tailored to the individual development project based on the planned layout of the development. The District will review and approve the improvements, including the point of connection to existing facilities. In some cases, key pipelines within the developments may need to be upsized so they can be used to connect/extend some of master planned facilities identified herein.

6.3.1 PIPELINE IMPROVEMENTS

All of the improvements identified herein are within the existing District boundary. The majority of the new pipelines, and potential to provide looping and parallel pipelines within the system is within the northern portion of the District. Two storage tank sites are proposed within the transmission system. Storage within the transmission system will provide redundancy in the event of a pipeline failure, and will also provide additional storage in the event of a water supply emergency, such as a treatment plant failure.

Phasing of the transmission system improvements will be dependent on when and where development occurs within the system. On the northern portion of the District, development will likely occur on lands north and adjacent to Foresthill Road and progress northerly up to Yankee Jim’s Road as supporting infrastructure occurs. Within the southwestern portion of the District, the area within Gas Canyon will likely begin to develop as well.

The proposed transmission pipelines to serve build-out are shown on Figure 6-3. The alignments shown are for planning purposes only necessary for modeling and determining planning level cost estimates. Detailed analysis including soils, topography, environmental constraints, right-of-ways, etc. will be necessary prior to selecting the actual alignment. The pipeline improvements proposed to serve the build-out condition are listed in Table 6-3 with a corresponding letter identifying the improvement on Figure 6-3.

6.3.2 STORAGE IMPROVEMENTS

Design criteria and recommended system storage improvements were discussed in Section 5. Treated water storage is needed within the system to provide equalization, emergency storage and fire flow capacity. Currently all storage is at the water treatment plant site. Given the size and configuration of the District providing storage within the distribution system is recommended. Based on the criteria presented in Section 5, upwards of seven (7) Mgal of