Ebbetts Pass Water Master Plan

May 2005

Calaveras County Water District

CALAVERAS COUNTY WATER DISTRICT

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HDR

Ebbetts Pass Water Master Plan

CALAVERAS COUNTY WATER DISTRICT

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Table of Contents

Figures

Tables

Appendices

Executive Summary

Chapter 1 - Executive Summary

The Ebbetts Pass Water System consists of one 4 mgd surface water treatment plant, 65 pressure zones, 17 storage tanks, 10 pumping stations, over 120 miles of distribution lines, and over 100 pressure reducing stations. Water in each pressure zone is pumped from the Hunters Water Treatment Plant (WTP) and stored in water storage tanks that is then distributed by gravity. The Ebbetts Pass Water System currently serves 5,446 retail water connections and six wholesale connections.

Future growth areas were identified by overlaying the land use maps on to the existing water system maps. Future residential growth is primarily anticipated within the Arnold community (Sawmill and Meadowmont pressure zones) and the Forest Meadows community (Forest Meadows 1 and 2 pressure zones). Infill growth in the remaining pressure zones account for approximately 25 percent of the future connections. The evaluation considered an average growth rate of 1.6 percent. The analysis identified 1,925 future connections at build out resulting in a total of 7,371 connections at build out.

According to historic water production records, the average annual demand for the Ebbetts Pass water system per connection is approximately 270 gpd. The existing system has a maximum day water demand of 3.4 mgd.

To comply with CCWD's Improvement Standards, analysis of the existing connections assumed the standard unit demand of 500 gpd/connection for all future connections. The analysis of existing connections also assumed the existing average demand per connection was increased every five years in equal increments until it complied with the standard demand of 500 gpd/connection after 20 years. Build out maximum day water demands were determined to be 8.1 mgd.

The Ebbetts Pass Water System's running annual average concentrations of haloacetic acids (HAA5's) exceeded the maximum contaminant level (MCL) of 60 mg/L in the fourth quarter of 2002 and first quarter of 2003. Since implementation of treatment and distribution modifications during February 2003, HAA5's have remained below the MCL.

CCWD's water rights allow 8,000 acre-feet to be delivered annually from the North Fork of the Stanislaus River to the Ebbetts Pass Water System for consumptive use. Build out water use is estimated at approximately 4,450 acre-feet/year. These water rights should be sufficient to meet the projected annual water production for each improvement phase.

To meet maximum day demands, Hunters WTP will require additional expansion. During Phase I, a third 2 mgd treatment train is recommended to increase plant capacity to 6 mgd. Prior to Phase III, a fourth 3 mgd treatment train, or replacement of one of the original treatment trains with a membrane microfiltration treatment system sized for 5 mgd is recommended.

Analysis also recommends replacement of all ten redwood storage facilities due to negative impact on the formation of HAA5's and standby power at all booster pumping stations.

Hydraulic model runs identified existing and buildout pipeline improvements necessary to meet existing and future water demands along with complying with District standards.

Recommendations

Recommended improvements have been divided into five-year planning phases to facilitate implementation and to assist CCWD in planning and funding the water system improvements. Table 1 summarizes the recommended improvement cost per phase. Detailed tables of the costs are included in Appendix A.

Table 1. Summary of Capital Improvement Costs.

Recommended Improvements	Phase I	Phase II	Phase III	Phase IV
	Yr 1 to 5	Yr 6 to 10	Yr 11 to 15	Yr 16 to Buildout
Recommended Improvement Total Cost	$14,504,600	$4,522,300	$5,624,700	$846,100
Contingency (25%)	$3,626,150	$1,130,575	$1,406,175	$211,525
Engineering, Administration, CM (20%)	$2,900,920	$904,460	$1,124,940	$169,220
Total Cost	$21,031,670	$6,557,335	$8,155,815	$1,226,845
Total Improvement Cost	$36,971,665			

Existing System

Chapter 2 - Existing System

Existing Service Area

Calaveras County Water District's (CCWD's) Ebbetts Pass Water System Improvement District 5 supplies treated water to businesses and residents along the Ebbetts Pass/Highway 4 corridor. The service area encompasses the communities of Forest Meadows, Hathaway Pines, Avery, Arnold, White Pines, Dorrington, Camp Connell, and the Calaveras Big Trees State Park. The existing service area is defined by the limits of the Stanislaus National Forest.

The existing water supply is drawn from the Collierville Tunnel and transported via a 20 inch pipeline to the 4 mgd Hunters Water Treatment Plant (WTP). According to CCWD records, the existing water system supplies 5,446 retail connections within the Ebbetts Pass service area. Included in these connections are two schools, Hazel Fischer School (approximately 300 elementary school students) and Avery Middle School (approximately 300 junior high students). The system also serves six wholesale connections: Timber Trails, State Park, Oak Hollow Campground, Snowshoe Springs, Fly in Acres, and Blue Lake Springs Mutual. Table 2 presents a summary of service area connections.

Table 2. Service Area Connections.

Service Area	No. of Connections	Commercial	School
Big Trees 1,3	234	No	No
Big Trees 60K	277	No	No
Big Trees 4,5	873	No	No
Big Trees 8	101	No	No
Subtotal – Big Trees	**1485**	**No**	**No**
Sawmill	2256	Yes	Yes
Meadowmont 13	232	No	No
Pinebrook	251	No	No
Diablo View	69	No	No
Subtotal – Sawmill	**2808**	**Yes**	**Yes**
Avery	**579**	**Yes**	**Yes**
Meadowmont	**74**	**Yes**	**No**
Forest Meadows 1 and 2	**500**	**No**	**No**
Wholesale Demands	**6**	**No**	**No**
System Total	5452		

Water Supply

Raw water is drawn from the Collierville Tunnel, which is part of the newly constructed North Fork Stanislaus River Hydroelectric Development Project, and transported via a 20-inch pipeline to the Hunters Lake Water Treatment Plant (WTP). Originally constructed in 1965, the WTP was expanded to 4 mgd in 1992. The Hunters Reservoir diversion is used as a back-up supply of water. Hunter Reservoir is owned and operated by the Utica Power Authority.

Distribution System

Water distribution is accomplished through a series of pumping stations and storage tanks along the Highway 4 corridor. The existing water system supplies 5,446 retail connections and six wholesale connections within the Ebbetts Pass service area. The Ebbetts Pass Water system consists of 65 pressure zones, 17 storage tanks, 10 pumping stations, over 120 miles of distribution lines, and over 100 pressure reducing stations. There are five main service zones within the Ebbetts Pass Water System:

- Big Trees
- Sawmill
- Avery
- Meadowmont
- Forest Meadows

Water in each pressure zone is pumped from the tanks serving the zone below, up to the tanks serving that zone. System demands are met by a combination of pumped flow and gravity flow from the tanks.

Storage Facilities

Table 3 is a summary of the storage tanks available in each zone. These storage tanks equalize the demands during normal operations, provide emergency storage during power outages and provide fire fighting storage.

Table 3. Summary of Existing Storage Facilities.

TANK	Elevation (FT)	Volume (GAL)	Tank Material	Tank Diam. (FT)	Tank Height (FT)	Gals per FT
Hunters WTP Clearwell (SCADA)	3200	950,900	Steel	90	20	47,547
Larkspur (F.M. Steel)	3441	147,900	Steel	30	27.5	5283
Heather (F.M. Wood)	3691	458,000	Redwood	66.6	17.6	26037
Timber Trails	3830	52,800	Redwood	23	17	3105
Avery (SCADA)	3515	712,700	Steel	69	25.5	27947
Meadowmont (Big Blue M.M.(SCADA))	3925	264,000	Steel	42	25.5	10355
Meadowmont 13	4265	101,000	Redwood	31	18	5641
Pinebrook (SCADA)	4305	1,000,000	Steel	75	29	33019
Sawmill (SCADA)	4470	2,840,000	Steel	120	33.6	84528
State Park		42,300	Redwood	20	18	2348
Big Trees 1 (SCADA)	4920	98,300	Redwood	30.5	18	5461
Bt 60,000 Tank (SCADA)	5210	55,600	Redwood	26	14	3968
Big Trees 3	4930	98,300	Redwood	30.5	18	5461
Big Trees 4 & 5 (SCADA) (2 Tanks)	5245	186,000	Redwood	30.5	17	5461
Big Trees 8	5355	98,300	Redwood	30.5	18	5461
District Total		7,106,100				

Pumping Stations

Table 4 is a summary of the pumping stations available in each zone.

Table 4. Summary of Existing Pumping Station Facilities.

Pumping Station	SCADA Available	Total Capacity GPM	Firm Capacity GPM	Pump 1 HP	Pump 1 GPM	Pump 2 HP	Pump 2 GPM	Pump 3 HP	Pump 3 GPM
Hunters WTP	Yes	2750	2200	200	1400	200	1400	200	1400
Larkspur (F.M. Steel)		900	450	40	450	40	450	NONE	NONE
Timber Trails		195	95	15	100	15	95	NA	NA
Avery	Yes	5100	3400	200	1700	200	1700	200	1700
Meadowmont (Big Blue M.M.)	Yes	5400	3600	350	1800	350	1800	350	1800
Sawmill	Yes	610	320	25	175	25	145	50	290
Big Trees 1	Yes	195	95	15	95	15	100	NA	NA
Dorrington	Yes	200	100	15	100	15	100	NA	NA
Big Trees 4 & 5	Yes	96	46	3	50	3	46	NA	NA

Several of the pumping stations have been equipped with a standby power generator system. Table 5 summarizes generator information at the various water facilities in the system.

Table 5. Summary of Existing Standby Power Generator Systems. July 2004

Pumping Station	KW	RPM	HP	Amps	Generator Model	KVA	Volts	Fuel Tank Size
Hunters WTP and Booster Pumping Station	275	1800	435	954	275DFBF40038F	344	120 / 480	500 Diesel
Avery Tank and Pumping Station	500	1800	750	752	500C2	625	120 / 480	1000 Diesel
Meadowmont Tank and Pumping Station	800	1800	1340	1203	900CB2	1000	120 / 480	1000 Diesel
Sawmill Tank and Pumping Station	80	1800	156	301	6GA01639	100	240	500 Diesel

Pipelines

The distribution system supplies both fire demands and the maximum usage demands of the Ebbetts Pass Water system. The distribution pipeline vary in diameter from two to 14 inches.

Water Treatment Facilities

The WTP uses a one million gallon clearwell and pumping station with firm capacity of 2,200 gpm to supply treated water to the Ebbetts Pass Water System. As part of the WTP expansion in 1992, the Hunters Pumping Station was constructed with three vertical turbine pumps (two duty, one standby) with provisions for installing a fourth pump to increase the pumping capacity to 5 mgd. Each pump is rated for 1,400 gpm at 390 feet TDH. The pumps are housed with the filter backwash pump in a prefabricated metal building. A diesel generator is located outside the building and provides standby power for both the pumping station and water treatment plant.

Planning Area Designation and Growth Projections

Planning Area
Designation and Growth
Projections

Chapter 3 - Planning Area Designation and Growth Projections

Future Growth Areas

Updated facility maps provided by CCWD showed the existing service areas of the Ebbetts Pass water system. Figure 1 shows the main distribution system for the Ebbetts Pass Water System.

A breakdown of the existing number of connections for each tank zone was provided by CCWD. The number of connections for each zone was needed to estimate the existing water demands for each zone and to appropriately size the system's storage facilities. Table 6 summarizes the estimated number of connections for each tank zone.

Table 6. Ebbetts Pass Tank Zones and Existing Number of Retail Connections.

Water Tank Zone	Estimated Number of Existing Retail Connections
Big Trees Village 1 and 3	234
Big Trees Village 60K	277
Big Trees Village 4 and 5	873
Big Trees Village 8	101
Subtotal – Big Trees Zone	**1485**
Sawmill	2256
Meadowmont 13	232
Pinebrook	251
Diablo View	69
Subtotal – Sawmill Zone	**2808**
Avery Zone	**579**
Meadowmont Zone	**74**
Forest Meadows 1 (Larkspur)	220
Forest Meadows 2 (Heather)	280
Subtotal – Forest Meadows Zone	**500**
Total Number of Existing Retail Connections	5446

Future growth areas were identified by overlaying the land use maps from the respective general plans (Ebbetts Pass Highway Special Plan, Arnold Community Plan, and the Avery–Hathaway Pines Community Plan) onto the existing system maps. The areas that are not currently developed were identified as future growth areas in accordance with the land use classifications provided in the general plans. For the Forest Meadows, Sawmill, Meadowmont and Avery areas, more detailed development plans were used to identify the future growth areas. Future residential growth is primarily anticipated within both the Arnold (Sawmill and

Meadowmont pressure zones) and Forest Meadows (Forest Meadows 1 and 2 pressure zones) communities per the general plans and proposed development plans. Growth within the remaining service areas will be accomplished though infill. Table 7 summarizes the estimated number of future connections in each growth area.

The Ebbetts Pass Highway Special Plan (General Plan) identifies two substantial growth areas: between Big Trees Village and Arnold and between Forest Meadows and Murphys. The growth area south of Big Trees Village encompasses approximately 880 acres and is zoned as single family residential (see Figure 2). At this point in time, growth in this area is considered unlikely and is not considered in this study.

Table 7. Projected Number of Connections in Ebbets Pass Service Areas.

Service Area	Basis of Growth	Estimated Connections
Big Trees	Infill of Available Lots	355
Sawmill	Proposed Development (Lake Meadows)	50
Meadowmont 13	Infill of Available Lots	45
Pinebrook	Infill of Available Lots	100
Diablo View	Infill of Available Lots	15
Meadowmont	Proposed Developments (Ellis Project)	360
Avery	Proposed Development (Red Apple)	70
Forest Meadows	Proposed Development	930
	Total Future Connections	1,925

The second growth area between Forest Meadows and Murphys is designated single family residential with five acre minimum lot size. The General Plan further identifies five acre minimum density areas to be served by well and septic. Therefore, this growth area will not be served by the Ebbetts Pass Water System and will not be considered in determining future demands.

The review of the Arnold Community Plan identified several smaller future growth areas. These areas lie within the Sawmill and Meadowmont existing pressure zones and are designated as either single family residential, multi family residential, or rural residential. Figure 3 shows the majority of the growth areas within the Sawmill pressure zone. Figure 4 shows one additional Sawmill pressure zone growth area and the anticipated growth areas within the Meadowmont pressure zone.

The Avery–Hathaway Pines Community Plan noted that all areas designated for single family residential zones have been developed. The growth areas presented in the community plan were designated for rural residential with a five acre density. Again, the community plan further identifies five acre minimum density areas to be served by well and septic. Therefore, this growth area will not be served by the Ebbetts Pass Water System and will not be considered in determining future demands. No future growth areas are identified within the Avery-Hathaway Community Plan that will impact the Ebbetts Pass Water System.

The final growth area is associated with the Forest Meadows area, and this area is included in the Ebbetts Pass Community Plan. However, the development community has a detailed plan for build-out of the Forest Meadows area. The development plans provided and communicated by the development community will be used to determine future connection and demands associated with the Forest Meadows area, which includes 930 future connections.

Several of the service areas have developments proposed that will be used to determine future connections in lieu of the general and special plans. These service areas include Sawmill, Meadowmont and Avery. The developments proposed are summarized in Table 8.

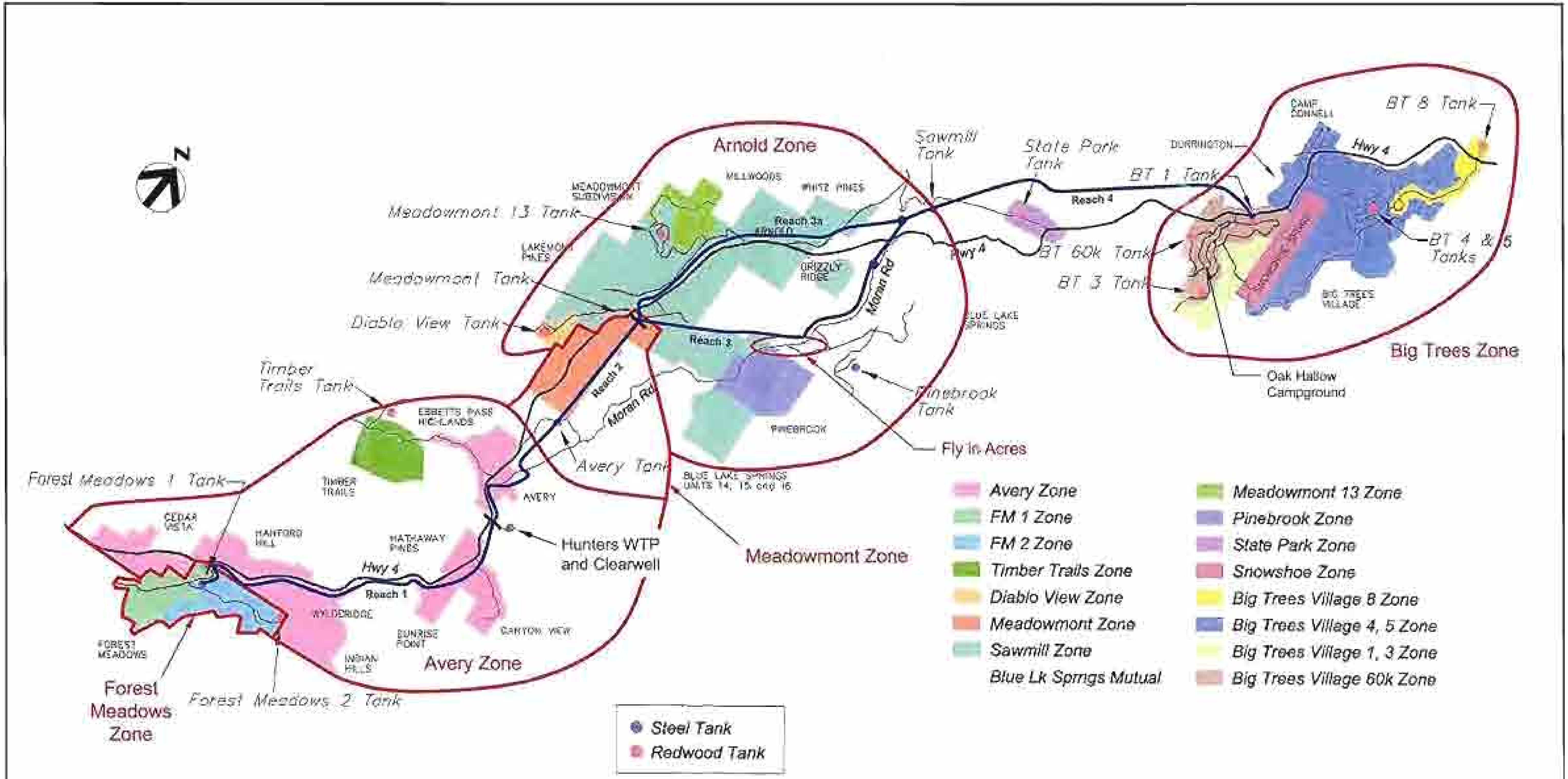
Within each Ebbetts Pass community, the evaluation assumed infill development would occur within the existing services built out areas.

The growth areas will be incorporated at a rate equivalent to the historical growth rate for the Ebbetts Pass water service area, which is an annual growth rate of 1.6 percent. These growth projections will be addressed in five year increments through 20 years and in buildout scenarios.

A breakdown of total undeveloped lots for each service was provided by CCWD. Service areas without immediate development plans were assumed to develop 50 to 70 percent of the available lots at build-out. This assumption was based on the inability to develop several lots due to severe topography changes. These areas include Big Trees, Pinebrook and Diablo View..

Table 8. Proposed Developments.

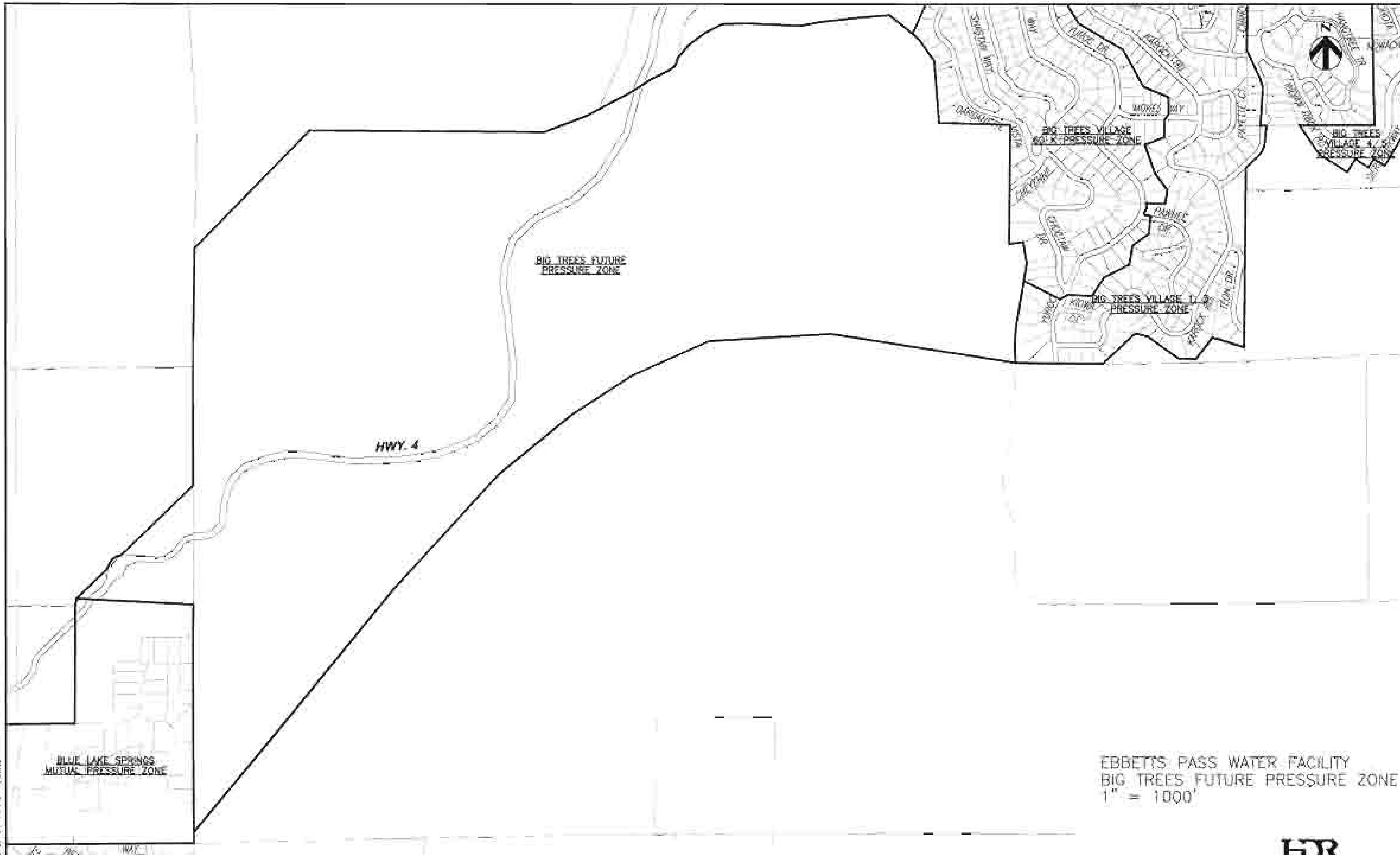
Development	No. of Connections	Service Area
Lake Meadow	50	Sawmill Tank Zone
Ellis Project	300	Meadwomont Tank Zone
	30	Meadwomont Tank Zone
	30	Meadwomont Tank Zone
Red Apple	70	Avery Tank Zone
Total	**480**	



Ebbetts Pass Water
Main Distribution System

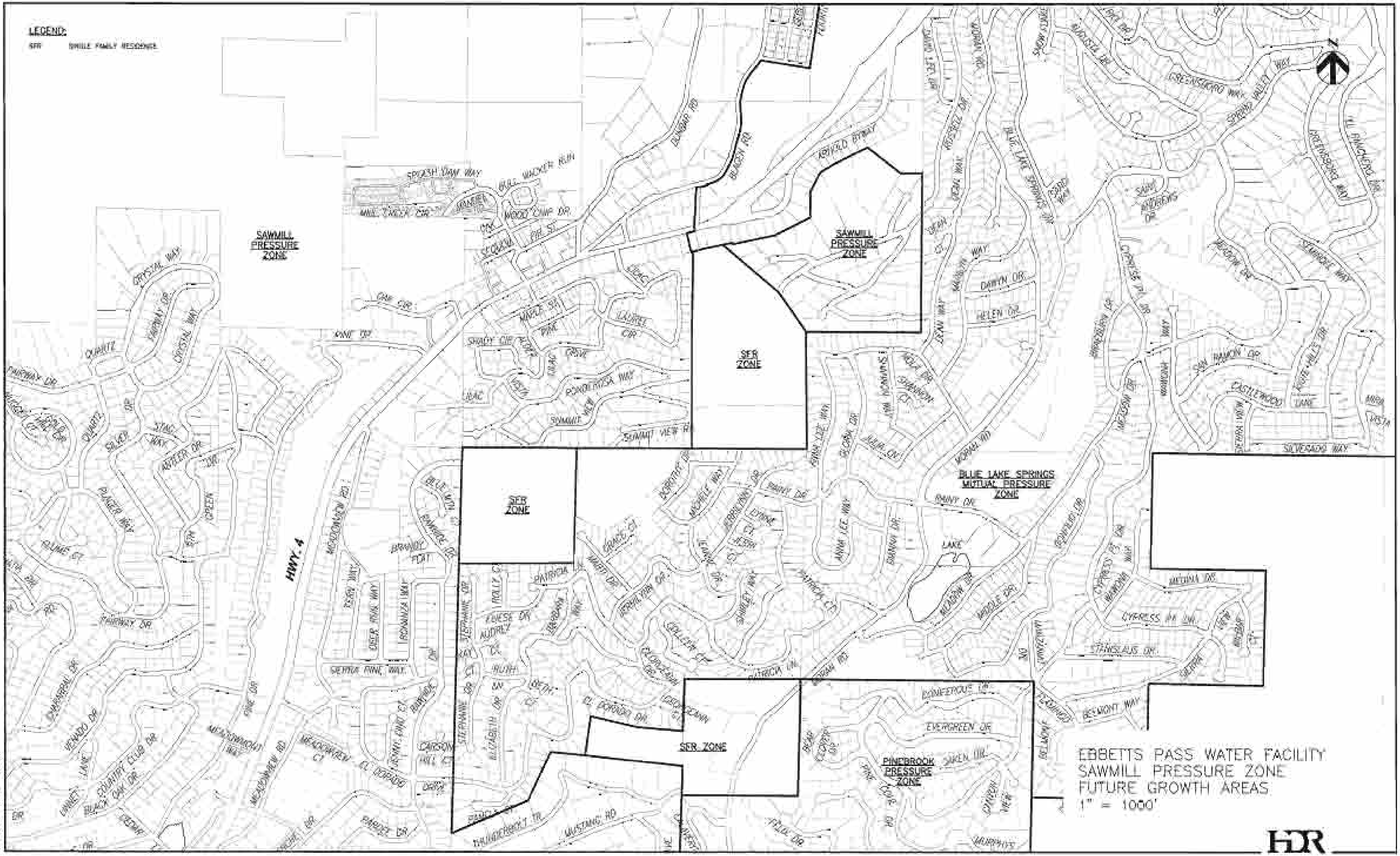
HDR

Figure 1



EBBETTS PASS WATER FACILITY
BIG TREES FUTURE PRESSURE ZONE
1" = 1000'

Figure 2



LEGEND:
SFR SINGLE FAMILY RESIDENCE
SAWMILL PRESSURE ZONE
SAWMILL PRESSURE ZONE
SFR ZONE
SFR ZONE
SFR ZONE
BLUE LAKE SPRINGS MUTUAL PRESSURE ZONE
PINEBROOK PRESSURE ZONE
HWY. 4
LAKE
EBBETTS PASS WATER FACILITY
SAWMILL PRESSURE ZONE
FUTURE GROWTH AREAS
1" = 1000'
HDR

Figure 3

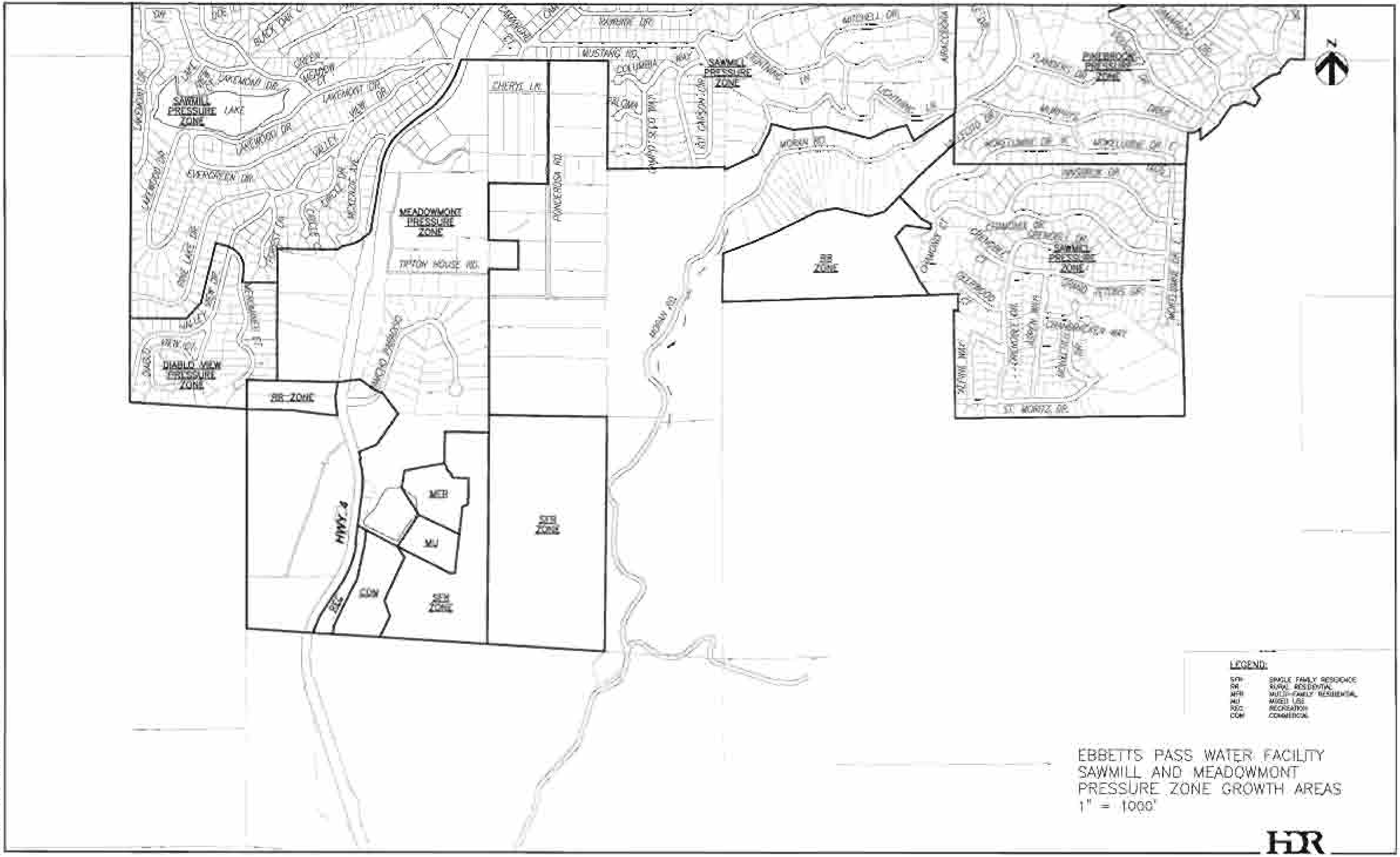

SAWMILL PRESSURE ZONE
MEADOWMONT PRESSURE ZONE
PIKERIDGE PRESSURE ZONE
DIABLO VIEW PRESSURE ZONE
RR ZONE
SFR ZONE
MFR
MU
COM
REC
HWY. 4
LAKEMONT DR.
LAKEWOOD DR.
EVERGREEN DR.
MUSTANG RD.
COLUMBIA WAY
CHERYL LN.
PONDEROSA RD.
TIPTON HOUSE RD.
MORAN RD.
ST. MORITZ DR.
LEGEND:
SFR SINGLE FAMILY RESIDENCE
RR RURAL RESIDENTIAL
MFR MULTI-FAMILY RESIDENTIAL
MU MIXED USE
REC RECREATION
COM COMMERCIAL
EBBETTS PASS WATER FACILITY
SAWMILL AND MEADOWMONT
PRESSURE ZONE GROWTH AREAS
1" = 1000'
HDR

Figure 4

Demand Characterization

Chapter 4 - Demand Characterization

Historic water production records from the Hunters WTP and pumping station were utilized to determine the average annual demand for the Ebbetts Pass water system. The average annual production is shown in Table 9.

In determining the average demand per connection, six wholesale services had to also be considered. The Ebbetts Pass water system provides water to six wholesale services at Timber Trails, State Park, Oak Hollow Campground, Snowshoe Springs, Fly in Acres, and Blue Lake Springs Mutual. The demand from these wholesale services is not representative of demand from the remaining pressure zones served by the water system. Therefore, to determine the Ebbetts Pass water system's average demand per connection, the average annual demand for the wholesale services was deducted from the water system's average annual production.

Table 9. Hunters WTP Average Annual Water Production.

Year 2001-2003	Annual Production (Mgal)	Water to Wholesale Connections (Mgal)	Number of Retail Connections	Average Demand per Retail Connection (gpd/conn)	Month with Maximum Demand
Average	620	84	5446	270	August

The average water demand per connection is approximately 270 gpd. This unit demand is significantly lower than the revised CCWD Improvement Standards' unit demand of 500 gpd/connection for single-family homes above 3,000 feet in elevation. This difference is most likely the result of the part-time residency which is common to the Ebbetts Pass service area. Given that the future residency mix between full-time and part-time is uncertain and beyond the scope of this master plan, a phasing approach is used to bring the existing demands up to CCWD's standard demand over a 20 year period. This conservative approach should accommodate any possible future transition to full-time residency.

To comply with CCWD's Improvement Standards, this evaluation will consider a unit demand of 500 gpd/connection for all future connections. The existing average demand per connection will be increased every five years in equal increments until it complies with the standard demand of 500 gpd/connection after 20 years. The respective demands per connection and resultant system demands are summarized in Table 10. The standard demand will also be applied to all water connections when estimating the buildout water demands, which will occur within the 20 year phasing period.

The peaking factors used in this evaluation are also based on the June 1997 CCWD Improvement Standards. According to these standards, the maximum day peaking factor is 2.0 (based on average day demand). The peak hour peaking factor is 3.0 (based on average day demand).

The capacity of the water treatment facilities will be sized to meet the projected maximum day demands in the five year phasing intervals and at build-out. According to the CCWD Improvement Standards, the transmission facilities (pipeline and pumping stations) will be sized to meet anticipated maximum day demand plus fire flow.

Existing Water Demands

The existing Hunters WTP has a maximum capacity of 4 mgd and a firm capacity of 3.7 mgd. Firm capacity is equal to 92.5 percent of the maximum capacity, which accounts for losses during backwash events. Firm capacity needs to meet the water system's maximum day demand. This requirement is met using the maximum day historical demands of 3.4 mgd. However, under the 500 gpd/connection unit demand scenario, the WTP capacity of 4 mgd is not sufficient to meet the existing service area's maximum day demand.

This analysis is further justification for using a 20 year phasing schedule to increase existing system demands to meet CCWD's standard. The existing system analysis will use the historical production records. Table 10 summarizes the estimated water demands for the existing water system for two unit demand scenarios.

Table 10. Existing Water Demands Analysis.

Planning Area	Unit Demand Scenario	Unit Demand gpd/conn	Number of Retail Connections	Average Day Wholesale Demands MGD	Average Day MGD	Maximum Day MGD	Peak Hour MGD
Existing Service Area	Based on Water Records	270	5,446	0.23	1.5	3.4	n/a
Existing Service Area	Based on CCWD Standards	500	5,446	0.23	2.7	5.4	8.2

Projected Buildout Water Demands

Table 11 summarizes projected build-out water demand for the Ebbetts Pass Water service area. These demands will be used to estimate the WTP and distribution system build-out capacities. For improvements needed to serve the existing service area, the water facility capacities will be increased in phases as noted in Table 12. Future connections are identified utilizing the 1.6 percent growth rate compounded annually with the exception of the Forest Meadows Zone, which utilized developer-provided growth projections. The wholesale connections were also addressed for growth. Five of the six wholesale connections were identified as being built-out at existing conditions and only Blue Lake Springs was identified for growth, which was projected utilizing the 1.6 percent growth rate compounded annually. Tables 13 through 15 show phased demand for retail and wholesale connections as described.

Blue Lake Springs Mutual is an independent water system equipped with its own sources of supply that use interties with CCWD's Ebbetts Pass water system to supplement their supplies during peak demand events. In 2002 and 2003 Blue Lake Springs Mutual's annual demand was 72 mgd and 70 mgd respectively. During 2002 Blue Lake Spring Mutual received approximately 5 mgd from CCWD. Blue Lake Springs Mutual has 1,640 existing connections and anticipates an additional 200 connections at build-out. Historical demands per connection (120 gpd) was used to determine Blue Lake Springs Mutual's future demand.

Table 11. Projected Number of Connections and Demands at Build-Out.

Planning Area	Unit Demand gpd/conn	Number of Connections	Average Day MGD	Maximum Day MGD	Peak Hour MGD
Existing Retail Service Area	500	5,446	2.72	5.45	8.17
Wholesale Connections	N/A	N/A	.36	.72	1.08
Infill Growth (Big Trees, Meadowmont 13, Pinebrook, Diablo View)	500	515	.26	.52	.77
Proposed Developments (Sawmill, Meadowmont, Avery)	500	480	.24	.48	.72
Forest Meadows Growth Area	500	930	0.47	0.93	1.40
Service Area Total Build-out Demands			**4.02**	**8.10**	**12.14**

Table 12. Phased Demand Approach for Existing Retail Service Connections.

Phase	Unit Demand gpd/conn	Number of Connections	Average Day MGD	Maximum Day MGD	Peak Hour MGD
Phase I (5-Year)	328	5446	1.78	3.57	5.35
Phase II (10-Year)	385	5446	2.10	4.19	6.29
Phase III (15-Year)	443	5446	2.41	4.82	7.23
Phase IV (20-Year)	500	5446	2.72	5.45	8.17

Table 13. Phased Demand Approach for Future Retail Service Connections.

Phase	Cumulative Number of New Retail Connections			Average Day MGD ***	Maximum Day MGD	Peak Hour MGD
	Forest Meadows *	Other Areas **	Total			
Phase I (5-Year)	147	409	556	0.28	0.56	0.83
Phase II (10-Year)	341	851	1192	0.60	1.19	1.79
Phase III (15-Year)	596	995	1591	0.80	1.59	2.39
Phase IV (20-Year)/ Buildout	930	995	1925	0.96	1.93	2.89

* *New connections for Forest Meadows community based on development plans provided and communicated by the development community as identified in the draft Forest Meadows Wastewater Master Plan report, average growth rate approximately 46 connections per year.*

** *Increase based on a historical average growth rate of 1.6 percent per year for all communities except Forest Meadows.*

*** *Average Day demand based a unit demand of 500 gpd/conn*

Table 14. Phased Demand of Wholesale Connections, Average Day (MGD).

Phase	Blue Lake Springs	Fly in Acres	State Park	Timber Trails	Snowshoe Springs	Oak Hollow Campground
I	0.01	0.02	0.03	0.02	0.05	0.01
II	0.20*	0.02	0.03	0.02	0.05	0.01
III	0.22*	0.02	0.03	0.02	0.05	0.01
IV	0.23*	0.02	0.03	0.02	0.05	0.01

* – *Assumes CCWD provides full supply for Blue Lake Springs Mutual.*

Table 15. Phased Demand for Ebbetts Pass Water System (Combined Existing and Future including wholesale connections).

Phase	Average Day MGD	Maximum Day MGD	Peak Hour MGD
Phase I (5-Year)	2.20	4.4	6.6
Phase II (10-Year)	3.03	6.06	9.09
Phase III (15-Year)	3.56	7.12	10.68
Phase IV (20-Year) / Buildout	4.04	8.08	12.12

Service Area Demands

The unique characteristic of the Ebbetts Pass water system, in conjunction with the phasing approach proposed, requires the total number of system connections to be broken down by service area. The system tanks that gravity feed isolated pressure zones defined the service area designations. Since much of the water system is isolated into service areas with unique pressure zones these areas need to be addressed independently from the rest of the system.

The resultant service area existing water demands and connections are presented in Table 16. Table 17 summarizes the service area demands and connections at buildout.

Table 16. Service Area Existing Demands and Associated Connections.

Service Area	No. of Connections	Unit Demand (gpm/conn)	Average Day (MGD)	Maximum Day (MGD)	Peak Hour (MGD)
Big Trees 1,3	234	270	0.06	0.13	0.19
Big Trees 60K	277	270	0.07	0.15	0.22
Big Trees 4,5	873	270	0.24	0.47	0.71
Big Trees 8	101	270	0.03	0.05	0.08
Subtotal – Big Trees	**1485**		**0.40**	**0.80**	**1.20**
Sawmill	2256	270	0.61	1.22	1.83
Meadowmont 13	232	270	0.06	0.13	0.19
Pinebrook	251	270	0.07	0.14	0.20
Diablo View	69	270	0.02	0.04	0.06
Subtotal – Sawmill	**2808**		**0.76**	**1.53**	**2.28**
Avery	**579**	**270**	**0.16**	**0.31**	**0.47**

Service Area	No. of Connections	Unit Demand (gpm/conn)	Average Day (MGD)	Maximum Day (MGD)	Peak Hour (MGD)
Meadowmont	74	270	0.02	0.04	0.06
Forest Meadows 1 and 2	500	270	0.13	0.27	0.41
Wholesale Demands	6	N/A	0.23	0.46	0.69
System Total	5452		1.70	3.41	5.11

Table 17. Service Area Buildout Demands and Associated Connections.

Service Area	No. of Connections	Unit Demand (gpm/conn)	Average Day (MGD)	Maximum Day (MGD)	Peak Hour (MGD)
Big Trees 1,3	284	500	0.14	0.28	0.43
Big Trees 60K	351	500	0.18	0.35	0.53
Big Trees 4,5	1,092	500	0.55	1.09	1.64
Big Trees 8	113	500	0.06	0/11	0.17
Subtotal – Big Trees	**1,840**		**0.92**	**1.84**	**2.76**
Sawmill	2,306	500	1.15	2.31	3.46
Meadowmont 13	277	500	0.14	0.28	0.42
Pinebrook	351	500	0.18	0.35	0.53
Diablo View	84	500	0.04	0.08	0.13
Subtotal – Sawmill	**3,018**		**1.51**	**3.02**	**4.53**
Avery	649	500	0.32	0.65	0.97
Meadowmont	434	500	0.22	0.43	0.65
Forest Meadows 1 and 2	1,430	500	0.72	1.43	2.15
Wholesale Demands	6	N/A	0.36	0.72	1.08
System Total	7,377		4.06	8.08	12.15

Existing and Future Regulations

Chapter 5 - Existing and Future Regulations

Drinking Water Regulations

The quality of the water provided by existing and any future facilities must meet all existing and proposed regulatory requirements. A summary of the existing and proposed drinking water quality regulations covering surface water and groundwater sources is below.

Background

The Safe Drinking Water Act (SDWA) of 1974 gave the United States Environmental Protection Agency (EPA) the authority to set standards for contaminants in drinking water supplies. The EPA established primary regulations for the control of contaminants that affect public health and secondary regulations for compounds that affect the taste, odor or aesthetics of drinking water. Under the provisions or the SDWA, the California Department of Health Services (CDHS) has the primary enforcement responsibility. Title 22 of the California Administrative Code establishes CDHS authority, and stipulates State drinking water quality and monitoring standards.

Existing and Proposed Federal Regulations

The EPA has recently finalized and is in the process of finalizing several new regulations since the 1986 and 1996 Amendments to the SDWA. These regulations address both surface water and groundwaters. Significant final and proposed regulations are shown in Table 18. The schedule for promulgation of the Safe Water Drinking Act Regulations (Current as of June 22, 2001) is shown in Table 19.

Table 18. Recently Adopted and Proposed Federal Regulations that Apply to the CCWD Ebbetts Pass WTP.

Regulations	Year Rule Finalized	Targeted Contaminants
National Interim Primary Drinking Water Regulations	1975	Set maximum levels for a wide variety of contaminants
Total Trihalomethanes	1979	Trihalomethanes
Fluoride Rule	1986	Fluoride limits
Surface Water Treatment Rule	1989	Giardia lamblia, viruses, Legionella, and heterotrophic plate count
Total Coliform Rule	1989	Representative sampling of the distribution system for total and fecal coliform
Phase II Rule (organics)	1991	VOCs, SOCs, and IOCs
Lead and Copper Rule	1991	Lead and copper corrosion products
Phase V Rule (organics)	1992	VOCs, SOCs, and IOCs
Stage 1 Disinfection/Disinfection By-products Rule (D/DBPR)	1998	Disinfection Byproducts (THMs and HAAs); compliance date for systems serving greater than 10,000 was January 2002
Interim Enhanced Surface Water Treatment Rule (IESWTR)	1998	Giardia, Cryptosporidium, Turbidity, DBPR profiling

Regulations	Year Rule Finalized	Targeted Contaminants
Arsenic Rule	2001	Arsenic
Filter Backwash Rule	2001	Filter backwash recycle
Long-term 1 Enhanced Surface Water Treatment Rule	2002	Microbiological, Turbidity, and control of DBPs
Public Health Security and Bioterrorism Prevention and Response Act	2002	Vulnerability Assessments
Radon Rule	2004	Radon
Contaminant Candidate List 2	2004	CCL1 required no new regulated contaminants, CCL2 may include perchlorate, metolachor, and MTBE
Stage 2 Disinfectants/Disinfection Byproducts Rule	2004	Introduces locational running annual average compliance for the 80/60 TTHM/HAA5 requirements
Long-term 2 Enhanced Surface Water Treatment Rule	2004	Introduction of microbial toolbox for control of Cryptosporidium
Groundwater Rule	2004	Microbial protection of groundwater supplies
Source Water Protection		Delineate boundaries and determine origins and susceptibility of water supplies to contamination

Table 19. Schedule for Promulgation of Safe Water Drinking Act Regulations (Current as of June 22, 2001).

Regulation	Proposed	Final	Effective
Fluoride	11/85	4/86	10/87
Trihalomethanes	2/78	11/79	11/83
8 VOCs (Phase I)	11/85	7/87	1/89
Surface Water Treatment Rule (SWTR)	11/87	6/89	6/93
Coliform Rule	11/87	6/89	12/90
Lead and Copper	8/88	6/91	1/92[1]
Minor Revisions to Lead and Copper	4/98	1/00	1/01
26 Synthetic Contaminants[9], Seven Inorganic Contaminants (Phase II)	5/89	1/91[2]	7/92
MCLs for barium, pentachlorophenol (Phase II)	1/91	7/91	1/93
Phase V Organics, Inorganics	7/90	7/92	1/94
Radionuclides (Phase III) Except Radon	4/00	12/00	12/03
Radionuclides (Phase III) Radon	11/99	8/01[3]	8/04[4]
Sulfate	12/94	Decision on whether to regulate due 8/01	
MCLs for aldicarb, aldicarb sulfoxide, aldicarb sulfone	Administrative hold; no current schedule available		
Disinfectants/Disinfection Byproducts, Stage 1 DBPR	7/94	12/98[3]	1/02[6,7]
Disinfectants/Disinfection Byproducts, Stage 2 DBPR	9/01	5/02	5/05[8]
Information Collection Rule	2/94	5/96	Completed
Interim ESWTR	7/94	12/98[3]	1/02[6]
Interim ESWTR, Stage 1 Long Term Enhanced SWTR	4/00	8/01	1/047

Regulation	Proposed	Final	Effective
Interim ESWTR, Stage 2 Long Term Enhanced SWTR	9/01	5/02	5/05
Filter Backwash Recycle Rule	4/00	6/01	12/03[3]
Consumer Confidence Reports Rule	2/98	8/98	9/98
Ground Water Rule (GWR)	5/00	11/01	6/04
Operator Certification, State Guidance	3/98	2/99	2/01
Unregulated Contaminants, Monitoring Only[10]	2/99	9/99	1/01
Five New Drinking Water Contaminants	8/00	8/01	8/04
Chlorine Gas as Restricted Use	9/00	10/01	10/03
Source Water Protection Program, Guidance[5]	8/97	Completed	Completed
Arsenic	6/00	1/01	Delayed to January 2006

Notes:

1.) Start date for tap monitoring in systems of more than 50,000 consumers.
2.) MCL, MCLG for atrazine to be reconsidered.
3.) Dates mandated by district court
4.) Assumes regulation in effect three years after final promulgation.
5.) Program required as part of 1996 amendment.
6.) For PWS serving more than 10,000 consumers
7.) Efecgive January 2004 for PWS serving more than 10,000 consumers.
8.) Running annual averages to be computed at each sampling location (LRAA) including sites with high DBP.
9.) MCL for atrazine to be revisited.
10.) Tiered monitoring approach pending availablility of analytical methods.
Dates will be affected by the new administration withdrawal of ruled for review, January 2001.

The State of California is required to adopt regulations at the state level that meet or exceed federal regulations. Following is a general discussion of the key requirements of each of the regulations that may pertain to the Ebbetts Pass facilities.

Organic Contaminant Regulations

Phase I Regulations were finalized in July 1987 and included MCLs for eight volatile organic contaminants (VOCs). Phase II Regulations were finalized in July 1991 and established MCLs for 34 contaminants including nine inorganic contaminants (IOCs), 10 VOCs, and 15 synthetic organic contaminants (SOCs). Phase V Regulations were finalized in July 1992 and established MCLs for 23 contaminants including five IOCs, three VOCs, and 15 SOCs.

Radionuclides

Regulations for radionuclides were first established under the National Interim Primary Drinking Water Regulations in 1976. The Phase III Regulations were proposed in July 1991, and finalized in 2000. Table 20 shows the MCLs and the monitoring method. Additionally, CDHS established MCLs for tritium, strontium and gross beta activity. Under State law, utilities are required to sample for each contaminant once ever four years. Due to the controversy over the proposed radon standard, the promulgation of all final radionuclide regulations have been delayed until this year (2003).

Table 20. Radionuclides Regulation.

Contaminant	MCL	EPA Methods
Combined Radium -226 and -228	5 pCi/L	903.0, 903.1
Uranium	30 ug/L	908.0, 908.1
Beta/Photon Emitters	4 mrem/yr	900.0,901.1
Adjusted Gross Alpha	15 pCi/L	900.0

Arsenic Regulation

The current drinking water standard for arsenic is 50 ug/L. Starting January 23, 2006, the new Federal MCL will be 10 ug/L. In March 2003, the California EPA Office of Environmental Health Hazard Assessment proposed an Arsenic public health goal of 4 ppt. There is a possibility CDHS may adopt an arsenic MCL as low as 2 ug/L pending their risk/benefit evaluation.

Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) was promulgated in June 1989. The SWTR was promulgated to control the levels of turbidity, Giardia lamblia, viruses, Legionella, and heterotrophic plate count bacteria in United States drinking waters. The SWTR requires all utilities using surface water or any groundwater supply under the influence of a surface water supply to provide adequate disinfection, and under most conditions, to provide filtration. (Exemptions from filtration of surface water supplies are provided in rare instances where the source water supplies meet extremely rigid requirements for water quality and the utility possesses control of the watershed.)

The SWTR includes the following general requirements in order to minimize human exposure to microbial contaminants in drinking water:

- Utilities are required to achieve at least 99.9 percent removal and/or inactivation of Giardia lamblia cysts (3-log removal) and a minimum 99.99 percent removal and/or inactivation of viruses (4-log removal). The required level of removal/inactivation must occur between the point where the raw water ceases to be influenced by surface water runoff to the point at which the first customer is served.
- The disinfectant residual entering the distribution system must not fall below 0.2 mg/L for more than four hours during any 24 hour period.
- A disinfectant residual must be detectable in 95 percent of distribution system samples. An HPC concentration of less than 500 colonies/ml can serve as a detectable residual if no residual is measured.
- Each utility must perform a watershed sanitary survey at least every five years.
- Additional Requirements for filtered supplies:

- These rules have been updated by the Enhanced Surface Water Treatment Rule (see below).

Total Coliform Rule

The Total Coliform Rule (TCR) went into effect on May 1, 1992. Under the TCR, utilities must submit a monitoring plan to CDHS for their approval. The plan must provide for representative sampling of the distribution system. The total number of samples and frequency of sampling required is dependent on the population served by the utility. A specific MCL value was not established for total or fecal coliforms under the TCR. Instead, there are three potential scenarios in which an MCL may be violated. These scenarios are:

- If more than one monthly sample proves to be coliform-positive, an MCL has been violated.
- If an original sample is E. Coli positive, which indicates the presence of fecal material; and if any repeat sample is total, fecal, or E. Coli positive.
- If an original sample is total coliform-positive and any repeat sample is E. Coli positive.

Lead and Copper Rule

The Lead and Copper Rule (LCR) was promulgated by the EPA on June 7, 1991. The objective of the LCR is to minimize the corrosion of lead and copper-containing plumbing materials in public water systems by requiring utilities to optimize treatment for corrosion control. The LCR establishes "action levels" in lieu of MCLs for regulating the levels of both lead and copper in drinking water. The action level for lead was established at 0.015 mg/L while the action level for copper was set at 1.3 mg/L. An action level is exceeded when greater than 10 percent of samples collected from the sampling pool contain lead levels above 0.015 mg/L or copper levels above 1.3 mg/L. Unlike an MCL, a utility is not out of compliance with the LCR when an action level is exceeded. Exceedance of an action level limit requires a utility to take additional steps to reduce lead and copper corrosion in the distribution system. Technical changes to the LCR were adopted in 2000.

Information Collection Rule

The Information Collection Rule (ICR) was published in the Federal Register in February 1994. The purpose of the ICR is to collect microbial data, water quality and disinfection byproduct data for systems serving over 100,000 people that are critical to the development of the EWSTR and the long term Disinfectant/Disinfection Byproduct Rule. Collection of information was completed in 1998 is now available for public review.

THM and Disinfection Byproducts Regulation

The initial THM regulation was promulgated in 1979 and applied to all public water systems serving populations greater than 10,000. The regulation established an MCL of 100 ug/L for total trihalomethanes (TTHMs) in the distribution system. (Total trihalomethanes include the summation of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.)

Systems must collect a minimum of four distribution system samples per treatment plant on a quarterly basis. Compliance with the MCL is based on the average concentration of the four quarterly monitoring periods.

The Disinfectants/Disinfection Byproducts (D/DBP) Rule was proposed in July 1994, promulgated in November 1998, and became effective in January 2002 for water systems serving greater than 10,000 persons. The Stage 1 limits on disinfection byproducts are:

- Total Trihalomethanes (TTHMs): 80 ug/L.
- Haloacetic Acids (HAAs): 60 ug/L.
- Bromate: 10 ug/L.
- Chlorite: 1.0 mg/L

The following maximum residual disinfectant levels (MRDLs) have been established to limit the applied dose of chlorine, chloramines and chlorine dioxide during drinking water treatment: (MRDLs represent the maximum residual concentration permitted at the consumer's tap.)

- Chlorine: 4.0 mg/L (as Cl_2).
- Chloramines: 4.0 mg/L (as Cl_2).
- Chlorine Dioxide: 0.8 mg/L (as ClO_2).

The EPA has determined that DBP-precursor materials should be regulated in lieu of regulating unidentified DBPs. Total Organic Carbon (TOC) serves as a surrogate for precursor material, and therefore requirements for TOC removal have been established. In order to minimize the level of TOC present at the point(s) of disinfection, the new D/DBP Rule requires implementation of treatment techniques such as enhanced coagulation at all conventional water treatment plants to reduce elevated levels of raw water TOC. TOC reduction requirements are shown in Table 21.

Table 21. TOC Reduction Requirements.

Source Water TOC, mg/L	Source Water Alkalinity, mg/L as Ca CO3		
	0-60	60-120	>120
2.0 – 4.0	35%	25%	15%
4.0 – 8.0	45%	35%	25%
> 8.0	50%	40%	30%

Stage 2 Disinfectant/Disinfection Byproduct Rule

The draft proposal for the Stage 2 D/DBPR currently includes the following provisions:

- Sets a MCLG for chloroform at 0.070 mg/L.

- Will require water systems using chlorine to conduct a yearlong initial distribution system evaluation (IDSE) to identify monitoring sites with peak disinfection byproduct (DBP) levels.
- Will require that no later than eight years after promulgation, systems comply with the current 80/60 TTHM/HAA5 standards at each new site as locational running annual average values.
- Will temporarily raise the TTHM/HAA5 limits to 120/100 to allow time for utilities to make adjustments to come into compliance with the 80/60 TTHM/HAA5 standards.

See the following section for specific D/DBP compliance issues for the Ebbetts Pass Water Treatment System.

Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR)

The LT1ESWTR was promulgated January 2002 and becomes effective January 2005. The requirements are the same as for the IESWTR, but now also include systems serving less than 10,000. The following requirements are included in the rule:

- Requirements based on source water Giardia:
  - 3-log inactivation/removal of Giardia if source water levels < 1 cyst/100 L.
  - 4-log inactivation/removal of Giardia if source water levels < 9 cysts/100 L.
  - 5-log inactivation/removal of Giardia if source water levels < 99 cysts/100 L.
  - 6-log inactivation/removal of Giardia if source water levels > 99 cysts/100 L.
- MCLG for Cryptosporidium of 0.
- Systems that filter must achieve a 2-log removal of Cryptosporidium.
- Surface water or groundwater systems under the influence of surface water must achieve, through disinfection alone, at least 0.5-log inactivation or Giardia and a 4-log inactivation of viruses.
- Combined filter effluent turbidity requirements for conventional filtration.
- Individual filter monitoring requirements:
  - Record continuous monitoring of individual filter performance every 15 minutes.
  - Calibrate turbidimeters using manufacturer recommended procedures.
  - If continuous monitoring failure use four hour sample interval for up to five days for compliance.

Filter Backwash Rule

The purpose of the filter backwash rule is to control re-entry of pathogens and other contaminants into the drinking water treatment process. The key requirements of the rule include:

- Recycle streams must be returned ahead of the potion of primary coagulant addition.
- Direct filtration plants may be required to provide additional information and make modifications deemed necessary.
- Conventional plants that practice direct recycle and have less than 20 filters must perform a one time, one month long self assessment.

Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR)

The LT2ESWTR was recently proposed with promulgation expected in 2004 and an effective date of 2010. Under the LT2ESWTR, water plants using conventional treatment will be required to monitor source water quality for Cryptosporidium for 24 months. Based on the results, the water source will be classified into a bin number (Table 22) subject to the requirements of the microbial toolbox shown in Table 23. The toolbox introduces ultraviolet (UV) disinfection and membranes as new technologies that will be considered for control of Cryptosporidium oocysts resistant to chlorine.

Table 22. Bin Requirements.

Bin Number	Average Cryptosporidium Concentration	Additional Treatment Requirements for Systems with Conventional Treatment That are in Full Compliance with IESWTR1
1	Cryptosporidium <0.075/L	No action
2	0.075 ≤ Cryptosporidium < 1.0/L	1-log treatment (systems may use any technology or combination of technologies from toolbox as long as total credit is at least 1-log).
3	1.0/L ≤ Cryptosporidium < 3.0/L	2.0 log treatment (systems must achieve at least 1-log of the required 2-log treatment using ozone, chlorine dioxide, UV, membranes, bag/cartridge filters, or in-bank filtration.
4	Cryptosporidium ≥ 3.0/L	2.5-log treatment (systems must achieve at least 1-log of the required 2.5-log treatment using ozone, chlorine dioxide, UV, membranes, bag/cartridge filters, or in-bank filtration.

Table 23. Microbial Toolbox Components to Be Used in Addition to Existing Treatment.

Approach	Potential Log Credit			
	0.5	1	2	>2.5
Watershed Control				
Watershed Control Program (1)	X			
Reduction in oocyst concentration (3)	As measured			
Reduction in viable oocyst concentration (3)	As measured			
Alternative Source				
Intake relocation (3)	As measured			
Change to alternative source of supply	As measured			
Intake management/reduce source water oocysts (3)	As measured			
Managing timing of withdrawal (3)	As measured			
Managing level of withdrawal in water column (3)	As measured			
Pretreatment				
Off-stream raw water storage with Detention – X days (1)	X			
Off-stream raw water storage with detention – Y weeks (1)		X		

Approach	Potential Log Credit			
	0.5	1	2	>2.5
Presettling basin with coagulant	X	→		
Lime softening (1)		→		
In-bank filtration (1)		X	——	→
Improved Treatment				
Lower finished water turbidity (0.15 NTU @ 95 percent)	X			
Slow sand filtration (1)				X
Roughing filter (1)	X	——	——	→
Membranes (MF, UF, NF, RO) (1)				X
Bag filters (1)		X	——	→
Cartridge filters (1)			X	
Improved Disinfection				
Chlorine Dioxide (2)	X	X		
Ozone (2)	X	X	X	
UV (2)				X
Peer Review/Other Demonstration/Performance Validation				
Peer review program (example: Partnership Phase IV)		X		
Performance studies demonstrating reliable specific log removals for technologies not listed above.	As demonstrated			

Key to table symbols:

(X) indicates potential log credit based on proper design and implementation in accordance with EPA guidance.

Arrow indicates estimation of potential log credit based on site specific or technology specific demonstration of performance.

Footnotes:

(1) Criteria to be specified in guidance to determine allowable credit.

(2) Inactivation dependent upon dose and source water classification.

(3) Additional monitoring for Cryptosporidium after this action would determine new bin classification and whether additional treatment is required.

The District should plan for the possible addition of UV disinfection if higher inactivation of Cryptosporidium is required by this rule in the future.

Source Water Protection Rule

Source water protection regulations are intended to require utilities to assess the origins and susceptibility of surface water and groundwater supplies to contamination. The rule requires establishment of a Source Water Assessment Program (SWAP) that delineates boundaries of the water supply sources, inventories of potential contaminants, assesses vulnerability of each source to contamination, and provides public education and outreach.

State Regulations

The State of California retains primacy for enforcement of drinking water regulations. In this role, the state must adopt regulations equal to or more stringent than federal regulations. For the most part, state regulations are equal to federal regulations with the following exceptions:

Cryptosporidium Action Plan

The state sets additional more stringent standards for the recycle of filter backwash and other recycle streams including a goal of less then 2.0 NTU in the recycle return. It also states the recycle stream flow be less than 10 percent of the influent flow. The plan also sets as goals maximum settled water turbidity of 2.0 NTU and filter effluent turbidity of less than 0.1 NTU in 95 percent of samples.

California IESWTR

The state has increased the required level of monitoring for filters and may require the following:

- Increases combined filter effluent (CFE) turbidity continuous monitoring from every four hours to every 15 minutes.
- Requires reporting 50th, 90th, 95th, 98th, and 99th percentile turbidity values instead of reporting the "number and percentage less than 3.0 NTU."
- Sets an "action level" at 0.3 NTU and applies it at all times after the filter has been in continuous operation for 60 minutes (federal language sets the level at 0.5 NTU after four hours of continuous operation.)
- Requires annual filter media inspections.
- Requires continuous generation of disinfection profiles.
- Requires weekly verification on online turbidimeters regardless of manufacturers' recommendations.
- Requires source water monitoring for fecal/total coliforms using density analyses.
- Requires all systems using a disinfectant to have a detectable residual in at least 95 percent of distribution system samples every month.
- Requires monitoring and reporting of sedimentation basin effluent turbidity (information only).
- Requires monitoring of turbidity and flow of recycled backwash water (information only).

Summary of Regulatory Impacts to Consider for Planning Future Treatment Plant Expansions

The following measures should be considered in planning for future expansions:

1. To achieve higher than 2.0 log inactivation of Cryptosporidium that may be required by the LT2ESWTR, space for installation of UV disinfection should be provided on the site. Membranes are another option to consider for compliance; however, given the investment in the existing conventional plant, membranes will most likely not be cost effective.
2. Recommended surface water supply monitoring is presented in Table 24.
3. Recommended treated water sampling and monitoring is shown in Table 25.

Table 24. Recommended Monitoring Plan to Evaluate the Water Quality Issues at the Intake to the Treatment Plant.

Parameter	Monitoring Frequency
Turbidity	Continues/daily
Total/fecal coliform	Weekly/special event*
E. Coli	Weekly/special event*
Cryptosporidium	Once a month**
TOC/DOC	Monthly/special event
TTHMs/HAAs, formation potential and SDS	Quarterly
Temperature	Daily
PH	Daily
Alkalinity	Daily
Color	Monthly (1)
Odor	Monthly (1)/more often during an event
General mineral	Annually
Inorganic	Annually
Ammonia	Special samples***
Organic chemicals	As required by DHS

Notes:

** = Recommended good practice.*
*** = Start after LT2ESWTR is finalized.*
**** = Might want to analyze for MTBE, perchlorate and other depending on watershed assessment.*

Table 25. Sampling Frequency of treated Water at the Water Treatment Plant.

Test	Frequency	State/Federal Frequency Requirements
Alkalinity, pH, chlorine residual	Daily	Daily
Hardness	Annually	Anually
Turbidity	Daily (every four hours or continuous)	Daily (continuous)
Bacteriological	4 per week distribution system and daily at water treatment plant	4 per week in distribution system
General mineral, general physical	Annually	Annually
Inorganic chemicals	Annually	Annually
Organic chemicals	Every 3 years	Every 3 years
Radiological	Every 4 years	Every 4 years

Test	Frequency	State/Federal Frequency Requirements
Trihalomethanes / HAA5	Quarterly	Quarterly
Corrosivity	Annually	Annually

Source Water Assessment

As a result of the SDWA amendments of 1996, source water protection has become a national priority. The amendments added to the act in 1996 provide for a new, more comprehensive water-shed based "prevention" approach to be applied to improving and preserving water quality of the public water supply source. The key elements of this Source Water Assessment Program (SWAP) apply to protecting surface water supplies, as well as to safeguarding groundwater supplies through the Wellhead Protection Program.

A SWAP must include the following four key elements:

1. Delineation of the boundaries of the areas providing source water for public water supply systems.
2. Inventory of the sources of regulated and certain unregulated contaminants of concern in the delineated areas (to the extent practical).
3. Determination of the vulnerability of each water source to contamination.
4. Public education and outreach.

These assessments should ultimately lead to development of a comprehensive prevention and protection program that includes monitoring contaminants, implementing management measures to control or mitigate sources of contamination, and contingency planning.

The State of California structured its SWAP program to allow water utilities to conduct their own assessments. In case of a new source of supply, a source water assessment must be conducted before CDHS will issue a permit for the use of the new source. Assessment programs may make use of pertinent existing information and data to prevent duplication of effort. The Watershed Sanitary Survey conducted in 1998 can serve as an initial step in conducting source water assessments. The impacts of these and other pertinent regulations are summarized in Table 26.

Table 26. Regulatory Summary.

Regulation	Key Provisions	Potential Impacts	Mitigating Action
Total Coliform Rule (TCR)	Ensure absence of coliform bacteria in distribution system. Violations of rule can lead to public notification action.	Maintain disinfectant residual. Operate storage reservoirs in system to maintain microbiological quality.	Disinfection strategies could impact byproduct formation potential.
Groundwater Disinfection Rule (GWDR)	Engineered disinfection or "natural" disinfection needed. Maintain minimum disinfectant residual of 0.2 mg/L in distribution system.	N/A	No impact on this project.

Regulation	Key Provisions	Potential Impacts	Mitigating Action
Disinfectants/Disinfection Byproduct Rule (D/DBPR)	Stage 1 and 2 sets the MCLs for TTHM and HAA5 (ug/L) respectively as follows: Stage 1 MCLs are 80 and 60, RAA. Stage 2 MCLs proposed at 100 and 120, LRAA. Stage 2 MCLs lowered to 0/60, LRAA by 2010. Bromate MCL set at 10 ug/L (bromate MCL will be reviewed in six years and potentially lowered to 5 ug/L).		
Filter Backwash Recycle Rule	Reduce potential risks posed from disinfectant resistant pathogens in the plant's recycle flows.		
Arsenic Rule	MCL of 5 ug/L is currently being discussed. Arsenic health risk studies are underway. The carcinogenic database and assessments are being revised.	No anticipated problems with Stanislaus River water.	
Phase I, II, V Inorganics and SOCs	MCLs were set for a very long list of organic compounds and for a number of inorganics.	Current water sources meet MCLs.	No impact to this project.
Lead and Copper Rule (LCR)	A treatment technique requirement for optimal corrosion control treatment based on Action Levels (Als) for lead at 15 ug/L and copper at 1,300 ug/L at consumers' taps.	Stanislaus River Water is slightly corrosive; however both lead and copper measured at homes are below the MCLs.	Corrosion protection chemical already being added.
Enhanced Surface Water Treatment Rule (ESWTR), LT1ESWTR, LT2ESWTR	Treatment requirements for virus, giardia and cryptosporidium with specific log removals. Cryptosporidium MCLG set at zero Cryptosporidium removal set at 2.0 log. LT2ESTWR agreement in principle includes requirements for additional log removal/inactivation for cryptosporidium based on source water raw levels and treatment utilized.	Long-term rule will initially require additional monitoring to determine "bin." Additional log removal/inactivation of cryptosporidium may be required. Compliance can be based on combination of tools from "toolbox."	Evaluate sequential disinfectants, Clo2/ozone, and UV to achieve protozoan level inactivation and removal. Other tools may include watershed controls and optimized pretreatment.
Cryptosporidium Action Plan	Combined filter effluent turbidity of 0.1 NTU in 95 percent of samples. Sedimentation/clarification 1 to 2 NTU.	During high turbidity events combined filter effluent could exceed the combined filter level of 0.15 NTU.	Evaluate plant performance, optimize pretreatment.
Sulfate Rule	MCL of 500 mg/L for sulfate.	--	No impact.
MTBE	Secondary MCL of 5 ug/L primary MCL of 13 ug/L.	Not detected.	No impact expected.
Perchlorate	18 ug/L	Not detected.	No impact expected.

Regulation	Key Provisions	Potential Impacts	Mitigating Action
NDMA	Action level at present 0.020 ug/L, could be reduced to 0.002 ug/L	No data available.	No impact expected.

DBP Monitoring Results

Table 27 presents the disinfection byproduct (DBP) sample locations for the Ebbetts Pass Water Treatment Plant. The DBP sample locations represent four different pressure zones within the system.

Table 27. Ebbetts Pass DBP Sample Locations.

Location	Pressure Zone
DSS 1 – 5387 Meko Drive	Big Trees 8 (BT-8)
DSS 12 – 2074 Mokelumne Hill East	Pinebrook
DSS 18 – 4100 Lakemont Drive	Sawmill
DSS 32 – 596 Sugarbush	Forest Meadows Tank 1

Table 28 presents the HAA5 monitoring results for the Ebbetts Pass Water Treatment System since the beginning of 2002. The running annual average exceeded the maximum contaminant level (MCL) of 60 ug/L in both the 4th quarter of 2002 and the 1st quarter of 2003. Note that with treatment and distribution system modifications during February 2003, the level of HAA5 dropped dramatically in the 1st quarter of 2003. The four quarterly averages since the February 2003 operating modifications were implemented have all been below the 60 ug/L MCL for HAA5. Note also that for each of the current monitoring locations, the locational running annual average for HAA5 (as required by the Stage 2 D/DBPR) is below the MCL.

Table 28. Total Haloacetic Acid Monitoring Results.

Monitoring Period	DSS 1 Site (ug/L)	DSS 12 Site (ug/L)	DSS 18 Site (ug/L)	DSS 32 Site (ug/L)	Quarterly Average (ug/L)	Running Annual Average (ug/L)
1st Qtr 2002	72	60	52	62	61.5	--
2nd Qtr 2002	98	67	60	59	71.0	--
3rd Qtr 2002	60	64	61	56	60.3	--
4th Qtr 2002	102	84	73	87	86.5	69.8
1st Qtr 2003	72	39	32	46	47.3	66.3
2nd Qtr 2003	53 / 46	32 / 36	30 / 35	25 / 30	35.9	57.5
3rd Qtr 2003	42	40	34	32	37.0	51.7
4th Qtr 2003	43	38	32	33	36.5	39.2

Table 29 presents the TTHM monitoring results for the Ebbetts Pass Water Treatment System since the beginning of 2002. The running annual average has been below the maximum contaminant level (MCL) of 80 ug/L in all monitoring periods. Note that with treatment and distribution system modifications during February 2003 for HAA5 compliance also reduced the level of TTHM in the system. The four quarterly averages since the February 2003 operational modifications were implemented have all been about one half the 80 ug/L MCL for TTHM.

Note also that for each of the current monitoring locations, the locational running annual average for TTHM (as required by the Stage 2 D/DBPR) is below the MCL.

Table 29. Total Trihalomethane Monitoring Results.

Monitoring Period	DSS 1 Site (ug/L)	DSS 12 Site (ug/L)	DSS 18 Site (ug/L)	DSS 32 Site (ug/L)	Quarterly Average (ug/L)	Running Annual Average (ug/L)
1st Qtr 2002	51	50	44	42	46.8	–
2nd Qtr 2002	81	67	67	50	66.3	–
3rd Qtr 2002	111	85	59	53	77.0	–
4th Qtr 2002	102	62	76	67	76.8	66.7
1st Qtr 2003	52	37	37	38	41.0	65.3
2nd Qtr 2003	41	44	44	30	39.8	58.7
3rd Qtr 2003	60	42	43	30	43.8	50.4
4th Qtr 2003	42	32	38	28	35.0	39.8

Summary of Haloacetic Acid Reduction Treatment Study

A study of the Ebbetts Pass water system Haloacetic Acid (HAA5) problems was performed by HDR in December 2003. Figure 5 shows concentrations of HAA5 in the distribution system. A treatment study was needed to comply with Articles 37 and 38 of Federal Administrative Order Docket. PWS-AO-2003-001 regarding the haloacetic acid violation at the Ebbetts Pass Water Treatment System. The study identified treatment and distribution system modifications applicable to the Ebbetts Pass water treatment system for the reduction of haloacetic acid levels in the distribution system.

Existing literature and plant operating data were reviewed to evaluate and compare a variety of methods for the reduction of HAA5 formation. The primary goal of this study was to reduce disinfection byproduct levels throughout the Ebbetts Pass Water System while maintaining the current level of pathogen removal. The disinfection byproducts of concern were the haloacetic acids due to the MCL exceedance in the fourth quarter of 2002 and the first quarter of 2003. Plant data shows the majority of the HAA5s are produced in the distribution system and not at the treatment facility.

From the study, HDR determined that haloacetic acid formation in the Ebbetts Pass System were impacted by the following:

- **Pre-chlorination of raw water at the treatment plant,** which has been eliminated since it is not used to meet CT requirements for disinfection, if the treatment process can handle the change. Eliminating pre-chlorination could reduce HAA5 formation by approximately 35 percent.
- **Type of disinfectant**, some of which have the potential to produce fewer DBPs at the treatment facility. However, alternative disinfectants such as ozone and UV disinfection require chlorine for secondary disinfection. The distribution system configuration would

make it difficult to use monochloramine or chlorine dioxide as an alternative to chlorine for secondary disinfection.

- **TOC content of the finished water**, which on average is very low (1.35 mg/L) and any additional methods to remove TOC would have limited impact on HAA5 formation. Even at these low TOC levels, the treatment plant removes on average about 30 percent of the raw water TOC.
- **Water age**, which could be reduced in some areas by reducing the working storage volume while still providing adequate storage for fire in conjunction with adjusting PRV zones.
- **Water temperature**, which cannot be controlled by the treatment plant, but rather understood that warmer months could result in higher DBP levels.
- **Redwood storage tanks**, which can be phased out over time as storage requirements change. This will become more important for the Ebbetts Pass Water Treatment System to comply with the Stage 2 Disinfectants/Disinfection Byproducts Rule.

Study Recommendations

The recommendations of the December 2003 HAA5 study were:

- Continue to use chlorine as the primary and secondary disinfectant. Lower booster chlorine addition in the distribution system at the Sawmill Pumping Station.
- Continue to operate treatment plant for optimum TOC removal.
- Decrease water age by reducing the working volume of storage tanks in areas with excess storage capacity after considering all water demands, including fire along with adjusting PRV zones.
- Replace redwood storage tanks over time as needed for efficiency of operation and increased capacity per the Draft Ebbetts Pass Water System Master Plan.

Based on these recommendations, the CIP will consider the replacement of all the redwood tanks with steel tanks over the next 10 years (Phases I and II). To reduce water age, a dual-tank system will be considered for each tank location requiring modifications.

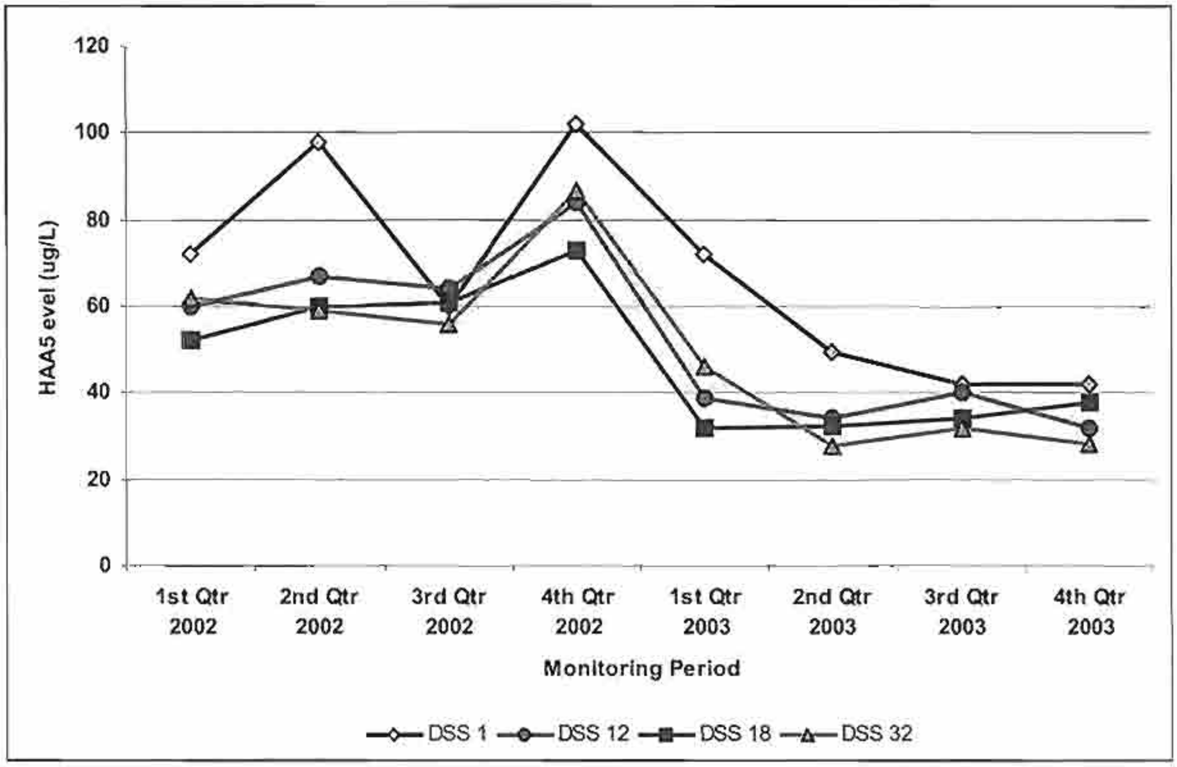


Figure 5. HAA5 Formation by Ebbetts Pass Monitoring Location.

Evaluation of Future Water Supply Alternatives

Evaluation of Future
Water Supply
Alternatives

Chapter 6 - Water Supply

Water Source

The North Fork of the Stanislaus River is the source of water for the Ebbetts Pass system. A combination of direct diversions and storage rights from several water permits provides the water supply for these systems. Table 30 is a summary of the current consumptive water rights that are available.

Table 30. Summary of CCWD Water Rights for Consumptive Use on the Stanislaus River.

Source	Direct Diversion, (Cfs)	Storage (afa)	Point of Diversion/ Storage Facility	Application No. (Permit No.)	Permitted Place of Use
North Fork Stanislaus	7[b] 3	-	McKays Point Dam, Utica Canal System	A012910 (15015)[b,c]	Ebbetts Pass System, Slurry Pipeline
North Fork Stanislaus	7	-	Ramsey	A012912 (15017)[b]	Ebbetts Pass System
North Fork Stanislaus	3	-	McKays Point Dam	A012912A (14769)[b]	Ebbetts Pass System
North Fork Stanislaus		37,000	Spicer Meadow Reservoir	A019149 (15024)[a, b]	Ebbetts Pass, Copper Cove System
North Fork Stanislaus		2,200	McKays Point Dam	A011792B (15013)[a, b]	Ebbetts Pass, Copper Cove System
North Fork Stanislaus		350	North Fork Diversion	A019149 (15024)[a]	Ebbetts Pass, Copper Cove System
Highland Creek		152,000	Spicer Meadow Reservoir	A011792B (15013)[a, b] A013091 (15018)[a,b] A019149 (15024)[a]	Ebbetts Pass, Copper Cove System

a – Total amount of water is limited for use within the Copper Cove system to 6,000 acre-feet per annum under these permits.
b – CCWD may divert or re-divert up to 7 cfs for use in the Ebbetts Pass and 3 cfs (limited to 1,000 afa) to the Utica System for delivery to the slurry pipeline. The total amount of water, from all permits, is limited to 8,000 afa for the Ebbetts Pass system under these permits. By separate agreement with the NCPA, only 5,000 afa is diverted until the year 2009.
C - Permit No. 15015 grants a diversion right of 65 cfs but currently allows only 20 cfs to be diverted from March to July.

Together, these water rights allow 8,000 acre-feet annually (afa) to be delivered to the Ebbetts Pass system for consumptive. Under a separate agreement with the Northern California Power Agency (NCPA), 5,000 afa of the 8,000 afa is diverted until the year 2009 when the full 8,000 afa can be diverted. Permit No. 15015 restricts the amount of direct diversion to 7 cubic feet per second (cfs) in the Ebbetts Pass area during March 1 to July 1 of each year. Permit No. 14769 allows 3 cfs to be diverted all year round for use in Ebbetts Pass. Release from storage provides the water supply that is needed when direct diversions are insufficient during the other months of the year.

Supply and Demand Comparison

The water use per connection varies throughout the District and is reflective of the area demographics. The Ebbetts Pass system is a mixture of commercial, seasonal and fulltime occupancy use, which results in an average consumption of 0.31 acre-feet per year per connection. It is anticipated that this average consumption will tend to increase over time as more fulltime occupancy occurs and as outside landscaping increases. For planning purposes, the unit consumption will increase at a rate of 0.01 af every year beginning in 2005.

The number of connections is anticipated to increase at an average rate of 1.6% annually over the next 20 years. This rate considered the geologic boundaries, type of development, and potential to expand beyond the current service area.

CCWD also acts as a wholesale water purveyor to two small providers in the Ebbetts Pass area: Fly In Acres Water Company and Snowshoe Springs Mutual. The water use for these small communities is residential. The water supplied to these customers is conveyed through the Ebbetts Pass system. The total amount of water consumed by both communities is approximately 81 acre-feet per year. This amount of water is not anticipated to increase significantly in the future as these communities are nearly built-out.

shows the comparison of the supply and demand from 1995 to build out. The District's water supplies, at the projected build-out of the service area as projected by the Master Plan are projected to be sufficient.

Table 31. Past, Current, and Projected Water Demand and Supply, af.

	1995	2000	2005	2010	2015	2020	Buildout
Number of Connections	4,722	5,066	5,500	5,940	6,415	6,928	7,377
Water Demand	1,482	1,665	2,061	2,219	2,711	3,267	4,481
Supply	5,000	5,000	5,000	8,000	8,000	8,000	8,000

SCADA Evaluation

Chapter 7 - SCADA Evaluation

Summary of Previous Evaluations

Since 1998 CCWD has been placing SCADA systems at major WTP and wastewater facilities. In June 2003, A.T.E.E.M Electrical Engineering reviewed and evaluated CCWD various SCADA systems, including Ebbetts Pass SCADA equipment. A.T.E.E.M's evaluation documented computer hardware and software and provided recommendations for ongoing maintenance and improvements. The results were summarized in a letter to CCWD.

For the Ebbetts Pass area, the SCADA PC is located at the Hunters WTP. This SCADA monitors the following remote facilities:

- Pinebrook Tank
- Moran Valve Station
- Sawmill Tank
- Meadowmont Tank
- Avery Tank
- Big Tree 60,000 Tank
- Big Trees 1 Tank
- Big Trees 4&5 Tank
- Big Trees 8 Tank
- Dorrington Booster Pumping Station (BPS)

The Big Tree 60,000 tank is the SCADA hub site for Big Trees 1, Big Trees 4&5, Big Trees 8, and Dorrington BPS. At the WTP, programmable logic controllers (PLCs) monitor each filter operation.

Equipment

According to A.T.E.E.M's report, the SCADA computer at the Hunter WTP is manufactured by Gateway with a 19 inch cathode ray tube (CRT) display. The SCADA software uses a Microsoft Windows NT 4.0 operating system, WonderWare Version 7.0.2, and SCADAlarm Version 4.0.1. A.T.E.E.M recommended the following upgrades to the Hunter WTP system:

- New computer with liquid crystal display (LCD display) and optical mouse.
- Windows 2000 office professional, Wonderware upgrade to 8.0, SCADAlarm upgrade to 5.0.
- Add a report builder application to generate automatic reports.
- Add a spare SCADAlarm modem.

According to the A.T.E.E.M report, SCADA computers have mechanical devices such as hard disks that have limited life and typically require replacement at four year intervals. CRT displays have a normal lifetime of three years continuous use before the quality of screen image deteriorates. A.T.E.E.M recommended replacing CRT displays that were three years or older with an LCD type monitor. The spare SCADAlarm modem was recommended since modems are subject to transient voltage damage when connected to phone lines. After being purchased and before placing on the shelf, the spare modem should be connected and tested to insure it is in proper working order.

With regard to SCADA software maintenance, A.T.E.E.M recommended the existing software be upgraded only when new SCADA hardware is installed. This reduces any incompatibility issue which might take days to resolve or not be resolved at all. For each new computer, the following software was recommended in the interest of uniformity throughout CCWD:

- Operating System: Windows XP with Office 2000 Professional.
- WonderWare Version: 8.0 or higher.
- SCADAlarm Version: 5.0 or higher.

A.T.E.E.M also noted none of the CCWD plants have the ability to generate reports. A.T.E.E.M has found a report generation software ("Report Builder" sold by Work Smart Automation) that has the flexibility to ignore out-of-range data, exclude data (for example during a filter backwash), or allow for manual operator entry override when false data is listed in the report. This Report Builder uses standard Microsoft Excel spreadsheets for report display summaries and trends. It includes pre-made reports such as the State's "Monthly Summary of Turbidity Monitoring," which could reduce report setup time to a minimum. Routing of reports can be made to printers, email recipients, or web page. A.T.E.E.M recommended this software to assist CCWD with automatic generation of required reports and documentation of each system's operation. The cost of this report software was estimated at $1,600 per machine plus setup costs. This software requires the computer to have Windows NT 5.0 or a Windows 2000 operating system with Service Pack 2 or higher installed, which the Ebbetts Pass SCADA system does not have.

System Evaluation

Chapter 8 - System Evaluation

The Ebbetts Pass Water System was evaluated for its ability to meet existing and future water demands, existing and future water quality requirements, and to comply with District Standards. The system was divided into five categories for this evaluation: water supply, water treatment, storage, pumping, and piping. A system wide hydraulic model was used to further analyze the system's distribution facilities, which include storage, pumping, and piping.

Water Supply

Raw water is drawn from the Collierville Tunnel, which is part of the newly constructed North Form Stanislaus River Hydroelectric Development Project, and transported via a 20-inch pipeline to the Hunters WTP. A prior study that focused on water supply for Ebbets Pass concluded that an in-line booster station will be required prior to the end of Phase II. Drastic fluctuations in the reservoir level can reduce the head so that future demand will not be adequately conveyed to the WTP.

Water Treatment Facilities

The Hunters WTP was expanded in 1992 to replace the old filtration plant that served the system since 1965. The new WTP includes two contact clarification/filtration treatment trains, each with a production capacity of 2 mgd or 1400 gpm. With both trains in service, the WTP has a total production capacity of 4 mgd or 2800 gpm.

Each train's treatment process includes coagulation, flocculation and clarification through a Microfloc Trident upflow clarifier, filtration through a Microfloc Trident Advent packaged mixed media gravity filter, and chlorination with sodium hypochlorite. Contract time for disinfection inactivation is provided in an on-site one million gallon circular clearwell storage tank.

The coagulated raw water flows through two adsorption clarifiers at a flow rate of 8.4 gpm/sf. Each clarifier has a total surface area of 140 square feet. The maximum hydraulic loading rate is 10 gpm per square ft. Each mixed media filter has an inside dimension of 25'-10" by 10'-10" (approximately 280 square feet footprint). The filter media consists of anthracite, silica sand, and garnet sand over support gravel. The fitlers are operated at 5 gpm per square feet. The average filter run is 24 hours or 5-feet of head loss, whichever occurs earlier. The clarifier and filter backwash water are discharged into one of two concrete backwash settling basins that are designed to recycle the washwater. After one-hour settling time, backwash water is recycled to the headworks. The average recycling rate is 3.57 percent (maximum 7.5 percent in 2001). Average reclaimed water turbidity ranged from 1.05 to 2.06 NTU with an average of 1.43 NTU during 2001.

The Hunters Pumping Station at the Hunters WTP has a pumping capacity of 2,750 gpm (4 mgd). The pumping station was constructed with three vertical turbine pumps (2 duty, 1 standby) with provisions for installing a fourth pump to increase the pumping capacity to 3,675 gpm (5.3 mgd). The pumps are housed along with the filter backwash pumps in a prefabricated metal building. A diesel generator, located outside the building, provides standby power for the pumping station and water treatment plant.

Future Water Demands

Table 32 summarizes the maximum day demands for each improvement phase.

Table 32. Ebbetts Pass Water System Maximum Day Demands.

Phase	Maximum Day Demand MGD
Phase I (5-Year)	4.40
Phase II (10-Year)	6.06
Phase III (15-Year)	7.12
Phase IV (20-Year) / Buildout	8.08

Recommended Treatment Improvements

To meet the maximum day demands, the Hunters WTP will require additional expansion. During Phase I, a third treatment train sized for 2 mgd is recommended to increase the WTP maximum capacity to 6 mgd and provide firm capacity of 5.55 mgd. Prior to Phase III, CCWD may consider the installation of a fourth treatment train sized for 3 mgd to increase the WTP maximum capacity to 9 mgd and firm capacity to 8.3 mgd. Since the WTP original trains (installed in 1992) will be approximately 30 years old, an alternative to adding a fourth train would be to replace one original train with a membrane microfiltration treatment system sized for 5 mgd.

The membrane system could be an immersible type with hollow fiber design capable of excluding all bacterial and protozoan pathogens. Filtrate is a high quality water that meets all state and federal requirements. Approximately once every one to three months, the membrane cassettes will require a chemical cleaning in a special cleaning tank. Two membrane manufacturers, Zenon and US Filter-Memcor manufacture the immersed style membranes. The membrane system could be designed in stages as needed to meet demands. A membrane treatment system offers many advantages including ensuring long-term regulatory compliance, elimination of alum and polymer addition, and the least amount of new construction. Membranes provide a positive barrier against pathogens that does not rely on chemical addition as filters normally do. The use of membranes for potable water treatment increases every year and their price continues to drop as more systems are installed.

A more detailed evaluation of the alternative treatment possibilities is recommended and is beyond the scope of this master plan.

Hydropneumatic System

Since June 2003, the Hunters WTP has been experiencing drastic swings in flow and pressure, which are adversely affecting the operations. The flow rates at the Hunters WTP have varied from approximately 1500 gpm to 3500 gpm. SCADA data from a pressure sensor upstream of the Hunters WTP regulatory valves have recorded pressures varying from 15 psi to 75 psi on the raw water pipeline. Review of plant data indicate that the average raw water turbidity in 2002 was 0.5 NTU's and for 2003 was 0.8 NTU's. The increase appears to be attributable to the hydraulic problems.

In June 1997, a report was written outlining several alternatives to correct surge problems at Hunters. Following this report, CCWD installed two regulatory pressure sustaining and flow control valves at the plant (one valve per unit). Since the regulatory valves are not capable of reacting fast enough to the constant changing pressure waves, CCWD would like to consider the 35,000 gallon surge tank alternative recommended in the June 1997 report. To accommodate the existing and buildout demands, additional surge evaluation is recommended to size the hydropneumatic system.

The Capital Improvement Plan will include the installation of a hydropneumatic tank system in the raw water supply to the Hunters WTP. The cost is based on cost estimates developed for similar surge control systems and include surge tank, tank supports, concrete slab, air compressor and controls, electrical components, connecting piping, fittings and valves and appurtenances.

Distribution Facilities

Hydraulic Model Criteria

CCWD provided HDR a computer hydraulic model of the Ebbetts Pass Water System. The model included approximately 1,050 pipe segments, approximately 900 junction nodes, and 17 storage tanks. The model was prepared for CCWD by another consultant and was provided in H2ONet format. CCWD has elected to use H2OMap Water as the software application for its hydraulic model instead of H2ONet. HDR converted the existing H2ONet model into an H2OMap model.

Modeled Demands

Existing Water Demands

HDR performed an analysis of CCWD's demand data for 2001 and 2002. Six wholesale connections at Timber Trails, State Park, Oak Hollow Campground, Snowshoe Springs, Fly in Acres, and Blue Lake Springs Mutual were considered as discrete point demands. The remaining water demand was spread equally over CCWD's 5446 retail connections. The observed average day demand per connection was 270 gallons per day (gpd). The existing demands are summarized in Table 33.

Table 33. Existing Demands.

Existing number of retail connections	5,446
Average demand per retail connection (gpd)	270
Calculated average day demand - retail (mgd)	1.47
Average Timber Trails wholesale demand (mgd)	0.02
Average State Park wholesale demand (mgd)	0.03
Average Oak Hollow Campground wholesale demand (mgd)	0.01
Average Snowshoe Springs wholesale demand (mgd)	0.05
Average Fly in Acres wholesale demand (mgd)	0.02
Average Blue Lake Springs Mutual wholesale demand (mgd)	0.10
Calculated average day demand - total (mgd)	1.70
District Peaking Factor: Maximum Day to Average Day	2.0
Calculated maximum day demand (mgd)	3.41
District Peaking Factor: Peak Hour to Average Day	3.0
Calculated peak hour demand (mgd)	5.11

The model provided by CCWD included several different model scenarios, each intended to represent a different set of demands, initial settings, pipe sizes, pump settings, and tank levels. HDR used the demand set contained in the model for adjusted maximum day demands. The total system-wide demand for this demand set was 3.62 mgd. A new demand set was created and named 2003 maximum day demands. The 2003 maximum day demands were calculated by prorating the Adjusted Max Day Demands so that the system-wide total was 3.41 mgd. Additional demand sets were then created in the model for 2003 average day demands and 2003 peak hour demands. These demands were calculated using CCWD's standard peak values of 2.0 and 3.0.

Future Water Demands

Future water demands are expected to be increased in order to bring the existing unit demand of 270 gpd in compliance with CCWD standard (500 gpd) and to accommodate future growth. The future buildout demands used in the hydraulic model are consistent with those identified in Table 15. The demands for the wholesale connections, Timber Trails, State Park, Oak Hollow Campground, Snowshoe Springs, and Fly in Acres are not expected to change over time. Demand of Blue Lake Springs Mutual's wholesale connection is expected to increase over time.

Demands were calculated for a 20 year planning horizon, which was assumed to represent buildout conditions. Buildout demands are summarized in Table 34.

Table 34. Buildout Demands.

Buildout number of retail connections	7,371
District standard demand per retail connection (gpd)	500
Calculated average day demand - retail (mgd)	3.69
Average Timber Trails wholesale demand (mgd)	0.02
Average Oak Hollow Campground wholesale demand (mgd)	0.01
Average Snowshoe Springs wholesale demand (mgd)	0.05
Average Fly in Acres wholesale demand (mgd)	0.02
Average Blue Lake Springs Mutual wholesale demand (mgd)	0.23
Average State Park wholesale demand (mgd)	0.03
Calculated average day demand - total (mgd)	4.05
District Peaking Factor: Maximum Day to Average Day	2.0
Calculated maximum day demand (mgd)	8.10
District Peaking Factor: Peak Hour to Average Day	3.0
Calculated peak hour demand (mgd)	12.14

A new demand set was created in the model and named buildout maximum day. New demands were added in the locations of Forest Meadows and Arnold to represent expected development. In addition, the other nodal demands were adjusted to reflect the increase in per-connection demand from 270 gpd to 500 gpd. HDR then used the buildout maximum day demand set and CCWD's standard peaking factors of 2.0 and 3.0 to calculate demands sets for buildout average day and buildout peak hour.

Fire Flows

One of the most important functions of a water distribution system is to provide water to fight fires. The Ebbetts Pass Fire District has established fire flow requirements for the system. The fire is assumed to occur during maximum day demand conditions. The requirements vary for different types of development, and are summarized in Table 35 in gallons per minute (gpm).

Table 35. Fire Flow Requirements.

Development	Required Fire Flow (gpm)
Residential Districts and/or Individual Dwellings < 3699 Sq. Ft.	1000
Commercial/Industrial Districts and/or Individual Dwellings > 3600 Sq Ft.	1,500
Undeveloped Commercial/Industrial Districts	1,500

Per Ebbetts Pass Fire District Fire Code, Section 13, August 2003.

The required fire flow was assigned to each node in the model, based on the type of development in that area. To meet CCWD requirements, pressure must not drop below 20 pounds per square inch (psi) in all parts of the system during the fire flow event. The system was originally designed for a residential fire flow demand of 500 gpm. Thus, the fire flow demands have been doubled as requested by the local fire district.

Evaluation Criteria and Model Input Data

HDR updated the model to include demands sets for existing and buildout conditions. For each time frame, demand sets were defined for average day demands, maximum day demands, and peak hour demands. The automated fire flow analysis tool in H2OMap was used to evaluate the system's ability to deliver fire flow.

In addition to the 20 psi criteria during fire flow, CCWD has established a normal operating criteria of 35 psi minimum pressure and 115 psi maximum pressure. The system was evaluated for its ability to maintain 35 psi during maximum day and peak hour conditions. However, the 115 psi maximum pressure is not consistent with how the system is currently operated. Several areas of the existing system have pressures over 200 psi under existing conditions. These changing pressures are due to the hilly terrain served by the Ebbetts Pass system. These pressures could not be reduced without additional PRV's, new pressure zones, and additional booster pump stations.

For the purposes of the model, it was assumed future supply would be provided through expansion of the Hunters WTP. If additional water supply were introduced in different areas of the system, the recommended improvements to the distribution system would change accordingly.

Storage

The Ebbetts Pass Water System includes 16 treated water storage tanks. Information about these tanks is summarized in Table 36.

Table 36. Hydraulic Model Criteria - Existing Storage Facilities.

Tank Name	Ground Elevation	Min Level	Max Level	Diameter (ft)	Working Volume (gal)	Total Volume (gal)
Big Trees 8	5,355	1.0	18.0	30.5	93,000	98,000
Big Trees 4	5,245	12.0	17.0	30.5	27,000	93,000
Big Trees 5	5,245	12.0	17.0	30.5	27,000	93,000
Big Trees 60K	5,210	9.0	14.0	26.0	20,000	56,000
Big Trees 3	4,930	1.0	18.0	30.5	93,000	98,000
Big Trees 1	4,920	8.0	18.0	30.5	55,000	98,000
Sawmill	4,470	18.0	33.6	120.0	1,320,000	2,842,000
Pinebrook	4,305	9.0	10.0	75.0	100,000	1,000,000
Meadowmont 13	4,265	1.0	18.0	31.0	96,000	102,000
Meadowmont	3,925	14.0	25.6	42.0	120,000	265,000
Timber Trails	3,830	1.0	17.0	23.0	50,000	53,000
Heather	3,691	10.6	17.6	68.8	195,000	489,000
Avery	3,515	14.0	25.5	69.0	322,000	713,000
Larkspur	3,441	15.0	27.5	30.0	66,000	145,000
Hunters WTP Clearwell	3,200	8.0	20.0	90.0	571,000	952,000
Total					**3,155,000**	**7,097,000**

Pressure Zones

The Ebbetts Pass system is divided into 65 pressure zones. Some pressure zones are fed directly by storage tanks while others rely on pressure reducing valves (PRVs) or booster pumps to control the pressure in the zone. In the hydraulic model provided by CCWD, all nodes are assigned to a pressure zone. HDR verified the boundaries for each pressure zone and corrected the zone designations for some model nodes. The boundaries between pressure zones are defined by PRVs, booster pumps, or closed pieces of pipe. Some of the zone boundaries were corrected by closing pipes that connect different pressure zones.

The model provided by CCWD includes 77 PRVs. All of these valves had an initial setting in the model provided by CCWD. In some cases, HDR adjusted the pressure setting to improve system performance.

Pumping

The existing system includes 10 booster pump stations with a total of 20 pumps. Information about these pumps is summarized in Table 37.

Table 37. Hydraulic Model Criteria - Existing Booster Pumps.

Pump Description	Shutoff Head	Design Head (ft)	Design Flow (gpm)	High Head (ft)	High Flow (gpm)
Avery Pump #1	670	390	1440	210	1600
Avery Pump #2	670	390	1440	210	1600
Big Trees #1 Pump #1	0	475	100	0	0
Big Trees #1 Pump #2	0	475	100	0	0
Big Trees Tank 4 & 5 Pump #1	0	150	50	0	0
Big Trees Tank 4&5 Pump #2	0	150	46	0	0
Dorrington Pump #1	0	446	100	0	0
Dorrington Pump #2	0	446	100	0	0
Forest Meadows Pump #1	0	264	450	0	0
Forest Meadows Pump #2	0	264	450	0	0
Hunters Dam Pump #1	650	380	1500	200	1400
Hunter's Dam Pump #2	650	380	1500	200	1400
Meadowmont Pump #1	1200	740	1440	420	1800
Meadowmont Pump #2	1200	720	1440	420	1800
Sawmill Pump #1	0	424	175	0	0
Sawmill Pump #2	0	512	145	0	0
Sawmill Pump #3	0	512	290	0	0
Timber Trails Pump #1	0	446	100	0	0
Timber Trails Pump #2	0	469	95	0	0

Emergency (Standby) Power

Standby power is necessary for critical facilities in the event of a power outage. At a minimum, it is recommended that CCWD have emergency generation capabilities at the booster pumping stations. Table 38 summarizes CCWD's existing standby power facilities in the Ebbetts Pass water distribution system. Of the ten booster pumping stations in the system, only four pumping stations have standby power. Since the pressure zones are gravity fed and some zones are dependent on other zones, standby power is recommended at all booster pumping stations. CCWD recently got Board approval to install generators at three more pump stations: Dorrington, Big Trees – 1, and Big Trees 4 and 5.

Table 38. Ebbetts Pass Existing Standby Power Generators. July 2004.

Location	KW	HP	KVA	Volts	Size of Fuel Diesel Tank
Hunters Plant – Fixed Generator	275	435	344	120 / 480	500
Avery Tank – Fixed Generator	500	750	625	240 / 480	1000
Meadowmont Tank – Fixed Generator	800	1340	1000	240 / 480	1000
Sawmill – Fixed Generator	80	156	100	240	500

Pipelines

The Ebbetts Pass system includes approximately 120 miles of distribution pipe. The pipe is summarized by size in Table 39.

Table 39. Existing Distribution Pipe.

Diameter (inches)	Total Length (miles)
2	0.5
4	2.0
6	79.0
8	29.5
10	2.8
12	5.5
14	1.5
16	0.6
18	1.2
20	0.2
Total	122.8

Hydraulic Model Scenarios

The hydraulic model was run to evaluate system performance under existing demands. Four scenarios were run:

- Average Day Demands.
- Maximum Day Demands.
- Peak Hour Demands.
- Maximum Day Demands Plus Fire Flow.

Recommended Improvements

Storage

The storage requirements for the Ebbetts Pass system will be different for the different pressure zones. Ideally, storage should be provided at a high enough elevation so that water can flow by gravity to customers in the case of power outage or fire. The existing and buildout demands were summarized by pressure zone. Each storage tank serves one pressure zone directly, and most serve additional pressure zones through PRVs. The demands are summarized by storage tank in the table below. This analysis assumes that fireflow capacity for each tank zone includes capacity of all tanks that can gravity feed that zone. The analysis also incorporates available pumping capacity for each tank zone in determining available fireflow capacity.

CCWD standards state storage capacity will be equal to the sum of the following three components:

1. Fire flow storage, a minimum of four hours times the appropriate fire flow demand.
2. System peaking storage, equal to 20 percent of the maximum day flow.
3. Emergency storage, equal to four hours of the maximum day demand.

The existing storage tanks and the future required volumes are summarized in Table 40.

Table 40. Required Storage Volumes.

Tank Zone	Total Volume (gal)	Existing Maximum Day Demand (gpm)	Buildout Maximum Day Demand (gpm)	Pumping Capacity (gpm)	Redundant Storage (tanks)	Fireflow Demand (gpm)	Existing Required Volume (gal)	Buildout Required Volume (gal)	Existing Shortfall (gal)	Buildout Shortfall (gal)
Big Trees 8	98,000	35	69	96		1,000	258,333	276,667	160,333	178,667
Big Trees 4 & 5	186,000	361	673	200	BT 8	1,000	430,667	595,667	244,667	409,667
Big Trees 60K	56,000	104	194	200		1,000	295,000	342,667	239,000	286,667
Big Trees 1 & 3	197,000	555	1,034	610	BT 60K	1,000	533,333	786,333	336,333	589,333
Sawmill	2,842,000	1,402	2,936	2,880		1,500	1,100,667	1,911,000	-	-
Pinebrook	1,000,000	97	174		Sawmill	1,000	961,333	331,667	-	-
Meadowmont 13	102,000	90	160		Sawmill	1,000	287,667	324,333	185,667	222,333
Meadowmont	265,000	1,430	3,338			1,500	1,115,333	2,123,667	850,333	1,858,667
Timber Trails	53,000	28	28			1,000	254,667	254,667	201,667	201,667
Avery	713,000	1,645	3,741	2,880		1,500	1,229,000	2,336,333	516,000	1,623,333
Forest Meadows 1 and 2	634,000	187	992	2,880		1,000	339,000	764,333	-	130,333

The following is a summary of recommendations for the required storage volumes. Both Big Trees 8 and Big Trees 60K tanks have fire flow storage requirements that greatly exceed their operational requirements and as a result will have a negative impact on their water quality. It is recommended to provide emergency fire flow pumps at Big Trees 4 & 5 and Big Trees 1 & 3 to provide the necessary fire flow for tanks Big Trees 8, and Big Trees 60K. Pinebrook and Meadowmont 13 tanks can receive the needed fire flow storage by gravity flow from the Sawmill Tank, which exceeds the buildout shortfalls identified for each tank. It has also been identified that Meadowmont 13 may be abandoned and replaced by installing a new PRV. Timber Trails would have similar problems as Big Trees 8 and Big Trees 60K tank; however, the tank supplies an independent system that can not be supplemented by the additional of a fire booster pump station. It is recommended to maintain the size of the existing tank for Timber Trails to avoid water quality issues.

Big Trees Storage Alternative Approach

An alternative approach was considered for addressing the storage requirements for the Big Trees service area. This approach included the replacement of BT 1 and 3 and BT 4 and 5 storage tanks with in-line booster pump stations. BT 8 and BT 60K storage tanks would be upsized to provide the storage for the Big Trees service area. BY 60K would be supplied from Sawmill Tank in conjunction with a series of three in-line booster pump stations (Big Trees 1, Dorrington, BT 4 and BT 5). A more detailed analysis would have to be performed to determine the control strategy for supplying BT 8.

An additional hydraulic model scenario was run to investigate the results. After eliminating the four storage tanks, nodes in the vicinity of Big Trees Tanks 1 and 3 become deficient in fire flow, as to be expected. However, constructing a loop using a PRV set at 35 psi outlet pressure, from Apache Rd. at Sioux Tl. recuperates most of those fire flows. Independently, nodes in the vicinity of Big Trees Tanks 4 and 5 lose some fire flow when eliminating the tanks, however this deficiency is to be expected without local improvements such as a fire flow pump.

BT 60K would be sized to provide operational and fire flow storage for BT 60K, BT 1 and BT 3 service areas which results in a storage requirement of 325,000 gallons. This approach reduces the storage requirements for the Big Trees Service area by approximately 750,000 gallons. If CCWD wishes to pursue this approach a more detailed analysis is required.

The District requested the installation of two tanks at each storage facility that currently has a redwood tank or was identified as needing additional storage. The two tank facility is preferred to accommodate maintenance of the tanks. Table 41 presents recommended storage improvements as discussed above.

Table 41. Recommended Storage Improvements.

Tank	Storage Volume (Gallons)	Comments
Big Trees 8	130,000	Two tanks at 65,000 gallons each
BT 4 and 4	600,000	Two tanks at 300,000 gallons each

Tank	Storage Volume (Gallons)	Comments
Big Trees 60K	6000,000	Two tanks at 300,000 gallons each
Big Trees 1 and 3	800,000	Two tanks at 70,000 gallons each
Meadowmont 13	0	Replace with PRV
Timber Trails	50,000	One 50,000 gallon tank
Heather (Forest Meadows)	770,000	Two tanks at 385,000 gallons each
Avery	1,300,000	One 1,300,000 gallon tank
Meadowmont	1,500,00	One 1,500,000 gallon tank
State Park	50,000	One 50,000 gallon tank

Redwood Storage Tanks

Figure 6 graphically shows the HAA5 data for the Ebbetts Pass System. Note that the HAA5 levels at DSS 1 are typically much higher than the other three locations. CCWD tested the influent and effluent of one of its redwood storage tanks in 1999. The testing showed that HAA5 increased from 29 ug/L to 48 ug/L just by passing through the redwood storage tank. Therefore, removal of the redwood tanks should provide a reduction in HAA5 formation in the Ebbetts Pass Water System. The Capital Improvement Plan will prioritize replacing the existing redwood tanks with steel tanks.

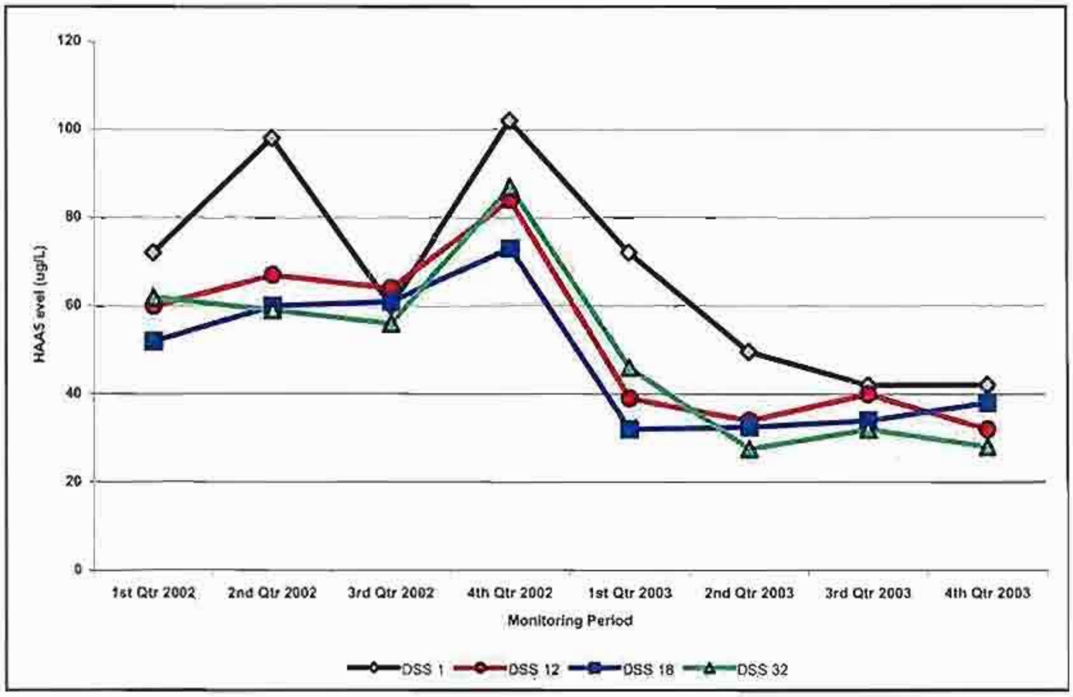


Figure 6. HAA5 Formation by Ebbetts Pass Monitoring Location.

Pumping

CCWD standards state a pump station should be able to deliver its design flow with the largest pump out of service. The standards also state that typically a pump station will be designed to deliver the maximum day demand. Peak hour demands and fire flows are expected to be supplied by storage without additional pumping.

The expected future demands were used to calculate booster pumping requirements at the existing pump stations. These requirements are summarized in Table 42.

Table 42. Booster Pumping Requirements.

Booster Pump Station	Existing Number of Pumps	Total Existing Design Flow (gpm)	Tanks Served	Existing Maximum Day Demand (gpm)	Buildout Maximum Day Demand (gpm)	Existing Required New Capacity (gpm)	Buildout Required New Capacity (gpm)
Big Trees Tank 4&5	2	96	Big Trees 8	35	69	-	-
Dorrington	2	200	Big Trees 8, Big Trees 4&5	361	673	161	473
Big Trees #1	2	200	Big Trees 60K	104	194	-	-
Sawmill	3	610	Big Trees 1&3, Big Trees 4&5, Big Trees 8, Big Trees 60K	555	1,027	-	417
Lakemont Pines	1	80-hp	Diablo View	28	49	-	-
Meadowmont	2	2,880	Sawmill, Lakemont, Pinebrook, Meadowmont 13, Big Trees 1&3, Big Trees 4&5, Big Trees 8, Big Trees 60K	1,617	3,312	-	432
Avery	2	2,880	Meadowmont, Sawmill, Lakemont, Pinebrook, Meadowmont 13, Big Trees 1&3, Big Trees 4&5, Big Trees 8, Big Trees 60K	1,645	3,715	-	835
Timber Trails	2	195	Timber Trails	28	28	-	-
Forest Meadows	2	900	Heather	187	992	-	92
Hunter's Dam	2	3,000	All	2,360	5,440	-	2,440

Booster Pump Station	Existing Number of Pumps	Total Existing Design Flow (gpm)	Tanks Served	Existing Maximum Day Demand (gpm)	Buildout Maximum Day Demand (gpm)	Existing Required New Capacity (gpm)	Buildout Required New Capacity (gpm)
Gold Hill Circle	0	-	Recommended new station for fire flow			500	500

Emergency (Standby) Power

Table 43 summarizes the recommended standby power improvements to the Ebbetts Pass water distribution system.

Table 43. Ebbetts Pass Recommended New Standby Power Generators.

Pumping Station Location	Lead Pump HP	Lag Pump HP	Recommended Generator Size
Larkspur (Forest Meadows)	40	N/A	60 KW
Timber Trails	15	N/A	30 KW
Avery	200	200	500 KW
Big Trees 1	15	N/A	30 KW
Dorrington Pumping Station	30	N/A	60 KW
Big Trees 4&5	3	N/A	12 KW

Pipelines

The pipeline improvements identified during the hydraulic model runs are summarized in the tables below. Pipe sizes were increased in areas of excessive head loss. The model was then run for buildout demands to identify additional needed improvements. In general, the improvements identified for existing demands are associated with providing fire flow to different areas of the system and meeting CCWD standards (ie. minimum pipe diameter of six inches). The results of the fire-flow scenario evaluation are included in Appendix B. Most of the improvements identified for buildout are related to improving the backbone of the system to convey water during high-demand periods. Tables 41 through 43 describe these improvements.

Table 44. Pipeline Improvements Recommended for Phase I.

Pipe ID	Existing Diameter (in)	New Diameter (in)	Length (ft)
P1796	4	8	573
P276	2	8	213
P281	2	8	168
P2836	2	8	286
P286	2	8	481
P2953	6	8	1362
P2983	6	8	959
P301	2	8	400
P3028	6	8	1273
P316	2	8	140

P3308	4	8	173
P3318	4	8	197
P3323	4	8	516
P3328	4	8	472
P3338	4	8	545
P3348	4	8	265
P3353	4	8	594
P3398	6	8	476
P3403	2	8	548
P346	2	8	81
P3538	6	8	121
P441	2	8	206
P4723	4	8	1196
P4798	4	8	243
P3278	8	12	1129
P3288	8	12	1054
P3293	8	12	505
P3303	8	12	297
P3393	8	12	2468
P3543	8	12	5370
P3573	8	12	1804
P3583	8	12	1309
P3653	8	12	3761
P4183	6	12	60
P4188	6	12	77
P4733	8	12	211
P4738	8	12	846
P4623	12	12	1208.6
P4628	12	12	1076.01
P4963	12	12	1730.12
P186	10	12	548
P1921	10	12	1197
P1931	10	12	386
P1936	10	12	204
P1791	10	12	454
P4568	8	12	388
P1591	10	12	1168
P1596	10	12	245
P1403	10	12	639
P136	12	12	2207.15
P1433	12	12	351.61
P2966	12	12	894.78
P2608	12	12	741.06
P2818	12	12	756.17

P1898	12	12	442.39
P1893	12	12	34.24
P1863	12	12	546.87
P1868	12	12	29.62
P1858	12	12	3115.15
P1853	12	12	408.58
P2748	12	12	422.96
P2743	12	12	1201.33
P1828	12	12	2969.73
P2963	6	8	133
P2973	6	8	368
P2993	6	8	343
P2998	6	8	460
P3023	6	8	654
P326	6	8	111
P331	6	8	37

Table 45. Pipeline Improvements Recommended for Phases 2 through 4.

Pipe ID	Existing Diameter (in)	New Diameter (in)	Length (ft)
P1131	6	8	960
P1151	6	8	1278
P1171	6	8	1510
P121	6	8	701
P1281	6	8	24
P1568	6	8	118
P1588	6	8	890
P1603	6	8	545
P161	6	8	1451
P1616	6	8	796
P1668	6	8	193
P1686	6	8	234
P1696	6	8	434
P181	6	8	1821
P2048	6	8	741
P2053	6	8	592
P2063	6	8	428
P2068	6	8	561
P2121	6	8	582
P2156	4	8	321
P2396	6	8	545
P2638	12	18	1186
P2648	12	18	2194
P2653	12	18	2403

P2663	12	18	1888
P2668	12	18	117
P3268	12	18	1548
P4113	12	18	332
P4353	6	8	968
P4373	6	8	1068
P4383	6	8	311
P4388	6	8	333
P4393	6	8	216
P4763	6	8	232
P5078	12	18	28
P3149B	-	6	226
P3256	6	8	927
P3376	6	8	246
P3446	6	8	512
P3496	6	8	1785
P3546	6	8	297
P3556	6	8	335
P3631	6	8	1085
P4818	6	8	3813
P5143	-	6	181
P3368	6	8	1235
P3383	6	8	1548
P3413	6	8	579
P3468	6	8	348
P3478	6	8	315
P3493	6	8	738
P3498	6	8	280
P4708	6	8	1759
P5038	-	6	248

The recommended new pipelines are summarized in Table 46 below, and shown in Figure 7 and Figure 8.

Table 46. Summary of Pipeline Improvements.

Diameter (in)	Total Length (ft)
6	6,619
8	5,142
12	50,459
18	9,364
Total	71,916

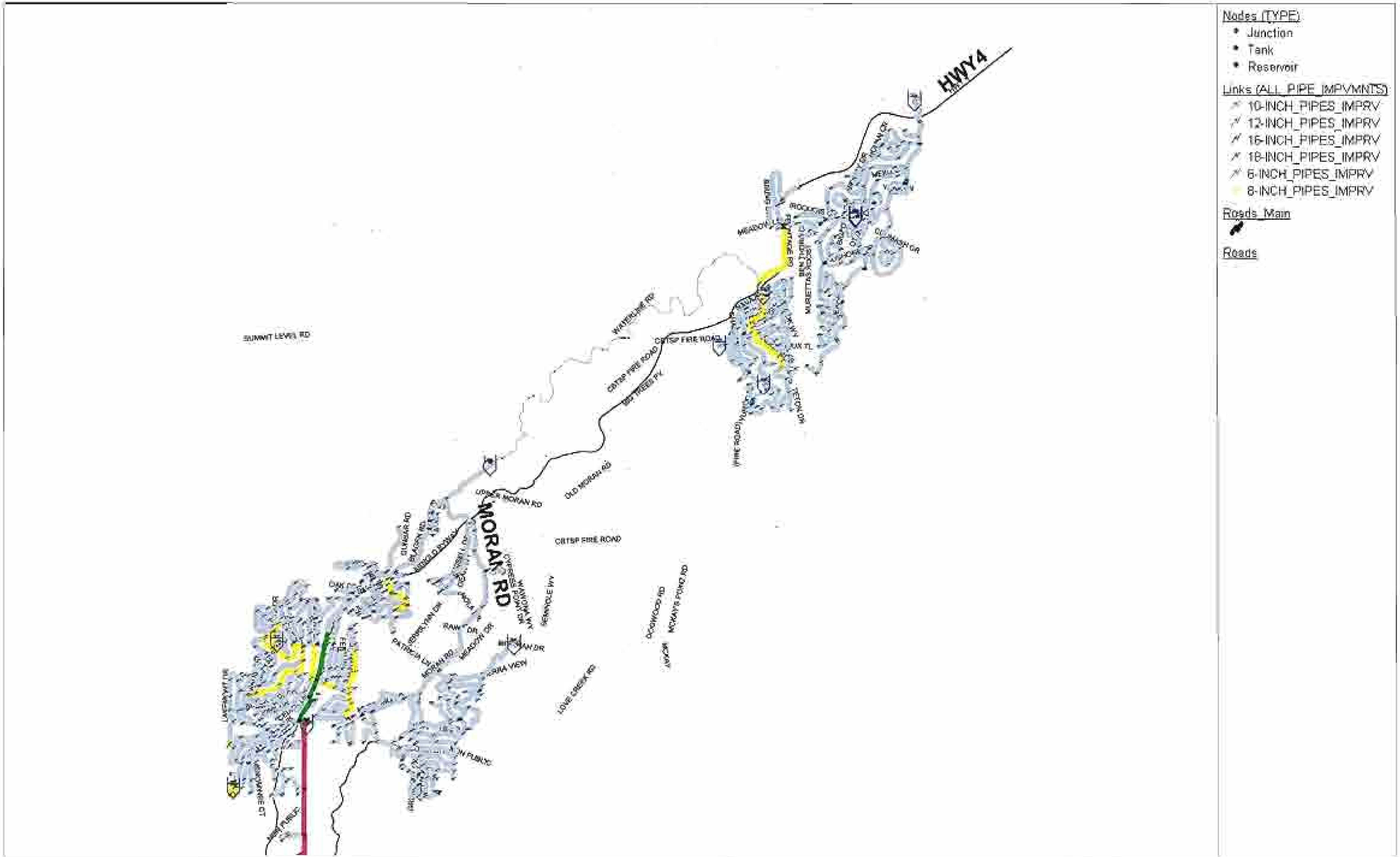


Figure 7. Ebbetts Pass Water Distribution System, Buildout System, Recommended Pipline Improvements Map, Northern Zones

Date: Wednesday, May 18, 2005

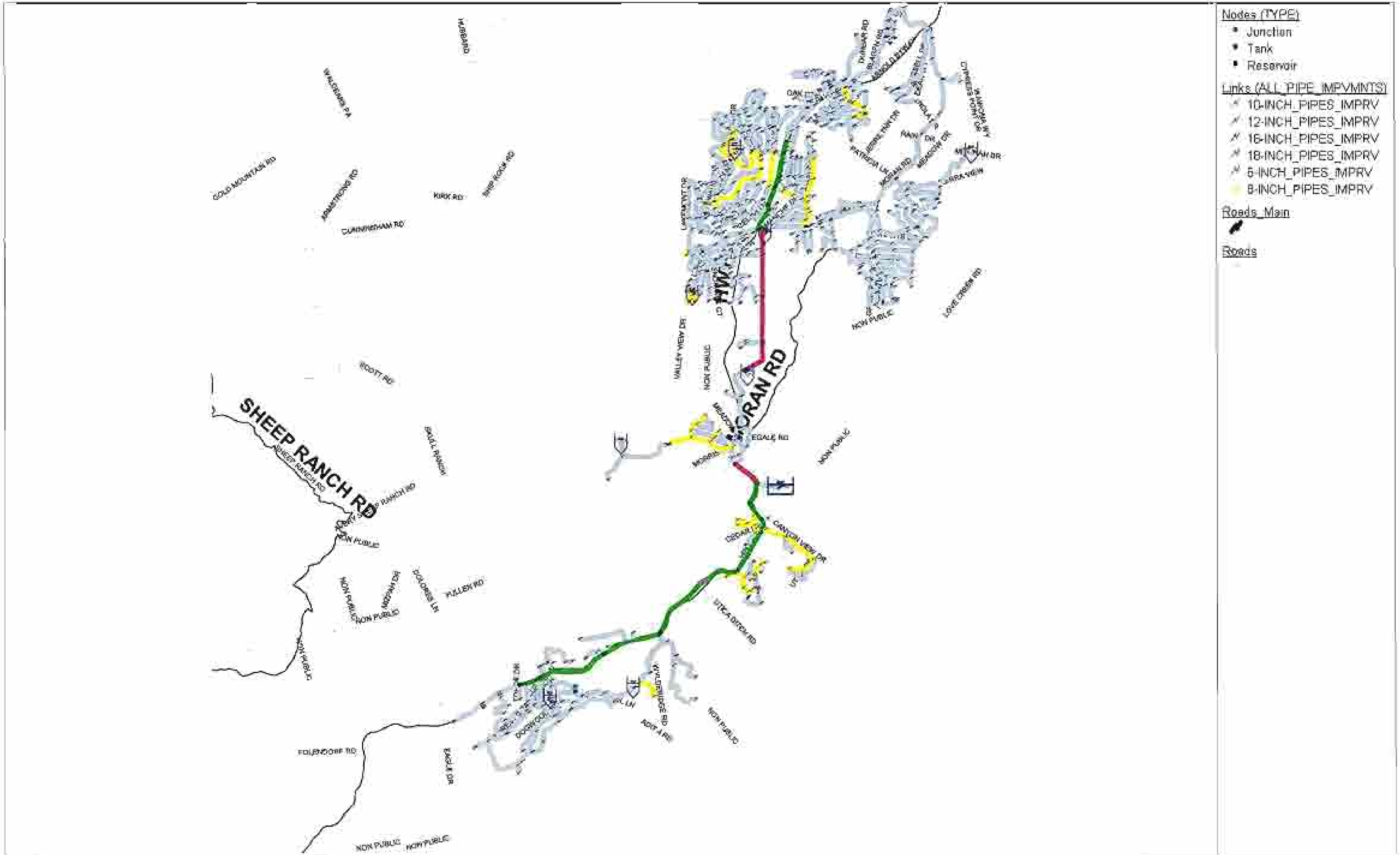


Figure 8. Ebbetts Pass Water Distribution System, Buildout System, Recommended Pipline Improvements Map, Southern Zones Date: Wednesday, May 18, 2005

Figure 9. Ebbetts Pass Water Distribution System, Buildout System, Recommended Pipline Improvements Map with IDs, Northern Zones Date: Wednesday, May 18, 2005

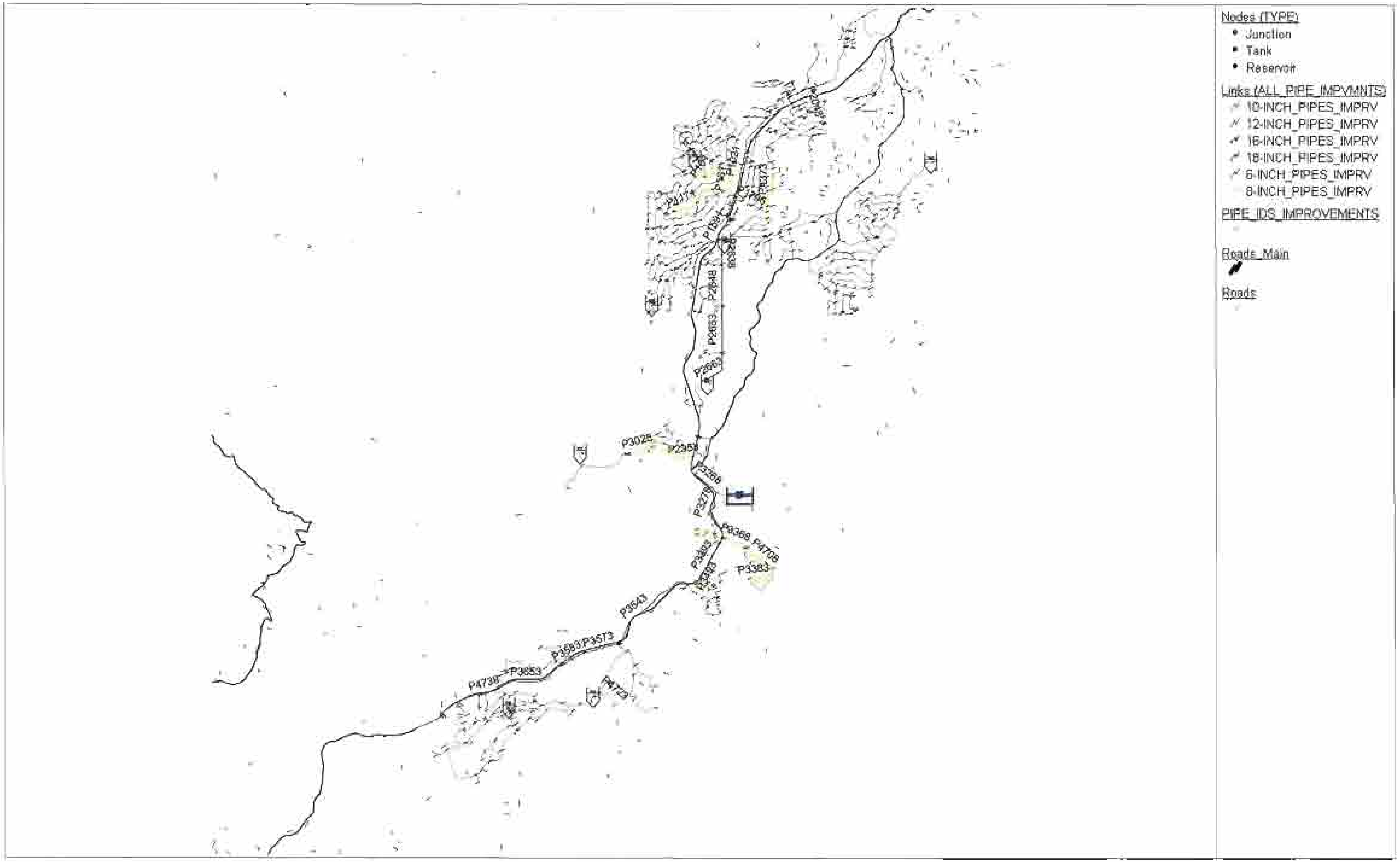


Figure 10. Ebbetts Pass Water Distribution System, Buildout System, Recommended Pipline Improvements Map with IDs, Southern Zones Date: Wednesday, May 18, 2005

Capital Improvement Plan

Chapter 9 - Capital Improvement Plan

This section presents the recommended Capital Improvement Plan for the Ebbetts Pass water system based on the evaluation in the previous chapters. The recommended improvements have been divided into five-year planning phases to facilitate implementation, and to assist CCWD in planning and funding the water system improvements. Table 47 summarizes the recommended improvement cost per phase. Detailed tables of the costs are included in Appendix A.

Table 47. Summary of Capital Improvement Costs.

Recommended Improvements	Phase I	Phase II	Phase III	Phase IV
	Yr 1 to 5	Yr 6 to 10	Yr 11 to 15	Yr 16 to Buildout
Water Supply		$500,000		
Storage Tanks	$4,523,000	$0	$0	$0
Booster Pumping	$702,500	$0	$625,000	$0
Standby Generator	$182,000	$86,000	$21,000	$0
Piping	$7,547,100	$3,936,300	$1,128,700	$846,100
WTP Expansion	$1,500,000		$3,850,000	
Hydropneumatic System (inc. Tank)	$50,000	$0	$0	$0
Sub-Total Cost	**$14,504,600**	**$4,522,300**	**$5,624,700**	**$846,100**
Contingency (25%)	$3,626,150	$1,130,575	$1,406,175	$211,525
Engineering, Administration, CM (20%)	$2,900,920	$904,460	$1,124,940	$169,220
Total Cost	**$21,031,670**	**$6,557,335**	**$8,155,815**	**$1,226,845**
Total Improvement Cost	**$36,971,665**			

Cost Estimates

Unit costs used are based on cost estimates developed for recent similar projects, recent bid prices, and historical trends. They are not based on detailed engineering design and analysis. Therefore, the construction cost estimates are considered to range from +30 percent to –30 percent of the expected bid prices.

Since knowledge about site-specific conditions of each proposed project is limited at the master planning stage, a 25 percent contingency will be applied to the baseline construction cost to account for unforeseen events and unknown conditions. A cost equal to 20 percent of construction cost (including contingencies) will be applied to account for additional items such as engineering, administration, construction management, and inspection costs.

Cost for new tanks are based on above-ground, dual, steel tanks. Costs for booster pumping stations will vary depending on the features designed into the station such as number of pumps, control features, surge protection features, buildings, architectural treatment, etc. For the Ebbetts Pass Water System, the costs for booster pumping stations are based primarily on replacing existing pumps or extending existing slabs to accommodate new pumps.

The estimated unit costs for pipelines are based on ductile iron piping and include trenching (minimum cover), installation, backfill fittings, service connections, pavement restoration, testing, traffic control, and appurtenances.

The Phase I cost estimate for the Hunters WTP expansion is based on the addition of a third treatment train in the existing facility. The third treatment train would have a capacity of 1,400 gpm (2 mgd). The Phase III cost estimate is for the replacement of the original treatment train with a membrane microfiltration system sized for a treatment capacity of 3,250 gpm (4.7 mgd).

Basis for Phased Improvements

Projects selected for Phase I are needed to meet CCWD's most critical needs. For storage tank improvements, those areas that have existing redwood tanks and have less reliable drinking water and fire flow supply were included in this phase.

Dorrington Pumping Station was included in Phase I to meet CCWD design standards on firm capacity. All other pumping stations have sufficient firm capacity to meet existing demands. To meet buildout demand conditions, Phase I included improvements to the Sawmill, Hunters WTP, and the new Gold Hill Circle pumping stations. Sawmill services other pressure zones and requires replacement of two smaller existing pumps. Hunters WTP is at the source of the distribution system.. Gold Hill Circle is needed to deliver fire flow to the Meadowmont 13 pressure zone. Other pumping station improvements were distributed in the subsequent phases to make the cost per phase more feasible.

For the piping improvements, those improvements identified to meet the existing demands were included in Phase I. For improvements needed for buildout demands were distributed to make the cost per phase more feasible based on projected growth areas.

Schedule

Chapter 10 - Schedule

Table 48. Ebbetts Pass Phase I Storage Tank Cost Schedule.

Storage Tank Improvements						
Project	**Phase I Cost**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Big Trees 8: Install two 65,000gal tanks	$195,000					$195,000
Big Trees 60K: Install two 70,000gal tanks	$210,000				$210,000	
Meadowmont Install one 1,300,000gal tank	$1,125,000	$1,125,000				
Big Trees 1 & 3 Install two 400,000gal tanks	$600,000				$600,000	
Big Trees 4&5 Install two 300,000gal tanks	$690,000					$690,000
Avery Install one 1,300,000gal tank	$975,000		$975,000			
Heather (Forest Meadows) Replace existing redwood tank with two 230,000gal tanks	$578,000			$578,000		
Timber Trails Replace existing redwood tank with one 50,000gal tank	$75,000			$75,000		
State Park Replace existing redwood tank with one 50,000 gal tank	$75,000				$75,000	
Sub-Total Cost Per Year	**$4,523,000**	$1,125,000	$975,000	$653,000	$885,000	$885,000

Table 49. Ebbetts Pass Phase I Booster Pumping Station Cost Schedule.

Booster Pumping Station Improvements						
Project	**Phase I Cost**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Sawmill: Replace two existing 25 HP pump with two 50 HP pumps (290 gpm each)	$150,000			$150,000		
Hunters WTP: Add one new 200 HP pump (1500 gpm)		$100,000				
Gold Hill Circle: Add two new 25 HP pumps (250 gpm each)	$50,000				$50,000	
Dorrington: Replace two existing 15 HP (100 gpm each) pumps with three 30 HP pumps (200 gpm each)	$112,500					$112,500
Meadowmont: Add new 350 HP (1,440 gpm)	$100,000		$100,00			
Avery: Add new 200 HP pump (1,440 gpm)	$75,000	$75,000				

Booster Pumping Station Improvements						
Project	Phase I Cost	Year 1	Year 2	Year 3	Year 4	Year 5
Big Trees 4 and 5 50 HP fire flow pump (650 gpm)	$50,000				$50,000	
Big Trees 1 65 HP fire flow pump (850 gpm)					$65,000	
Sub-Total Cost Per Year		$175,000	$100,000	$150,000	$165,000	$112,500

Table 50. Ebbetts Pass Phase I Pipe Cost Schedule.

Piping Improvements									
Pipe ID	Existing Diameter (in)	New Diameter (in)	Length (ft)	Phase I Cost	Year 1	Year 2	Year 3	Year 4	Year 5
P1796	4	8	573	$120 /LF				$68,800	
P276	2	8	213	$120 /LF					$25,600
P281	2	8	168	$120 /LF					$20,100
P2836	2	8	286	$120 /LF				$34,400	
P286	2	8	481	$120 /LF					$57,700
P2953	6	8	1362	$120 /LF		$163,400			
P2983	6	8	959	$120 /LF		$115,100			
P301	2	8	400	$120 /LF					$47,900
P3028	6	8	1273	$120 /LF		$152,700			
P316	2	8	140	$120 /LF					$16,800
P3308	4	8	173	$120 /LF	$20,700				
P3318	4	8	197	$120 /LF	$23,600				
P3323	4	8	516	$120 /LF			$62,000		
P3328	4	8	472	$120 /LF	$56,600				
P3338	4	8	545	$120 /LF			$65,400		
P3348	4	8	265	$120 /LF			$31,700		
P3353	4	8	594	$120 /LF			$71,300		
P3398	6	8	476	$120 /LF	$57,200				
P3403	2	8	548	$120 /LF	$65,800				
P346	2	8	81	$120 /LF					$9,700
P3538	6	8	121	$120 /LF	$14,500				
P441	2	8	206	$120 /LF			$24,800		
P4723	4	8	1196	$120 /LF				$143,500	
P4798	4	8	243	$120 /LF	$29,200				
P3278	8	12	1129	$140 /LF	$158,100				
P3288	8	12	1054	$140 /LF	$147,500				
P3293	8	12	505	$140 /LF	$70,800				
P3303	8	12	297	$140 /LF	$41,500				
P3393	8	12	2468	$140 /LF	$345,500				
P3543	8	12	5370	$140 /LF	$751,900				
P3573	8	12	1804	$140 /LF	$252,600				

P3583	8	12	1309	$140 /LF		$183,300			
P3653	8	12	3761	$140 /LF		$526,500			
P4183	6	12	60	$140 /LF		$8,400			
P4188	6	12	77	$140 /LF		$10,800			
P4733	8	12	211	$140 /LF		$29,500			
P4738	8	12	846	$140 /LF		$118,500			
P4623	12	12	1208.6	$140 /LF		$169,200			
P4628	12	12	1076.01	$140 /LF		$150,600			
P4963	12	12	1730.12	$140 /LF		$242,200			
P186	10	12	548	$140 /LF			$76,700		
P1921	10	12	1197	$140 /LF			$167,600		
P1931	10	12	386	$140 /LF			$54,000		
P1936	10	12	204	$140 /LF			$28,600		
P1791	10	12	454	$140 /LF			$63,600		
P4568	8	12	388	$140 /LF			$54,300		
P1591	10	12	1168	$140 /LF			$163,500		
P1596	10	12	245	$140 /LF			$34,300		
P1403	10	12	639	$140 /LF			$89,500		
P136	12	12	2207.15	$140 /LF			$309,000		
P1433	12	12	351.61	$140 /LF			$49,200		
P2966	12	12	894.78	$140 /LF			$125,300		
P2608	12	12	741.06	$140 /LF			$103,700		
P2818	12	12	756.17	$140 /LF				$105,900	
P1898	12	12	442.39	$140 /LF				$61,900	
P1893	12	12	34.24	$140 /LF				$4,800	
P1863	12	12	546.87	$140 /LF				$76,600	
P1868	12	12	29.62	$140 /LF				$4,100	
P1858	12	12	3115.15	$140 /LF				$436,100	
P1853	12	12	408.58	$140 /LF				$57,200	
P2748	12	12	422.96	$140 /LF				$59,200	
P2743	12	12	1201.33	$140 /LF				$168,200	
P1828	12	12	2969.73	$140 /LF				$415,800	
P2963	6	8	133	$120 /LF					$16,000
P2973	6	8	368	$120 /LF					$44,200
P2993	6	8	343	$120 /LF					$41,200
P2998	6	8	460	$120 /LF					$55,100
P3023	6	8	654	$120 /LF					$78,400
P326	6	8	111	$120 /LF					$13,300
P331	6	8	37	$120 /LF					$4,400
				Sub-Total Cost Per Year	$2,035,500	$1,870,200	$1,574,500	$1,636,500	$430,400

References

Chapter 11 - References

Ebbetts Pass Water Master Plan, Tudor Engineering Company, August 1974.

Evaluation of Water Supply Alternatives for Ebbetts Pass Improvement District No. 5, K.S. Dunbar and Associates, July 1986.

Appendices

Appendix A. CIP Cost Estimates.

CCWD Ebbetts Pass Water Master Plan

Capital Improvement Costs

Recommended Improvements	Phase I *Yr 1 to 5*	Phase II *Yr 6 to 10*	Phase III *Yr 11 to 15*	Phase IV *Yr 16 to Buildout*
Water Supply		$500,000		
Storage Tanks	$4,523,000	$0	$0	$0
Booster Pumping	$702,500	$0	$625,000	$0
Standby Generator	$182,000	$86,000	$21,000	$0
Piping	$7,547,100	$3,936,300	$1,128,700	$846,100
WTP Expansion	$1,500,000		$3,850,000	
Surge Anticipation Facility	$50,000			
Sub-Total Cost Per Phase	**$14,504,600**	**$4,522,300**	**$5,624,700**	**$846,100**
Contingency (25%)	$3,626,150	$1,130,575	$1,406,175	$211,525
Engineering, Administration, CM (20%)	$2,900,920	$904,460	$1,124,940	$169,220
TOTAL COST PER PHASE	**$21,031,670**	**$6,557,335**	**$8,155,815**	**$1,226,845**

TOTAL IMPROVEMENT COST	**$36,971,665**

Phase I Capital Improvement Costs

Recommended Improvements	Year 1	Year 2	Year 3	Year 4	Year 5
Storage Tanks	$1,125,000	$975,000	$653,000	$885,000	$885,000
Booster Pumping	$175,000	$100,000	$150,000	$165,000	$112,500
Standby Generator	$137,000	$0	$0	$0	$45,000
Piping	$2,035,500	$1,870,200	$1,574,500	$1,636,500	$430,400
WTP Expansion	$1,500,000				
Surge Anticipation Facility	$50,000				
SUBTOTAL COST PER YEAR	$5,022,500	$2,945,200	$2,377,500	$2,686,500	$1,472,900
Contingency (25%)	$1,255,625	$736,300	$594,375	$671,625	$368,225
Engineering, Administration, CM (20%)	$1,004,500	$589,040	$475,500	$537,300	$294,580
TOTAL COST PER YEAR, PHASE 1	**$7,282,625**	**$4,270,540**	**$3,447,375**	**$3,895,425**	**$2,135,705**

CCWD Ebbetts Pass Water Master Plan
Recommended Improvements to Storage Reservoirs

Replace Existing Redwood Tanks with Dual Steel Tanks

Service Area	Buildout Volume Required	Design Total Storage Volume	Unit Cost	Cost	Comments	Note	Phase I	Phase II	Phase III	Phase IV
Big Trees 8	276,667 Gal	130,000 Gal	$1.50 /gal	$195,000	65,000 gal per tank	Excludes Portion of FF storage; pump to provi	$195,000			
Big Trees 4&5	595,667 Gal	600,000 Gal	$1.15 /gal	$690,000	300,000 gal per tank		$690,000			
Big Trees 60K	342,667 Gal	140,000 Gal	$1.50 /gal	$210,000	70,000 gal per tank	Excludes Portion of FF storage; pump to provi	$210,000			
Big Trees 1 & 3	786,333 Gal	800,000 Gal	$0.75 /gal	$600,000	400,000 gal per tank	Excludes FF storage; pump to provide FF	$600,000			
Meadowmont 13	324,333 Gal	-	-	-	To be replaced by PRV	Fire flow received from Sawmill	-			
Timber Trails	254,667 Gal	50,000 Gal	$1.50 /gal	$75,000	One 50,000 gal tank.	Maintain smaller tank for WQ reasons.	$75,000			
Heather (Forest Meadows)	764,333 Gal	770,000 Gal	$0.75 /gal	$578,000	385,000 gal per tank		$578,000			
State Park	-	50,000 Gal	$1.50 /gal	$75,000	One 50,000 gal tank.	Maintain smaller tank for WQ reasons.	$75,000			
			Total Cost to Replace Redwood Tanks	$2,423,000			$2,423,000	$0	$0	$0

Add Additional Storage to Steel Tank Sites

Service Area	Additional Storage Volume Required at Buildout	Recommended Tank Size	Unit Cost	Cost	Comments		Phase I	Phase II	Phase III	Phase IV
Avery	1,263,333 Gal	1,300,000 Gal	$0.75 /gal	$975,000	One 1.3MG tank	FF gravity fed from Meadowmont.	$975,000			
Meadowmont	1,498,667 Gal	1,500,000 Gal	$0.75 /gal	$1,125,000	One 1.5MG tank	FF to be provided by Avery pumps.	$1,125,000			
			Total Cost for Additional Steel Tanks	$2,100,000			$2,100,000	$0	$0	$0
					Total Cost Per Phase		$4,523,000	$0	$0	$0

	Year 1	Year 2	Year 3	Year 4	Year 5
Big Trees 8					$195,000
Big Trees 4&5					$690,000
Big Trees 60K				$210,000	
Big Trees 1 & 3				$600,000	
Meadowmont 13				-	
Timber Trails			$75,000		
Heather (Forest Meadows)			$578,000		
State Park				$75,000	
Avery		$975,000			
Meadowmont	$1,125,000				
COST PER YEAR, PHASE 1	$ 1,125,000	$ 975,000	$ 653,000	$ 885,000	$ 885,000
GRAND TOTAL PHASE 1	$ 4,523,000				

CCWD Ebbetts Pass Water Master Plan
Recommended Improvements to Booster Pumping Stations

Booster Pumping Station Improvements Needed to Meet Buildout Conditions and CCWD Design Standards for Firm Capacity

Service Area	Buildout Maximum Day Demand	Buildout Design Firm Pumping Capacity	Buildout Largest Pump on Standby	Buildout Design Total Pumping Capacity	Existing Firm Capacity	Required New Capacity	Comments	Buildout Required Total New HP	Unit Cost	Total Estimated Cost	Phase I	Phase II	Phase III	Phase IV
Sawmill	1,037 gpm	1,037 gpm	290 gpm	1,317 gpm	303 gpm	707 gpm	Replace two exist 25HP pumps with new 50 HP (280 gpm); add two more 50 HP pumps (280 gpm)	200 HP	LS	$300,000	$150,000		$150,000	
Meadowmont	3,312 gpm	3,312 gpm	1,440 gpm	4,752 gpm	1,440 gpm	1,872 gpm	Add two new 250 HP pumps (1440 gpm each) to match existing pumps	700 HP	LS	$200,000	$100,000		$100,000	
Avery	3,715 gpm	3,715 gpm	1,440 gpm	5,155 gpm	1,440 gpm	2,275 gpm	Add two new 200 HP pumps (1440 gpm each) to match existing pumps	400 HP	LS	$150,000	$75,000		$75,000	
Hunter's Dam	5,440 gpm	5,440 gpm	1,500 gpm	6,940 gpm	1,500 gpm	3,940 gpm	Add three new 200 HP pumps (1500 gpm each) to match existing pumps	600 HP	LS	$200,000	$100,000		$200,000	
Big Trees 4&5	69 gpm	69 gpm	50 gpm	119 gpm	49 gpm	85 gpm	Add one new 5 HP pump (50 gpm)	5 HP	LS	$5,000			$5,000	
Dorrington	673 gpm	673 gpm	100 gpm	773 gpm	100 gpm	573 gpm	Replace both existing 15 HP (100 gpm) pumps with three new 30 HP pumps (200 gpm)	90 HP	LS	$112,500	$112,500			
Big Trees 1	194 gpm	194 gpm	100 gpm	294 gpm	100 gpm	94 gpm	Add one new 15 HP pump (100 gpm)	15 HP	LS	$15,000			$15,000	
Timber Trails	48 gpm	49 gpm	100 gpm	148 gpm	95 gpm	none		-						
Larkspur (Forest Meadows)	992 gpm	992 gpm	450 gpm	1,442 gpm	450 gpm	542 gpm	Replace one pump with 50 HP (300 gpm) pump; add one more 50 HP (380 gpm) pump	100 HP	LS	$30,000			$30,000	
Additional Pumps Needed to Meet Fire Flow Demand														
Gold Hill Circle						500 gpm	Add three new 25 HP pump (250 gpm) for fire flow; two duty, one standby	75 HP	LS	$75,000	$50,000		$25,000	
Big Trees 4&5						850 gpm	Add one pump to existing pump station to augment Big Trees # fire flow; 50 HP pump (550 gpm) for fire flow.	50 HP	LS	$55,000	$50,000		$5,000	
Big Trees 1						850 gpm	Add one pump to existing pump station to augment Big Trees 60K fire flow; 65 HP pump (550 gpm) for fire flow.	65 HP	LS	$65,000	$65,000			
									TOTAL COST	$1,327,500	$702,500	$0	$625,000	$0

	Year 1	Year 2	Year 3	Year 4	Year 5
Sawmill			$150,000		
Meadowmont		$100,000			
Avery	$75,000				
Hunter's Dam	$100,000				
Big Trees 4&5				$50,000	
Dorrington					$112,500
Big Trees 1				$65,000	
Timber Trails	$0				
Larkspur (Forest Meadows)	$0				
Gold Hill Circle				$50,000	
PROJECT COST PER YEAR	$ 175,000	$ 100,000	$ 150,000	$ 165,000	$ 112,500
GRAND TOTAL PHASE I	$ 702,500				

CCWD Ebbetts Pass Water Master Plan

Recommended Distribution System Piping Improvements

Pipeline Improvements for Phase I

Pipe ID	Existing Diameter (in)	New Diameter (in)	Length (ft)	Unit Cost	Total Cost	Phase I	Year 1	Year 2	Year 3	Year 4	Year 5
P1796	4	8	573	$120 /LF	$68,800	$68,800				$68,800	
P276	2	8	213	$120 /LF	$25,600	$25,600					$25,600
P281	2	8	168	$120 /LF	$20,100	$20,100					$20,100
P2838	2	8	286	$120 /LF	$34,400	$34,400				$34,400	
P286	2	8	481	$120 /LF	$57,700	$57,700					$57,700
P2953	6	8	1362	$120 /LF	$163,400	$163,400		$163,400			
P2983	6	8	959	$120 /LF	$115,100	$115,100		$115,100			
P301	2	8	400	$120 /LF	$47,900	$47,900					$47,900
P3028	6	8	1273	$120 /LF	$152,700	$152,700		$152,700			
P316	2	8	140	$120 /LF	$16,800	$16,800					$16,800
P3308	4	8	173	$120 /LF	$20,700	$20,700	$20,700				
P3318	4	8	197	$120 /LF	$23,600	$23,600	$23,600				
P3323	4	8	516	$120 /LF	$62,000	$62,000			$62,000		
P3328	4	8	472	$120 /LF	$56,600	$56,600	$56,600				
P3338	4	8	545	$120 /LF	$65,400	$65,400			$65,400		
P3348	4	8	265	$120 /LF	$31,700	$31,700			$31,700		
P3353	4	8	594	$120 /LF	$71,300	$71,300			$71,300		
P3398	6	8	476	$120 /LF	$57,200	$57,200	$57,200				
P3403	2	8	548	$120 /LF	$65,600	$65,600	$65,600				
P346	2	8	81	$120 /LF	$9,700	$9,700					$9,700
P3538	6	8	121	$120 /LF	$14,500	$14,500	$14,500				
P441	2	8	206	$120 /LF	$24,800	$24,800			$24,800		
P4723	4	8	1196	$120 /LF	$143,500	$143,500				$143,500	
P4798	4	8	243	$120 /LF	$29,200	$29,200	$29,200				
P3278	8	12	1129	$140 /LF	$158,100	$158,100	$158,100				
P3288	8	12	1054	$140 /LF	$147,500	$147,500	$147,500				
P3293	8	12	505	$140 /LF	$70,800	$70,800	$70,800				
P3303	8	12	297	$140 /LF	$41,500	$41,500	$41,500				
P3393	8	12	2468	$140 /LF	$345,500	$345,500	$345,500				
P3543	8	10	5370	$140 /LF	$751,800	$751,800	$751,800				
P3573	8	12	1804	$140 /LF	$252,600	$252,600	$252,600				
P3583	8	12	1309	$140 /LF	$183,300	$183,300		$183,300			
P3853	8	12	3761	$140 /LF	$526,500	$526,500		$526,500			
P4183	8	12	60	$140 /LF	$8,400	$8,400		$8,400			
P4188	8	12	77	$140 /LF	$10,800	$10,800		$10,800			
P4733	8	12	211	$140 /LF	$29,500	$29,500		$29,500			
P4738	8	12	846	$140 /LF	$118,500	$118,500		$118,500			
P4823	12	12	1208.6	$140 /LF	$169,200	$169,200		$169,200			
P4828	12	12	1076.01	$140 /LF	$150,600	$150,600		$150,600			
P4963	12	12	1730.12	$140 /LF	$242,200	$242,200		$242,200			
P186	10	12	548	$140 /LF	$76,700	$76,700			$76,700		
P1921	10	12	1197	$140 /LF	$167,600	$167,600			$167,600		
P1931	10	12	386	$140 /LF	$54,000	$54,000			$54,000		
P1936	10	12	204	$140 /LF	$28,600	$28,600			$28,600		
P1791	10	12	454	$140 /LF	$63,600	$63,600			$63,600		
P4368	8	12	388	$140 /LF	$54,300	$54,300			$54,300		
P1591	10	12	1168	$140 /LF	$163,500	$163,500			$163,500		
P1596	10	12	245	$140 /LF	$34,300	$34,300			$34,300		
P1403	10	12	639	$140 /LF	$89,500	$89,500			$89,500		
P136	12	12	2207.15	$140 /LF	$309,000	$309,000			$309,000		
P1433	12	12	351.61	$140 /LF	$49,200	$49,200			$49,200		
P2906	12	12	894.78	$140 /LF	$125,300	$125,300			$125,300		
P2508	12	12	741.06	$140 /LF	$103,700	$103,700			$103,700		
P2818	12	12	756.17	$140 /LF	$105,900	$105,900				$105,900	
P1498	12	12	442.39	$140 /LF	$61,900	$61,900				$61,900	
P1893	12	12	34.24	$140 /LF	$4,800	$4,800				$4,800	
P1863	12	12	546.87	$140 /LF	$76,600	$76,600				$76,600	
P1868	12	12	29.62	$140 /LF	$4,100	$4,100				$4,100	
P1858	12	12	3115.15	$140 /LF	$436,100	$436,100				$436,100	
P1853	12	12	408.58	$140 /LF	$57,200	$57,200				$57,200	
P2748	12	12	422.96	$140 /LF	$59,200	$59,200				$59,200	
P2743	12	12	1201.33	$140 /LF	$168,200	$168,200				$168,200	
P1828	12	12	2969.73	$140 /LF	$415,800	$415,800				$415,800	
P2963	6	8	133	$120 /LF	$16,000	$16,000					$16,000
P2973	6	8	368	$120 /LF	$44,200	$44,200					$44,200
P2993	6	8	343	$120 /LF	$41,200	$41,200					$41,200
P2998	6	8	460	$120 /LF	$55,100	$55,100					$55,100
P3023	6	8	654	$120 /LF	$78,400	$78,400					$78,400
P326	6	8	111	$120 /LF	$13,300	$13,300					$13,300
P331	6	8	37	$120 /LF	$4,400	$4,400					$4,400
					TOTAL COST	$7,547,100	$2,035,500	$1,870,200	$1,574,500	$1,638,500	$430,400

Unit Costs		
Dia (in)	$/ft	
6	$	120
8	$	120
12	$	140
16	$	185

CCWD Ebbetts Pass Water Master Plan

Recommended Distribution System Piping Improvements

Pipeline Improvements for Buildout Demands

Pipe ID	Existing Diameter (in)	New Diameter (in)	Length (ft)	Unit Cost	Total Cost	Phase I	Phase II	Phase III	Phase IV
P1796	4	8	573	$120 /LF	$68,800	$68,800			
P276	2	8	213	$120 /LF	$25,600	$25,600			
P281	2	8	168	$120 /LF	$20,100	$20,100			
P2836	2	8	286	$120 /LF	$34,400	$34,400			
P286	2	8	481	$120 /LF	$57,700	$57,700			
P2953	6	8	1362	$120 /LF	$163,400	$163,400			
P2983	6	8	959	$120 /LF	$115,100	$115,100			
P301	2	8	400	$120 /LF	$47,900	$47,900			
P3028	6	8	1273	$120 /LF	$152,700	$152,700			
P316	2	8	140	$120 /LF	$16,800	$16,800			
P3308	4	8	173	$120 /LF	$20,700	$20,700			
P3318	4	8	197	$120 /LF	$23,600	$23,600			
P3323	4	8	516	$120 /LF	$62,000	$62,000			
P3328	4	8	472	$120 /LF	$56,600	$56,600			
P3338	4	8	545	$120 /LF	$65,400	$65,400			
P3348	4	8	265	$120 /LF	$31,700	$31,700			
P3353	4	8	594	$120 /LF	$71,300	$71,300			
P3398	6	8	476	$120 /LF	$57,200	$57,200			
P3403	2	8	548	$120 /LF	$65,800	$65,800			
P346	2	8	81	$120 /LF	$9,700	$9,700			
P3538	6	8	121	$120 /LF	$14,500	$14,500			
P441	2	8	206	$120 /LF	$24,800	$24,800			
P4723	4	8	1196	$120 /LF	$143,500	$143,500			
P4798	4	8	243	$120 /LF	$29,200	$29,200			
P3278	8	12	1129	$140 /LF	$158,100	$158,100			
P3288	8	12	1054	$140 /LF	$147,500	$147,500			
P3293	6	12	505	$140 /LF	$70,800	$70,800			
P3303	8	12	297	$140 /LF	$41,500	$41,500			
P3393	8	12	2468	$140 /LF	$345,500	$345,500			
P3543	8	12	5370	$140 /LF	$751,900	$751,900			
P3573	8	12	1804	$140 /LF	$252,600	$252,600			
P3583	8	12	1309	$140 /LF	$183,300	$183,300			
P3653	8	12	3761	$140 /LF	$526,500	$526,500			
P4183	6	12	60	$140 /LF	$8,400	$8,400			
P4188	6	12	77	$140 /LF	$10,800	$10,800			
P4733	8	12	211	$140 /LF	$29,500	$29,500			
P4738	8	12	846	$140 /LF	$118,500	$118,500			
P4623	12	12	1208.6	$140 /LF	$169,200	$169,200			
P4628	12	12	1076.01	$140 /LF	$150,600	$150,600			
P4963	12	12	1730.12	$140 /LF	$242,200	$242,200			
P186	10	12	548	$140 /LF	$76,700	$76,700			
P1921	10	12	1197	$140 /LF	$167,600	$167,600			
P1931	10	12	386	$140 /LF	$54,000	$54,000			
P1936	10	12	204	$140 /LF	$28,600	$28,600			
P1791	10	12	454	$140 /LF	$63,600	$63,600			
P4568	8	12	388	$140 /LF	$54,300	$54,300			
P1591	10	12	1168	$140 /LF	$163,500	$163,500			
P1596	10	12	245	$140 /LF	$34,300	$34,300			
P1403	10	12	639	$140 /LF	$89,500	$89,500			
P136	12	12	2207.15	$140 /LF	$309,000	$309,000			
P1433	12	12	351.61	$140 /LF	$49,200	$49,200			
P2966	12	12	894.78	$140 /LF	$125,300	$125,300			
P2608	12	12	741.06	$140 /LF	$103,700	$103,700			
P2818	12	12	756.17	$140 /LF	$105,900	$105,900			
P1898	12	12	442.39	$140 /LF	$61,900	$61,900			
P1893	12	12	34.24	$140 /LF	$4,800	$4,800			
P1863	12	12	546.87	$140 /LF	$76,600	$76,600			
P1868	12	12	29.62	$140 /LF	$4,100	$4,100			
P1858	12	12	3115.15	$140 /LF	$436,100	$436,100			
P1853	12	12	408.58	$140 /LF	$57,200	$57,200			
P2748	12	12	422.96	$140 /LF	$59,200	$59,200			
P2743	12	12	1201.33	$140 /LF	$168,200	$168,200			
P1828	12	12	2969.73	$140 /LF	$415,800	$415,800			
P2963	6	8	133	$120 /LF	$16,000	$16,000			
P2973	6	8	368	$120 /LF	$44,200	$44,200			
P2993	6	8	343	$120 /LF	$41,200	$41,200			
P2998	6	8	460	$120 /LF	$55,100	$55,100			
P3023	6	8	654	$120 /LF	$78,400	$78,400			
P326	6	8	111	$120 /LF	$13,300	$13,300			

CCWD Ebbetts Pass Water Master Plan
Recommended Distribution System Piping Improvements

Pipeline Improvements for Buildout Demands

Pipe ID	Existing Diameter (in)	New Diameter (in)	Length (ft)	Unit Cost	Total Cost	Phase I	Phase II	Phase III	Phase IV
P331	6	8	37	$120 /LF	$4,400	$4,400			
P1131	6	8	960	$120 /LF	$115,200		$115,200		
P1151	6	8	1278	$120 /LF	$153,300		$153,300		
P1171	6	8	1510	$120 /LF	$181,200		$181,200		
P121	6	8	701	$120 /LF	$84,200		$84,200		
P1281	6	8	24	$120 /LF	$2,900		$2,900		
P1568	6	8	118	$120 /LF	$14,100		$14,100		
P1586	6	8	890	$120 /LF	$106,800		$106,800		
P1603	6	8	545	$120 /LF	$65,400		$65,400		
P161	6	8	1451	$120 /LF	$174,200		$174,200		
P1616	6	8	796	$120 /LF	$95,600		$95,600		
P1668	6	8	193	$120 /LF	$23,100		$23,100		
P1686	6	8	234	$120 /LF	$28,000		$28,000		
P1696	6	8	434	$120 /LF	$52,000		$52,000		
P181	6	8	1821	$120 /LF	$218,500		$218,500		
P2048	6	8	741	$120 /LF	$88,900		$88,900		
P2053	6	8	592	$120 /LF	$71,100		$71,100		
P2063	6	8	428	$120 /LF	$51,400		$51,400		
P2068	6	8	561	$120 /LF	$67,300		$67,300		
P2121	6	8	582	$120 /LF	$69,800		$69,800		
P2156	4	8	321	$120 /LF	$38,600		$38,600		
P2396	6	8	545	$120 /LF	$65,400		$65,400		
P2638	12	18	1186	$185 /LF	$219,500		$219,500		
P2646	12	18	2194	$185 /LF	$405,800		$405,800		
P2653	12	18	2403	$185 /LF	$444,600		$444,600		
P2663	12	18	1888	$185 /LF	$349,300		$349,300		
P2668	12	18	117	$185 /LF	$21,600		$21,600		
P3268	12	18	1548	$185 /LF	$286,400		$286,400		
P4113	12	18	332	$185 /LF	$61,500		$61,500		
P4353	6	8	968	$120 /LF	$116,200		$116,200		
P4373	6	8	1068	$120 /LF	$128,200		$128,200		
P4383	6	8	311	$120 /LF	$37,300		$37,300		
P4388	6	8	333	$120 /LF	$39,900		$39,900		
P4393	6	8	216	$120 /LF	$25,900		$25,900		
P4763	6	8	232	$120 /LF	$27,900		$27,900		
P5078	12	18	28	$185 /LF	$5,200		$5,200		
P3149B	-	6	226	$120 /LF	$27,100			$27,100	
P3256	6	8	927	$120 /LF	$111,300			$111,300	
P3376	6	8	246	$120 /LF	$29,500			$29,500	
P3446	6	8	512	$120 /LF	$61,400			$61,400	
P3496	6	8	1785	$120 /LF	$214,200			$214,200	
P3546	6	8	297	$120 /LF	$35,600			$35,600	
P3556	6	8	335	$120 /LF	$40,200			$40,200	
P3631	6	8	1085	$120 /LF	$130,200			$130,200	
P4818	6	8	3813	$120 /LF	$457,500			$457,500	
P5143	-	6	181	$120 /LF	$21,700			$21,700	
P3368	6	8	1235	$120 /LF	$148,200				$148,200
P3383	6	8	1548	$120 /LF	$185,700				$185,700
P3413	6	8	579	$120 /LF	$69,500				$69,500
P3468	6	8	348	$120 /LF	$41,800				$41,800
P3478	6	8	315	$120 /LF	$37,900				$37,900
P3493	6	8	738	$120 /LF	$88,600				$88,600
P3498	6	8	280	$120 /LF	$33,600				$33,600
P4708	6	8	1759	$120 /LF	$211,100				$211,100
P5038	-	6	248	$120 /LF	$29,700				$29,700
				TOTAL COST	$13,458,200	$7,547,100	$3,936,300	$1,128,700	$846,100
				Average per Year Cost per Phase		$1,509,420	$787,260	$225,740	$169,220

TOTAL COST PER PHASE	$7,547,100	$3,936,300	$1,128,700	$846,100

CCWD Ebbetts Pass Water Master Plan
Recommended Distribution System Emergency Generator Improvements

Pumping Station	Lead Pump HP	Lag Pump HP	Recommended Generator Size (KW)	Total Cost	Phase I	Phase II	Phase III	Phase IV
Larkspur (Forest Meadows)	50	N/A	70	$35,000		$35,000		
Timber Trails	15	N/A	20	$21,000			$21,000	
Avery	200	200	600	$137,000	$137,000			
Big Trees 1	15	15	60	$30,000		$30,000		
Dorrington	30	30	120	$45,000	$45,000			
Big Trees 4&5	5	3	20	$21,000		$21,000		
				Total Cost Per Phase	**$182,000**	**$86,000**	**$21,000**	**$0**

Costs include weatherproof enclosure panel and 12-hour fuel tank (24-hr for 12 KW unit).

	Year 1	Year 2	Year 3	Year 4	Year 5
Larkspur (Forest Meadows)					
Timber Trails					
Avery	$137,000				
Big Trees 1					
Dorrington					$45,000
Big Trees 4&5					
PROJECT COST PER YEAR	$ 137,000	$ -	$ -	$ -	$ 45,000
GRAND TOTAL PHASE 1	$ 182,000				

P1796	4	8 P1796	P1796	573	$	68,754
P276	2	8 P276	P276	213	$	25,610
P281	2	8 P281	P281	168	$	20,124
P2836	2	8 P2836	P2836	286	$	34,373
P286	2	8 P286	P286	481	$	57,679
P2953	6	8 P2953	P2953	1362	$	163,410
P2983	6	8 P2983	P2983	959	$	115,129
P301	2	8 P301	P301	400	$	47,941
P3028	6	8 P3028	P3028	1273	$	152,730
P316	2	8 P316	P316	140	$	16,793
P3308	4	8 P3308	P3308	173	$	20,701
P3318	4	8 P3318	P3318	197	$	23,586
P3323	4	8 P3323	P3323	516	$	61,952
P3328	4	8 P3328	P3328	472	$	56,604
P3338	4	8 P3338	P3338	545	$	65,372
P3348	4	8 P3348	P3348	265	$	31,750
P3353	4	8 P3353	P3353	594	$	71,252
P3398	6	8 P3398	P3398	476	$	57,152
P3403	2	8 P3403	P3403	548	$	65,796
P346	2	8 P346	P346	81	$	9,709
P3538	6	8 P3538	P3538	121	$	14,514
P441	2	8 P441	P441	206	$	24,756
P4723	4	8 P4723	P4723	1196	$	143,524
P4798	4	8 P4798	P4798	243	$	29,158

Appendix B. Fireflow Report.

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results											
Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J0005	5.27	239.65	1,000	1.4	956.4	20.01	J0005	8.56	206.59	1000	890.99
J0010	0	8.61	1,000	5.82	-523.24	20	J0010	Limiting Node - excluded from scenario			
J0015	0	168.16	1,500	-250.56	789.46	20.01	J0015	0	135.12	1500	882.43
J0020	0	146.52	1,500	-250.99	734.58	20.01	J0020	645.83	113.51	1500	1559.1
J0025	2.34	146.55	1,500	-235.85	753.67	20.01	J0025	3.8	114.04	1500	944.48
J0030	0	13.87	1,000	12.92	-2,727.12	19.93	J0030	Limiting Node - excluded from scenario			
J0035	0	8.66	1,000	8.26	-4,575.27	19.79	J0035	Limiting Node - excluded from scenario			
J0040	0	178.42	1,000	167.67	7,452.48	20.56	J0040	0	157.41	1000	7462.06
J0045	8.2	146.56	1,500	-232.07	763.89	20.01	J0045	13.32	114.17	1500	961.14
J0050	0	198.96	1,500	-109.17	1,069.04	20.01	J0050	0	168.92	1500	1108.38
J0055	2.93	188.3	1,500	-94.98	1,085.23	20.01	J0055	4.76	159.1	1500	1185.81
J0060	0	169.24	1,000	43.59	1,117.96	20.01	J0060	0	141.2	1000	1314.79
J0065	0	169.18	1,000	41.05	1,103.51	20.01	J0065	0	141.15	1000	1309.99
J0070	0	169.12	1,500	-79.2	1,086.45	20.01	J0070	0	141.08	1500	1304.05
J0075	2.93	135.98	1,000	64.72	1,391.79	20.02	J0075	4.76	111.43	1000	1449.39
J0080	2.93	129.47	1,000	56.18	1,313.09	20.02	J0080	4.76	104.92	1000	1379.07
J0085	2.93	90.39	1,000	-4,408.15	103.82	20	J0085	4.76	65.92	1000	1379.07
J0090	4.1	109.91	1,000	21.5	1,015.19	20.01	J0090	6.66	85.37	1000	1182.88
J0095	2.93	77.38	1,000	-26.98	678.08	20	J0095	4.76	52.86	1000	1039.91
J0100	4.69	81.69	1,000	-34.46	869.67	20	J0100	7.62	57.19	1000	1042.77
J0105	0	101.19	1,000	-22.36	766.69	20.01	J0105	0	76.69	1000	1035.15
J0110	2.93	81.68	1,000	-43.84	638.46	20	J0110	4.76	57.19	1000	1013.54
J0115	3.52	99	1,000	-33.35	726.69	20.01	J0115	5.72	74.51	1000	1014.51
J0120	1.18	107.74	1,000	10.47	936.03	20.01	J0120	1.92	83.19	1000	1177.36
J0125	4.1	96.91	1,000	-10.71	809.06	20.01	J0125	6.66	72.35	1000	1087.39
J0130	4.69	103.41	1,000	-2.78	860.44	20.01	J0130	7.62	78.84	1000	1183.07
J0135	4.69	103.41	1,000	-13.95	809.44	20.01	J0135	7.62	78.85	1000	1025.34
J0140	0	111.16	1,000	66.31	1,647.26	20.03	J0140	0	88.18	1000	1878.9
J0145	0	109.2	1,000	67.56	1,715.74	20.03	J0145	0	86.4	1000	1998.23
J0150	1.18	122.6	1,000	85.76	2,069.77	20.04	J0150	1.92	100.17	1000	2267.45
J0155	1.18	144.27	1,000	103.88	2,162.78	20.05	J0155	1.92	121.83	1000	2267.44
J0160	0	110.65	1,000	86.07	2,644.97	20.07	J0160	0	88.78	1000	3364.32
J0165	0	129.19	1,000	118.77	12,369.33	21.53	J0165	0	107.85	1000	8668.64
J0170	0	174.04	1,000	163.3	14,743.98	22.17	J0170	0	153.03	1000	8735.26
J0175	0	200.65	1,000	-23.77	873.37	20.01	J0175	0	167.6	1000	882.43
J0180	0	178.42	1,000	167.67	2,487.41	20.06	J0180	0	157.42	1000	2487.82
J0185	0	5.99	1,000	5.96	-33,739.81	8.62	J0185	Limiting Node - excluded from scenario			
J0190	0	5.99	1,000	5.95	-1,538.41	19.98	J0190	Limiting Node - excluded from scenario			
J0195	1.76	94.29	1,500	88.65	15,201.26	22.31	J0195	2.86	92.31	1500	8795.15
J0200	1.18	78.74	1,500	72.47	11,201.15	21.25	J0200	1.92	76.79	1500	7100.16
J0205	1.18	80.9	1,000	73.91	4,711.07	20.22	J0205	1.92	78.96	1000	4692.31
J0210	3.52	71.68	1,500	65.47	9,217.63	20.85	J0210	5.72	69.79	1500	5811.43
J0215	12.3	60.21	1,000	-1.64	757.11	20.01	J0215	19.98	60.22	1000	1214.56
J0220	7.03	55.76	1,000	-11.51	656.16	20	J0220	11.42	55.87	1000	1176.18
J0225	8.2	53.69	1,000	-18.08	606.69	20	J0225	13.32	53.7	1000	1178.08
J0230	7.61	44.92	1,000	-32.3	472.91	20	J0230	12.36	45.04	1000	1107.75
J0235	15.23	44.51	1,000	-30.35	472.62	20	J0235	24.74	44.82	1000	1028.01
J0240	6.45	42.39	1,000	-33.27	434.15	20	J0240	10.48	42.66	1000	983.31
J0245	9.95	46.71	1,000	-44.35	448.75	20	J0245	16.16	46.98	1000	989
J0250	7.03	27.21	1,000	-74.94	162.84	20	J0250	Limiting Node - excluded from scenario			
J0255	6.45	33.71	1,000	-66.54	264.11	20	J0255	Limiting Node - excluded from scenario			
J0260	0	8.68	1,000	-106.19	0	20	J0260	Limiting Node - excluded from scenario			
J0265	5.86	8.68	1,000	-105.21	-383.84	20	J0265	Limiting Node - excluded from scenario			
J0270	2.34	60.61	1,500	54.54	7,739.19	20.6	J0270	3.8	58.78	1500	6192.86
J0275	3.52	75.48	1,000	71.99	13,854.59	21.92	J0275	5.72	73.78	1000	9427.32
J0280	2.93	58.36	1,500	52.26	7,207.49	20.52	J0280	4.76	56.55	1500	6327.56
J0285	0	53.8	1,500	47.64	6,205.94	20.39	J0285	0	52.04	1500	6116.14
J0290	0	57.42	1,000	53.46	6,277.90	20.39	J0290	0	55.82	1000	6198.67
J0295	0	56.75	1,000	53.42	7,244.54	20.52	J0295	0	55.31	1000	7148.04
J0300	1.18	58.4	1,000	55.71	13,021.16	21.7	J0300	1.92	57.08	1000	10340.87
J0305	1.76	66.29	1,000	64.81	18,334.53	23.36	J0305	2.86	65.58	1000	13699.33
J0310	1.76	61.96	1,000	60.4	15,045.09	22.26	J0310	2.86	61.24	1000	13699.33
J0315	2.34	18.63	1,000	-11.49	-170.45	20	J0315	Limiting Node - excluded from scenario			
J0400	0	80	1,000	-23.77	873.37	20.01	J0400	0	80	1000	882.44
J0405	14.06	64.83	1,000	-41.61	834.57	20.01	J0405	22.84	64.83	1000	1456.41
J0410	4.69	69.17	1,000	-40.09	832.56	20.01	J0410	7.62	69.17	1000	889.88
J0500	4.69	100	1,000	-47.37	794.14	20.01	J0500	7.62	100	1000	890.06
J0505	2.93	100	1,000	-52.08	782.19	20.01	J0505	4.76	100	1000	845.69
J0510	5.86	69.67	1,000	-101.46	646.67	20	J0510	9.52	69.66	1000	729.36
J0515	0.58	41.5	1,000	-172.66	490.42	20	J0515	0.94	41.5	1000	540.14
J0600	2.34	90	1,000	-58.78	736.92	20.01	J0600	3.8	90	1000	917.06
J0605	2.34	46.67	1,000	-123.14	529.73	20	J0605	3.8	46.67	1000	736.8
J0610	5.27	81.33	1,000	-79.1	684.18	20	J0610	8.56	81.33	1000	805.21
J0615	5.27	46.67	1,000	-142.13	509.35	20	J0615	8.56	46.66	1000	646.76
J0700	0	120.07	1,000	-28.55	862.87	20.01	J0700	0	119.74	1000	862.63
J0705	0	120.03	1,000	103.36	1,719.49	20.03	J0705	0	119.7	1000	1719.67
J0710	2.73	135.06	1,000	118.48	3,646.22	20.13	J0710	4.43	134.73	1000	2352.22
J0715	0	135.06	1,000	118.26	3,584.64	20.13	J0715	0	134.73	1000	2347.8
J0725	11.32	129.87	1,000	115.42	3,771.46	20.14	J0725	18.39	129.53	1000	2300.71
J0730	5.86	100.11	1,000	85.16	2,771.87	20.08	J0730	9.52	99.78	1000	2293.78
J0735	10.55	89.24	1,000	75.89	2,854.08	20.07	J0735	17.14	88.94	1000	2268.3
J0740	4.29	108.8	1,000	94.83	3,193.57	20.1	J0740	6.97	108.48	1000	2245.52
J0745	17.97	110.3	1,000	94.45	3,055.10	20.09	J0745	29.19	109.95	1000	2242.95
J0750	4.29	67.19	1,000	53.33	2,010.04	20.04	J0750	6.97	67.02	1000	1929.9
J0755	15.62	71.58	1,000	60.89	2,460.19	20.06	J0755	25.37	71.46	1000	2248.31
J0760	0	6.5	1,000	6.24	-7,791.44	19.39	J0760	Limiting Node - excluded from scenario			
J0765	0	4.33	1,000	-7.15	-1,195.23	19.99	J0765	Limiting Node - excluded from scenario			
J0770	1.95	23.83	1,000	-265.66	96.82	20	J0770	Limiting Node - excluded from scenario			
J0775	0	36.83	1,000	-2.15	633.62	20	J0775	0	36.83	1000	630.78
J0800	1.18	64.88	1,000	57	3,924.39	20.15	J0800	1.92	63.92	1000	2388.2
J0805	5.08	88.71	1,000	79.76	4,103.16	20.17	J0805	8.25	87.75	1000	2469.05

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results											
Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J0810	7.81	90.33	1,000	76.6	3,528.58	20.12	J0810	12.69	89.45	1000	2751.73
J0815	13.28	65.93	1,000	50.18	2,760.42	20.08	J0815	21.57	65.16	1000	2749.27
J0820	2.73	52	1,000	52	3,158.86	20.1	J0820	4.43	52	1000	2218.51
J0825	7.42	44.6	1,000	14.86	959.37	20.01	J0825	12.05	44.11	1000	947.42
J0830	3.13	58.59	1,000	14.83	969.37	20.01	J0830	5.08	58.45	1000	940.45
J0835	15.23	80.28	1,000	69.85	3,401.60	20.11	J0835	24.74	79.29	1000	2473.47
J0840	2.73	86.77	1,000	71.37	2,777.18	20.08	J0840	4.43	85.77	1000	2453.16
J0845	6.64	82.43	1,000	62.51	2,185.56	20.05	J0845	10.78	81.42	1000	2116.62
J0850	13.28	80.26	1,000	54.24	1,755.03	20.03	J0850	21.57	79.24	1000	1740.5
J0855	8.59	110.59	1,000	73.37	1,741.68	20.03	J0855	13.95	109.57	1000	1730.62
J0860	3.9	106.48	1,000	94.34	3,525.46	20.12	J0860	6.33	105.52	1000	2450.47
J0865	16.01	91.39	1,000	80.03	3,366.45	20.11	J0865	26	90.43	1000	2467.76
J0870	7.03	89.04	1,000	80.05	3,246.71	20.1	J0870	11.42	88.87	1000	2371.81
J0875	0	40	1,000	40	2,818.56	20.08	J0875	0	40	1000	2284.31
J0900	0	16.09	1,000	16.01	-5,270.78	19.72	J0900	Limiting Node - excluded from scenario			
J0905	0	31.3	1,000	31.05	6,369.99	20.41	J0905	0	31.29	1000	6454.6
J0910	2.34	59.59	1,000	58.94	8,104.03	20.66	J0910	3.8	59.55	1000	6882.04
J0915	3.13	53.15	1,000	52.31	6,605.53	20.44	J0915	5.08	53.11	1000	6619.2
J0920	19.92	73.19	1,000	71.32	5,933.83	20.35	J0920	32.35	73.08	1000	5722.52
J0925	7.42	97.03	1,000	91.64	4,215.63	20.16	J0925	12.05	96.91	1000	4208.41
J0930	7.81	58.59	1,000	56.77	4,723.63	20.22	J0930	12.69	58.45	1000	4518.57
J0935	3.52	99.57	1,000	97.11	6,487.75	20.42	J0935	5.72	99.44	1000	5263.29
J0940	2.34	114.66	1,000	112.01	6,988.19	20.49	J0940	3.8	114.53	1000	5528.04
J0945	1.56	101.66	1,000	97.7	5,149.31	20.27	J0945	2.53	101.53	1000	5145.72
J0950	8.2	98.89	1,000	96.28	7,015.80	20.49	J0950	13.32	98.8	1000	6295.65
J0955	1.95	83.72	1,000	79.07	4,402.25	20.19	J0955	3.17	83.64	1000	4404.06
J0960	15.62	70.47	1,000	68.76	7,792.19	20.6	J0960	25.37	70.41	1000	7792.96
J0965	7.03	57.34	1,000	56.45	8,193.72	20.67	J0965	11.42	57.31	1000	8232.65
J1000	2.34	55	1,000	-49.56	758.03	20.01	J1000	3.8	55	1000	951.62
J1005	1.76	54.99	1,000	-57.74	738.88	20.01	J1005	2.86	54.97	1000	950.68
J1010	2.34	52.8	1,000	-77.64	695.61	20	J1010	3.8	52.74	1000	845.38
J1015	2.34	59.29	1,000	-74.99	711.55	20.01	J1015	3.8	59.24	1000	845.38
J1020	1.76	41.95	1,000	-99.72	636.49	20	J1020	2.86	41.88	1000	688.82
J1025	1.76	39.78	1,000	-104.84	624.01	20	J1025	2.86	39.71	1000	659.68
J1030	1.18	39.78	1,000	-114.34	601.82	20	J1030	1.92	39.71	1000	587.77
J1035	18.16	109.08	1,000	-102.52	748.04	20.01	J1035	29.5	108.91	1000	686.43
J1040	2.34	126.39	1,000	-97.79	756.5	20.01	J1040	3.8	126.25	1000	660.62
J1100	0	75	1,000	39.98	1,077.24	20.01	J1100	0	75	1000	1108.37
J1105	2.93	75	1,000	38.76	1,074.93	20.01	J1105	4.76	75	1000	1113.13
J1110	1.18	85.83	1,000	29.87	1,034.69	20.01	J1110	1.92	85.83	1000	1110.28
J1115	2.93	92.33	1,000	46.24	1,096.25	20.01	J1115	4.76	92.33	1000	1113.12
J1120	4.69	85.83	1,000	16.61	993.86	20.01	J1120	7.62	85.83	1000	1116
J1200	1.18	73	1,000	24.24	1,016.04	20.01	J1200	1.92	73	1000	1404.57
J1205	12.89	60	1,000	39.55	1,095.19	20.01	J1205	20.94	60	1000	1201.95
J1210	2.93	107.66	1,000	-4.76	939.63	20.01	J1210	4.76	107.66	1000	977.28
J1300	4.1	36.83	1,000	-2.15	637.72	20	J1300	6.66	36.83	1000	637.44
J1305	0	210.15	1,000	84.83	1,252.82	20.02	J1305	0	210.15	1000	630.78
J1400	0	100	1,000	41.05	1,103.51	20.01	J1400	0	100	1000	1309.99
J1405	2.93	73.98	1,000	-3.07	898.48	20.01	J1405	4.76	73.94	1000	1314.74
J1410	0.58	102.1	1,000	-7.36	901.98	20.01	J1410	0.94	102.02	1000	996.69
J1415	17.58	143.23	1,000	-30.26	686.8	20.01	J1415	28.55	143.09	1000	1024.18
J1500	0.58	90	1,000	-7.36	901.98	20.01	J1500	0.94	90	1000	996.69
J1505	1.76	59.67	1,000	-55.86	740.39	20.01	J1505	2.86	59.66	1000	844.62
J1510	5.86	107.32	1,000	-112.92	713.84	20.01	J1510	9.52	107.31	1000	739.43
J1600	2.93	82.18	1,000	-2.92	853.98	20.01	J1600	4.76	76.67	1000	1091.66
J1605	2.93	108.16	1,000	19.95	1,002.57	20.01	J1605	4.76	102.67	1000	1099.25
J1610	2.93	82.16	1,000	-3.95	848.71	20.01	J1610	4.76	76.67	1000	1090.05
J1615	2.93	75.67	1,000	-5.77	826.51	20.01	J1615	4.76	70.18	1000	1085.52
J1620	0.58	80	1,000	0.02	863.38	20.01	J1620	0.94	74.51	1000	1077.62
J1625	4.1	88.66	1,000	8.94	929.55	20.01	J1625	6.66	83.18	1000	1011.06
J1630	0	84.33	1,000	6.65	907.17	20.01	J1630	0	78.84	1000	983.75
J1635	2.34	69.16	1,000	-30.73	702.68	20	J1635	3.8	63.68	1000	882.97
J1640	1.76	84.33	1,000	-28.22	752.7	20.01	J1640	2.86	78.84	1000	882.02
J1645	1.76	58.33	1,000	-51.92	597.54	20	J1645	2.86	52.84	1000	850.8
J1705	0	78.45	1,000	46.89	1,293.75	20.02	J1705	0	78.49	1000	1668.87
J1710	7.81	100.11	1,000	38.53	1,134.84	20.01	J1710	12.36	100.14	1000	1496.63
J1715	12.89	67.46	1,000	-15.98	791.39	20.01	J1715	20.94	67.64	1000	1491.37
J1717	2.14	186.52	1,000	128.85	2,231.65	20.05	J1717	3.48	182.91	1000	1467.63
J1720	7.03	47.81	1,000	-132.74	372.37	20	J1720	11.42	48.13	1000	1368.08
J1725	5.86	75.96	1,000	-241.91	397.75	20	J1725	9.52	76.3	1000	1366.18
J1730	13.47	34.74	1,000	-243.97	204.57	20	J1730	Limiting Node - excluded from scenario			
J1735	2.93	45.57	1,000	-284.74	244.62	20	J1735	4.76	45.96	1000	1121.11
J1740	2.93	52.07	1,000	-277.26	279.46	20	J1740	4.76	52.46	1000	1137.38
J1800	0	67	1,000	67	1,715.74	20.03	J1800	0	67	1000	1998.23
J1805	10.55	110.1	1,000	65.31	1,318.42	20.02	J1805	17.14	110.21	1000	2135.35
J1810	8.79	68.93	1,000	-16.37	740.94	20.01	J1810	14.28	69.03	1000	1046
J1900	2.93	80	1,000	65.31	1,310.80	20.02	J1900	4.76	80	1000	2122.97
J1905	35.15	62.52	1,000	-16.15	829.74	20.01	J1905	57.09	62.59	1000	1675.69
J1910	4.69	51.68	1,000	-44	595.22	20	J1910	7.62	51.76	1000	1312.89
J2005	0	138.31	1,000	-6,277.69	194.43	20	J2005	0	137.98	1000	195.68
J2010	15.36	133.95	1,000	53.5	1,207.05	20.01	J2010	24.95	133.62	1000	1206.68
J2015	2.38	28.11	1,000	10.56	689.48	20	J2015	Limiting Node - excluded from scenario			
J2020	11.81	56.26	1,000	-10.57	734.76	20.01	J2020	19.18	56.14	1000	731.94
J2100	0	4.2	1,000	4.1	-27,232.58	12.58	J2100	Limiting Node - excluded from scenario			
J2105	0	4.16	1,000	3.91	-996.03	19.99	J2105	0	4	1000	-1370.1
J2110	0	233.7	1,000	216.93	2,631.75	20.07	J2110	0	195.95	1000	2631.66
J2115	0	233.65	1,000	216.92	7,872.31	20.62	J2115	0	195.85	1000	7885.48
J2120	0	231.31	1,000	214.57	12,489.14	21.56	J2120	0	193.64	1000	20462.16
J2125	0	169.39	1,000	153.57	9,998.76	21	J2125	0	140.56	1000	19656.46
J2130	0	166.48	1,000	150.79	9,907.87	20.98	J2130	0	138.19	1000	19599.65
J2135	0	127.3	1,000	115.84	9,398.36	20.88	J2135	0	110.24	1000	18469.49

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results

Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J2140	2.87	87.49	1,000	82.18	10,255.45	21.05	J2140	4.68	80.56	1000	22830.61
J2145	0.36	93.99	1,000	81.68	3,362.32	20.11	J2145	0.59	87.04	1000	2643.71
J2150	0.72	74.49	1,000	59.36	2,277.90	20.05	J2150	1.17	67.54	1000	2279.57
J2155	1.8	87.49	1,000	74.15	2,919.01	20.09	J2155	2.92	80.54	1000	2421.87
J2160	1.8	70.16	1,000	55.09	2,163.25	20.05	J2160	2.92	63.2	1000	2162.47
J2165	1.8	83.16	1,000	68.8	2,298.21	20.05	J2165	2.92	76.2	1000	2257.28
J2170	0	17.24	1,000	18.01	-1,507.15	19.98	J2170	Limiting Node - excluded from scenario			
J2200	0	45	1,000	45	9,907.88	20.98	J2200	0	45	1000	12809.76
J2205	0	71	1,000	64.31	2,998.62	20.09	J2205	0	71	1000	2899.44
J2210	1.8	71	1,000	60.65	2,370.46	20.06	J2210	2.92	71	1000	2371.14
J2215	1.8	75.33	1,000	67.47	2,874.78	20.08	J2215	2.92	75.33	1000	2876.14
J2300	0	90	1,000	90	9,398.35	20.88	J2300	0	110.24	1000	18469.44
J2305	3.24	118.16	1,000	107.34	3,333.67	20.11	J2305	5.26	138.38	1000	2708.2
J2310	1.8	118.16	1,000	98.77	2,417.71	20.06	J2310	2.92	138.38	1000	2603.28
J2315	3.96	115.96	1,000	73.5	1,595.25	20.03	J2315	6.43	136.18	1000	1366.58
J2320	1.8	120.31	1,000	54.46	1,259.81	20.02	J2320	2.92	140.52	1000	1297.17
J2325	2.16	122.48	1,000	34.15	1,249.68	20.02	J2325	3.51	142.68	1000	1207.76
J2330	0.72	98.48	1,000	6.15	925.10	20.01	J2330	1.17	116.69	1000	1029.34
J2335	1.44	98.64	1,000	35.4	1,127.80	20.01	J2335	2.34	118.85	1000	1052.57
J2340	1.08	74.81	1,000	-1.36	856.96	20.01	J2340	1.75	95.02	1000	953.24
J2345	1.08	87.81	1,000	-4.5	846.24	20.01	J2345	1.75	108.02	1000	953.84
J2350	0.72	72.65	1,000	-13.61	784.43	20.01	J2350	1.17	92.85	1000	890.61
J2355	1.8	109.48	1,000	29.76	1,083.35	20.01	J2355	2.92	129.68	1000	1013.10
J2400	0	8.43	1,000	8.26	-3,008.46	19.91	J2400	Limiting Node - excluded from scenario			
J2405	0	8.41	1,000	8.23	-1,525.76	19.98	J2405	Limiting Node - excluded from scenario			
J2410	0	313.53	1,000	279.47	2,882.22	20.08	J2410	0	267.82	1000	2882.1
J2415	0	313.52	1,000	279.41	5,887.74	20.32	J2415	0	267.81	1000	3388.42
J2420	2.01	300.47	1,000	265.37	8,596.38	20.74	J2420	3.26	254.54	1000	3390.87
J2425	0	295.44	1,000	260.46	8,163.42	20.67	J2425	0	249.48	1000	3406.4
J2430	0	303.8	1,000	268.61	8,207.34	20.67	J2430	0	257.98	1000	3415.39
J2435	1.6	306.05	1,000	270.76	8,238.00	20.68	J2435	2.6	260.14	1000	3418.29
J2440	0	323.46	1,000	283.85	6,793.68	20.48	J2440	0	278.85	1000	3923.06
J2445	0	372.94	1,000	325.62	5,547.67	20.31	J2445	0	332.58	1000	3735.04
J2450	0	365.44	1,000	317.79	5,120.22	20.26	J2450	0	327.66	1000	3887.51
J2455	0	338.03	1,000	292.86	4,522.96	20.2	J2455	0	303.22	1000	3619.67
J2460	0	288.48	1,000	249.68	3,948.03	20.16	J2460	0	258.79	1000	3134.37
J2465	0	268.47	1,000	238.1	3,875.62	20.15	J2465	0	244.32	1000	2947.27
J2470	0	200.96	1,000	174.76	3,486.58	20.12	J2470	0	181.4	1000	2889.01
J2475	0	149.01	1,000	127.05	3,144.59	20.1	J2475	0	132.42	1000	2549.67
J2480	0	146.14	1,000	127.31	3,446.85	20.12	J2480	0	131.23	1000	2433.99
J2485	0	119.52	1,000	103.66	3,273.75	20.11	J2485	0	106.85	1000	2363.25
J2490	0	108.88	1,000	89.16	1,846.68	20.03	J2490	0	96	1000	1321.96
J2495	0	117.35	1,000	74.21	1,642.35	20.03	J2495	0	104.88	1000	1321.98
J2500	1.2	106.51	1,000	62.11	1,598.86	20.02	J2500	1.95	93.82	1000	1234.24
J2505	1.6	91.36	1,000	31.17	1,111.56	20.01	J2505	2.6	78.66	1000	1032.53
J2510	0	104.34	1,000	33.44	1,118.23	20.01	J2510	0	91.64	1000	1049.07
J2515	0	231.17	1,000	224.7	12,289.35	21.51	J2515	0	223.91	1000	4162.71
J2520	0.4	316.84	1,000	294.5	8,101.31	20.66	J2520	0.65	286.88	1000	8181.76
J2525	0.8	326.51	1,000	295.4	7,914.31	20.63	J2525	1.3	293.74	1000	8169.23
J2530	0	333.41	1,000	300.72	7,941.71	20.63	J2530	0	299.35	1000	8243.62
J2535	2.01	323.35	1,000	291.77	7,730.78	20.6	J2535	3.26	290.57	1000	8024.81
J2540	0.8	318.23	1,000	287.75	7,622.76	20.58	J2540	1.3	287.06	1000	7902.68
J2545	0	316.91	1,000	286.87	7,594.10	20.58	J2545	0	286.32	1000	7866.14
J2550	0	314.4	1,000	285.58	7,546.88	20.57	J2550	0	284.93	1000	7718.35
J2555	0	283.64	1,000	288.85	7,394.25	20.53	J2555	888.89	287.61	1000	7542.74
J2560	0	286.71	1,000	263.8	7,281.11	20.53	J2560	0	263.04	1000	7176.36
J2565	1.2	267.86	1,000	247.74	7,156.67	20.51	J2565	1.95	247.05	1000	2752.09
J2570	0	270.03	1,000	246.46	6,457.25	20.42	J2570	0	219.21	1000	2750.14
J2575	3.62	262.96	1,000	243.29	7,111.77	20.51	J2575	5.88	242.6	1000	2737.13
J2580	0	262.96	1,000	241.19	6,964.27	20.37	J2580	0	242.5	1000	2731.38
J2585	2.82	252.88	1,000	234.38	7,047.45	20.5	J2585	4.58	233.66	1000	2686.45
J2590	2.01	238.71	1,000	221.16	6,909.88	20.48	J2590	3.26	220.44	1000	2648.16
J2595	0	236.51	1,000	214.38	5,199.16	20.27	J2595	0	218.18	1000	2644.9
J2600	2.42	220.33	1,000	203.69	6,710.28	20.45	J2600	3.93	202.98	1000	2613.25
J2605	5.62	218.14	1,000	205.42	7,382.34	20.54	J2605	9.13	204.84	1000	2484.54
J2610	0	185.4	1,000	145.28	2,507.02	20.08	J2610	0	172	1000	1657.37
J2615	0	165.82	1,000	117.12	2,045.94	20.04	J2615	0	152.45	1000	1522.3
J2620	0	159.13	1,000	88.51	1,556.44	20.02	J2620	0	145.84	1000	1277.9
J2625	1.2	111.33	1,000	24.66	1,037.31	20.01	J2625	1.95	98.00	1000	1156.13
J2630	5.22	93.99	1,000	-11.03	805.59	20.01	J2630	8.48	80.75	1000	1056.08
J2635	2.01	65.82	1,000	-50.48	554.42	20	J2635	3.26	52.58	1000	874.77
J2640	6.44	65.82	1,000	-51.21	356.8	20	J2640	10.46	52.58	1000	873.31
J2645	2.42	87.48	1,000	-59.08	624.02	20	J2645	3.93	74.24	1000	868.88
J2650	2.01	218.1	1,000	205.42	7,366.41	20.55	J2650	3.26	204.64	1000	2482.48
J2655	4.82	217.48	1,000	205.39	7,336.87	20.57	J2655	7.83	204.61	1000	2559.72
J2660	1.2	217.42	1,000	205.38	7,562.62	20.57	J2660	1.95	204.61	1000	2556.01
J2665	0	257.2	1,000	248.56	10,120.04	21.03	J2665	0	247.79	1000	3198.19
J2670	0	261.89	1,000	252.9	10,617.29	21.13	J2670	0	252.12	1000	3335
J2675	0	269.5	1,000	261.56	11,297.92	21.28	J2675	0	260.77	1000	3489.94
J2700	10.86	55	1,000	55	8,247.28	20.88	J2700	17.64	55	1000	3433.32
J2705	6.7	130.83	1,000	108.42	2,385.79	20.06	J2705	10.88	130.82	1000	2386.45
J2707	0	97.4	1,000	-74.11	518.7	20	J2707	Limiting Node - excluded from scenario			
J2800	4.02	116.53	1,000	104.61	3,353.75	20.11	J2800	6.53	116.35	1000	3228.17
J2805	2.01	125.6	1,000	118.20	5,050.18	20.25	J2805	3.26	125.02	1000	3225.98
J2810	3.22	100	1,000	100	8,275.52	20.66	J2810	5.23	100	1000	3420.92
J2815	5.62	175.16	1,000	162.78	4,671.81	20.22	J2815	9.13	174.19	1000	2394.26
J2820	4.02	162.16	1,000	140.42	3,019.79	20.09	J2820	6.53	161.19	1000	2391.67
J2825	2.01	220.41	1,000	203.83	4,452.72	20.2	J2825	3.26	219.08	1000	1064.34
J2830	4.82	211.27	1,000	184.06	3,300.25	20.11	J2830	7.83	209.24	1000	1519.14
J2835	0	203.6	1,000	171.47	2,990.59	20.09	J2835	0	200.58	1000	1511.31
J2840	2.42	122.96	1,000	89.22	1,875.81	20.04	J2840	3.93	120.76	1000	1158.23

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results

Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J2845	0.8	104.34	1,000	65.8	1,596.53	20.03	J2845	1.3	101.2	1000	1102.67
J2850	0.8	84.8	1,000	41.5	1,288.98	20.02	J2850	1.3	81.61	1000	1027.9
J2855	2.42	67.43	1,000	18.62	959.75	20.01	J2855	3.93	64.17	1000	900.93
J2860	0	71.76	1,000	19.81	994.83	20.01	J2860	0	68.5	1000	897
J2865	2.01	39.24	1,000	-13.05	484.88	20	J2865	Limiting Node - excluded from scenario			
J2870	8.44	37.07	1,000	-15.62	452.11	20	J2870	Limiting Node - excluded from scenario			
J2875	6.84	43.56	1,000	-10.79	549.14	20	J2875	Limiting Node - excluded from scenario			
J2880	3.62	45.71	1,000	-11.58	563.14	20	J2880	Limiting Node - excluded from scenario			
J2885	0.4	50.04	1,000	-8.3	613.59	20	J2885	Limiting Node - excluded from scenario			
J2890	2.01	63.03	1,000	-0.27	739.87	20.01	J2890	Limiting Node - excluded from scenario			
J2895	0.4	56.53	1,000	-7.45	662.76	20	J2895	Limiting Node - excluded from scenario			
J2900	0.4	69.53	1,000	5.42	800.06	20.01	J2900	Limiting Node - excluded from scenario			
J2905	1.6	67.36	1,000	3	777.91	20.01	J2905	Limiting Node - excluded from scenario			
J3000	2.01	67.36	1,000	10.35	829.29	20.01	J3000	Limiting Node - excluded from scenario			
J3005	3.22	84.68	1,000	25.86	1,079.73	20.01	J3005	5.23	81.31	1000	877.06
J3010	1.6	93.35	1,000	29.32	1,100.78	20.01	J3010	2.6	89.97	1000	874.42
J3015	1.2	91.18	1,000	27.6	1,086.59	20.01	J3015	1.95	87.81	1000	873.77
J3020	4.42	50.04	1,000	-4.4	639.02	20	J3020	Limiting Node - excluded from scenario			
J3025	3.62	73.84	1,000	17.85	956.34	20.01	J3025	5.88	70.46	1000	863.56
J3030	0	71.64	1,000	20.65	1,016.85	20.01	J3030	0	68.21	1000	897
J3035	6.03	62.98	1,000	7.55	796.22	20.01	J3035	Limiting Node - excluded from scenario			
J3040	3.22	75.98	1,000	7.18	833.41	20.01	J3040	5.23	72.54	1000	769.56
J3045	5.62	65.15	1,000	8.58	811.77	20.01	J3045	Limiting Node - excluded from scenario			
J3050	11.26	69.47	1,000	6.97	820.57	20.01	J3050	18.29	66.04	1000	763.01
J3055	4.42	97.63	1,000	5.76	878.54	20.01	J3055	7.18	94.19	1000	751.9
J3060	3.62	106.3	1,000	0.7	862.9	20.01	J3060	5.88	102.86	1000	750.6
J3100	0	134.94	1,000	110	4,862.92	20.24	J3100	0	134.86	1000	2344.55
J3105	3.22	117.61	1,000	101.84	4,629.36	20.21	J3105	5.23	117.53	1000	4546.06
J3110	4.02	134.94	1,000	114.42	3,372.29	20.11	J3110	6.53	134.85	1000	2140.84
J3115	2.01	134.93	1,000	96.32	1,946.47	20.04	J3115	3.26	134.85	1000	1942.16
J3120	8.84	124.1	1,000	98.97	2,573.20	20.07	J3120	14.36	124.01	1000	1455.65
J3125	4.82	98.1	1,000	70.24	1,896.30	20.04	J3125	7.83	98.01	1000	1368.7
J3130	2.82	106.77	1,000	43.83	1,194.96	20.01	J3130	4.58	106.67	1000	1186.41
J3135	3.22	69.94	1,000	9.18	901	20.01	J3135	5.23	69.84	1000	892.13
J3140	4.02	89.45	1,000	69.87	3,492.97	20.12	J3140	6.53	89.38	1000	3384.19
J3145	6.44	95.97	1,000	90.57	4,671.99	20.22	J3145	10.46	95.92	1000	2805.89
J3150	4.02	117.61	1,000	103.71	4,552.62	20.21	J3150	6.53	117.54	1000	4473.99
J3155	6.03	115.44	1,000	96.64	3,160.52	20.1	J3155	9.79	115.37	1000	3166.02
J3160	3.62	117.61	1,000	102.12	4,608.61	20.21	J3160	5.88	117.53	1000	4528.43
J3165	5.22	87.31	1,000	83.34	4,417.42	20.19	J3165	8.48	87.27	1000	2574.71
J3170	8.04	82.97	1,000	27.84	1,083.26	20.01	J3170	13.06	82.92	1000	1081.57
J3175	0	70	1,000	70	3,939.95	20.16	J3175	0	70	1000	2080.08
J3180	0	74.28	1,000	26.22	1,156.21	20.01	J3180	0	74.21	1000	1156.53
J3185	2.82	82.95	1,000	55	3,245.58	20.11	J3185	4.56	82.88	1000	3197.34
J3200	0.4	100	1,000	88.22	2,410.19	20.06	J3200	0.65	100	1000	1305.74
J3205	4.02	108.55	1,000	95.93	2,420.62	20.06	J3205	6.53	108.38	1000	1364.57
J3210	3.22	147.54	1,000	100.83	1,668.46	20.03	J3210	5.23	147.37	1000	1363.27
J3215	19.7	70.91	1,000	48.97	1,518.13	20.02	J3215	32	69.57	1000	1472.84
J3220	8.04	87.88	1,000	57.28	1,534.65	20.02	J3220	13.06	85.01	1000	1493.8
J3225	11.26	100.83	1,000	73.13	1,779.40	20.03	J3225	18.29	98.69	1000	1622.39
J3230	6.03	123.8	1,000	92.85	2,053.74	20.04	J3230	9.79	120.59	1000	2021.63
J3235	7.64	70.95	1,000	57.78	3,198.18	20.1	J3235	12.41	66.51	1000	3140.8
J3240	3.57	40.62	1,000	32	4,005.10	20.16	J3240	5.8	36.18	1000	3827.15
J3245	3.22	109.89	1,000	90.26	3,041.49	20.09	J3245	5.23	105.36	1000	2137.94
J3250	3.22	109.88	1,000	89.72	2,970.13	20.09	J3250	5.23	105.35	1000	2085.31
J3255	4.42	90.38	1,000	60.65	1,796.65	20.03	J3255	7.18	85.85	1000	1510.18
J3260	4.42	75.22	1,000	26.47	1,088.74	20.01	J3260	7.18	70.68	1000	1071.88
J3300	0	134	1,000	123.91	3,782.20	20.14	J3300	0	133.97	1000	3686.33
J3305	16.48	116.67	1,000	108.99	4,031.29	20.16	J3305	26.77	116.64	1000	3826.09
J3310	5.22	114.5	1,000	108.06	4,249.07	20.18	J3310	8.48	114.48	1000	3941.67
J3315	5.22	112.34	1,000	106.51	4,366.69	20.19	J3315	8.48	112.31	1000	3991.35
J3320	4.82	121	1,000	115.77	4,681.71	20.22	J3320	7.83	120.98	1000	4037.37
J3325	10.86	142.67	1,000	138.75	5,436.63	20.29	J3325	17.64	142.65	1000	4217.66
J3330	0	212	1,000	212	6,982.75	20.49	J3330	0	212	1000	6683.74
J3335	0.4	88.51	1,000	81.85	3,621.13	20.13	J3335	0.65	88.48	1000	3510.1
J3340	2.01	125.34	1,000	102.88	2,322.48	20.05	J3340	3.26	125.31	1000	2315.42
J3345	4.02	86.34	1,000	79.76	3,587.12	20.13	J3345	6.53	86.31	1000	3500.14
J3350	6.7	84.17	1,000	71.18	2,406.67	20.06	J3350	10.88	84.14	1000	2395.68
J3355	0.4	84.17	1,000	77.69	3,547.52	20.13	J3355	0.65	84.15	1000	3522.72
J3360	1.2	92.84	1,000	78.34	2,416.96	20.06	J3360	1.95	92.81	1000	2405.8
J3365	2.01	88.51	1,000	82.92	3,991.73	20.16	J3365	3.26	88.48	1000	3777.44
J3370	2.42	103.68	1,000	98.91	4,645.81	20.22	J3370	3.93	103.66	1000	4110.79
J3375	0	21.44	1,000	19.72	902.64	20.01	J3375	Limiting Node - excluded from scenario			
J3400	0	100	1,000	100	8,318.21	20.69	J3400	0	100	1000	3408.4
J3405	6.79	104.24	1,000	95.18	3,497.24	20.12	J3405	11.03	104.25	1000	3419.44
J3410	1.08	106.35	1,000	51.64	1,290.06	20.02	J3410	1.75	106.27	1000	1260.84
J3415	1.43	104.18	1,000	3.48	907.39	20.01	J3415	2.32	104.1	1000	901.46
J3420	1.43	108.51	1,000	47.31	1,229.14	20.02	J3420	2.32	108.42	1000	1217.68
J3425	8.22	138.84	1,000	66.24	1,322.15	20.02	J3425	13.35	138.74	1000	1228.7
J3430	0.71	141	1,000	64.95	1,293.80	20.02	J3430	1.15	140.9	1000	1216.51
J3435	3.57	115.01	1,000	48.26	1,220.31	20.01	J3435	5.8	114.91	1000	1210.11
J3440	2.14	123.67	1,000	37.56	1,110.44	20.01	J3440	3.48	123.56	1000	1100.42
J3445	2.14	123.66	1,000	-43.44	771.36	20.01	J3445	3.48	123.56	1000	766.27
J3450	4.65	145.33	1,000	48.68	1,159.04	20.01	J3450	7.55	145.22	1000	1104.48
J3455	3.22	171.32	1,000	-83.35	755.3	20.01	J3455	5.23	171.21	1000	752.08
J3460	6.79	92.26	1,000	36.36	1,255.07	20.02	J3460	11.03	93.17	1000	1655.83
J3465	7.5	107.38	1,000	58.75	1,650.69	20.03	J3465	12.18	108.33	1000	2101.34
J3470	6.07	79.25	1,000	32.31	1,287.97	20.02	J3470	9.86	80.29	1000	2391.23
J3475	4.28	72.79	1,000	34.04	1,437.77	20.02	J3475	6.95	73.86	1000	3415.35
J3480	6.44	70.48	1,000	30.64	1,339.40	20.02	J3480	10.46	71.53	1000	2540.51
J3485	6.79	59.58	1,000	20.18	1,014.39	20.01	J3485	11.03	60.64	1000	2275.28

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results

Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J3490	3.57	57.22	1,000	16.2	818.17	20.01	J3490	5.8	58.37	1000	1859.11
J3495	5	50.67	1,000	5.91	549.89	20	J3495	8.12	51.83	1000	1677.15
J3500	2.86	39.84	1,000	-13.88	391.11	20	J3500	Limiting Node - excluded from scenario			
J3505	4.65	72.34	1,000	25.97	1,160.65	20.01	J3505	7.55	73.48	1000	1708.24
J3510	3.22	81	1,000	17.45	963.96	20.01	J3510	5.23	82.15	1000	1386.51
J3515	4.28	104.76	1,000	56.43	1,685.42	20.03	J3515	6.95	105.91	1000	1554
J3520	0.71	111.26	1,000	61.73	1,729.27	20.03	J3520	1.15	112.41	1000	1548.2
J3525	2.5	74.37	1,000	31.71	1,361.24	20.02	J3525	4.06	75.53	1000	1404.45
J3530	5.36	61.38	1,000	17.75	922.04	20.01	J3530	8.71	62.55	1000	1396.15
J3535	5.36	83.01	1,000	30.67	1,221.67	20.01	J3535	8.71	84.18	1000	1211.63
J3540	6.44	80.84	1,000	25.12	1,103.28	20.01	J3540	10.46	82.01	1000	1110.52
J3545	2.86	48.34	1,000	-14.32	431.61	20	J3545	4.65	49.51	1000	955.05
J3550	3.22	31.01	1,000	-34.5	228.9	20	J3550	Limiting Node - excluded from scenario			
J3555	0.71	48.34	1,000	-14.54	429	20	J3555	1.15	49.51	1000	947.71
J3560	2.14	44.01	1,000	-29.38	369.56	20	J3560	Limiting Node - excluded from scenario			
J3565	3.57	78.67	1,000	29.28	1,217.44	20.01	J3565	5.8	79.81	1000	1305.76
J3570	3.57	74.34	1,000	32.1	1,390.49	20.02	J3570	5.8	75.47	1000	1572.24
J3575	3.22	91.62	1,000	49.86	1,911.50	20.04	J3575	5.23	92.68	1000	2287.83
J3580	4.28	108.94	1,000	58.58	1,776.05	20.03	J3580	6.95	109.97	1000	2096.21
J3585	4.65	117.6	1,000	67.37	1,915.58	20.04	J3585	7.55	118.63	1000	2214.68
J3590	1.08	115.43	1,000	61.3	1,712.47	20.03	J3590	1.75	116.47	1000	1968.12
J3595	2.86	108.93	1,000	67.79	2,431.64	20.06	J3595	4.65	109.96	1000	2646.7
J3600	1.08	126.24	1,000	86.57	3,297.85	20.11	J3600	1.75	127.24	1000	3146.66
J3605	0	145.74	1,000	110	7,991.60	20.64	J3605	0	146.74	1000	8027.81
J3700	2.14	75	1,000	75	3,298.92	20.11	J3700	3.48	90	1000	3148.39
J3705	5	66.33	1,000	49.77	1,721.11	20.03	J3705	8.12	81.32	1000	1567.46
J3710	1.43	79.32	1,000	50.76	1,491.25	20.02	J3710	2.32	94.31	1000	1228.69
J3715	1.79	92.32	1,000	46.41	1,282.19	20.02	J3715	2.91	107.31	1000	1229.29
J3720	2.14	79.32	1,000	44.77	1,344.92	20.02	J3720	3.48	94.31	1000	1122.55
J3725	4.28	48.99	1,000	-119.31	387.59	20	J3725	6.95	63.98	1000	1059.54
J3730	0.71	94.49	1,000	45.28	1,253.61	20.02	J3730	1.15	109.47	1000	1120.22
J3735	1.43	72.81	1,000	38.52	1,268.51	20.02	J3735	2.32	87.78	1000	1254.56
J3740	3.57	70.64	1,000	29.7	1,127.21	20.01	J3740	5.8	85.61	1000	1153.27
J3745	1.43	68.48	1,000	24.27	1,053.27	20.01	J3745	2.32	83.44	1000	1106.69
J3755	4.28	59.81	1,000	-26.48	659.19	20	J3755	6.95	74.77	1000	780.47
J3760	1.79	77.14	1,000	27.03	1,076.26	20.01	J3760	2.91	92.1	1000	1150.38
J3765	3.22	83.64	1,000	13.94	954.63	20.01	J3765	5.23	98.6	1000	1061.63
J3770	1.43	77.14	1,000	20.29	1,004.09	20.01	J3770	2.32	92.1	1000	1087.79
J3775	1.43	72.8	1,000	-1,930.50	140.31	20	J3775	2.32	87.77	1000	1066.26
J3800	0	150	1,000	150	8,112.43	20.66	J3800	0	150	1000	8191.09
J3805	3.22	161.16	1,000	125.7	3,221.74	20.1	J3805	5.23	158.47	1000	1538.03
J3810	1.79	158.76	1,000	117.06	2,847.34	20.08	J3810	2.91	155.74	1000	1385.98
J3815	2.14	156.57	1,000	111.39	2,576.52	20.07	J3815	3.48	153.53	1000	1365.57
J3820	1.79	150.07	1,000	98.33	2,145.78	20.05	J3820	2.91	147.03	1000	1365
J3825	1.79	150.07	1,000	82.52	1,667.29	20.03	J3825	2.91	147.03	1000	1365
J3830	1.08	173.91	1,000	113.27	2,043.03	20.04	J3830	1.75	170.86	1000	1363.84
J3835	1.08	178.24	1,000	112.68	1,937.72	20.04	J3835	1.75	175.19	1000	1363.84
J3840	1.08	173.91	1,000	107.67	1,887.38	20.04	J3840	1.75	170.86	1000	1363.84
J3845	1.43	160.88	1,000	111.15	2,365.68	20.06	J3845	2.32	157.79	1000	1344.05
J3850	1.79	171.64	1,000	116.48	2,214.84	20.05	J3850	2.91	168.44	1000	1295.52
J3855	7.86	197.58	1,000	142.72	2,458.62	20.06	J3855	12.77	194.29	1000	1262.8
J3860	3.93	154.2	1,000	106.37	2,378.97	20.06	J3860	6.38	150.84	1000	1186.32
J3865	3.93	143.37	1,000	97.24	2,346.76	20.05	J3865	6.38	140.01	1000	1215.93
J3870	0.71	141.18	1,000	92.36	2,173.95	20.05	J3870	1.15	137.79	1000	1145.72
J3875	2.14	143.34	1,000	95.39	2,247.75	20.05	J3875	3.48	139.95	1000	1130.27
J3880	2.5	147.64	1,000	97.33	2,185.66	20.05	J3880	4.06	144.19	1000	1055.66
J3885	2.86	141.13	1,000	87.91	1,993.36	20.04	J3885	4.65	137.68	1000	989.26
J3890	3.93	134.63	1,000	65.2	1,496.94	20.02	J3890	6.38	131.18	1000	990.99
J3895	0.71	123.75	1,000	43.39	1,233.82	20.02	J3895	1.15	120.23	1000	694.98
J3900	1.43	154.12	1,000	101.07	2,128.46	20.05	J3900	2.32	150.65	1000	1178
J3905	6.44	158.45	1,000	106.23	2,213.29	20.05	J3905	10.46	154.98	1000	1218.89
J3910	6.07	141.12	1,000	56.08	1,314.23	20.02	J3910	9.86	137.64	1000	1218.29
J3915	8.22	193.11	1,000	143.29	2,708.04	20.07	J3915	13.35	189.64	1000	1269.69
J3920	7.15	182.3	1,000	134.03	2,660.58	20.07	J3920	11.61	178.84	1000	1319.34
J3925	5.72	162.86	1,000	119.32	2,763.68	20.08	J3925	9.29	159.49	1000	1342.74
J3930	4.65	158.55	1,000	115.41	2,734.52	20.07	J3930	7.55	155.23	1000	1311.06
J3935	7.15	178.3	1,000	134.64	2,922.06	20.08	J3935	11.61	175.34	1000	1480.49
J3940	3.57	195.35	1,000	153.17	3,252.86	20.11	J3940	5.8	191.97	1000	1398.3
J3945	1.79	195.35	1,000	153.03	3,241.78	20.11	J3945	2.91	191.97	1000	1390.84
J3950	1.08	199.66	1,000	149.9	2,729.45	20.07	J3950	1.75	196.25	1000	1354.4
J3955	3.57	210.46	1,000	162.43	2,961.10	20.09	J3955	5.8	207.01	1000	1319.17
J3960	4.28	221.27	1,000	171.57	2,940.76	20.09	J3960	6.95	217.79	1000	1321.18
J3965	2.5	190.92	1,000	138.03	2,469.74	20.06	J3965	4.06	187.42	1000	1335.69
J3970	1.43	193.08	1,000	-1,261.70	313.19	20	J3970	2.32	189.58	1000	1333.95
J3975	1.79	182.21	1,000	125.04	2,208.88	20.05	J3975	2.91	178.63	1000	1394.31
J3980	11.43	173.52	1,000	118.34	2,223.91	20.05	J3980	18.57	169.91	1000	1721.2
J3985	1.79	149.69	1,000	86.17	1,739.20	20.03	J3985	2.91	146.07	1000	1437.76
J3990	1.08	143.18	1,000	77.39	1,628.91	20.03	J3990	1.75	139.56	1000	1442.52
J3995	8.22	154.01	1,000	93.12	1,856.02	20.03	J3995	13.35	150.39	1000	1583.29
J4000	2.14	143.18	1,000	76.66	1,659.48	20.03	J4000	3.48	139.56	1000	1450.37
J4005	1.79	143.18	1,000	72.69	1,536.01	20.02	J4005	2.91	139.56	1000	1449.8
J4010	0.71	147.51	1,000	82.05	1,674.99	20.03	J4010	1.15	143.89	1000	1448.54
J4015	6.79	158.35	1,000	99.96	1,969.07	20.04	J4015	11.03	154.73	1000	1544.8
J4020	1.79	162.68	1,000	104.55	2,012.04	20.04	J4020	2.91	159.06	1000	1556.11
J4025	5.36	175.69	1,000	121.21	2,268.26	20.05	J4025	8.71	172.07	1000	1696.45
J4030	2.86	184.36	1,000	129.76	2,336.71	20.05	J4030	4.65	180.75	1000	1468.8
J4035	1.79	119.35	1,000	59.23	1,524.68	20.02	J4035	2.91	115.73	1000	1449.37
J4040	1.43	48.85	1,000	5.1	895.3	20.01	J4040	2.32	48.66	1000	1011
J4045	2.5	164.85	1,000	104.99	1,974.71	20.04	J4045	4.06	161.24	1000	1583.16
J4050	2.5	145.35	1,000	74.58	1,548.32	20.02	J4050	4.06	141.74	1000	1471.65
J4055	6.07	186.53	1,000	138.51	2,703.14	20.07	J4055	9.86	182.93	1000	1848.89

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results											
Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J4060	1.79	190.88	1,000	146.51	3,011.68	20.09	J4060	2.91	187.3	1000	1513.98
J4065	1.43	190.93	1,000	146.99	3,017.01	20.09	J4065	2.32	187.43	1000	1461.09
J4070	2.5	186.6	1,000	135.66	2,511.26	20.06	J4070	4.06	183.1	1000	1462.83
J4075	1.79	177.85	1,000	130.89	2,709.65	20.07	J4075	2.91	174.24	1000	1652.78
J4080	12.51	175.63	1,000	124.82	2,582.40	20.07	J4080	20.32	171.93	1000	2043.77
J4085	3.22	184.29	1,000	121.39	2,111.39	20.04	J4085	5.23	180.6	1000	2028.68
J4090	6.44	182.11	1,000	131.72	2,897.22	20.08	J4090	10.46	178.39	1000	2275.46
J4095	1.79	171.28	1,000	130	8,049.09	20.65	J4095	2.91	167.55	1000	8284.23
J4100	1.79	162.6	1,000	80.08	1,538.95	20.02	J4100	2.91	158.87	1000	1322.57
J4105	1.79	153.93	1,000	45.39	1,173.20	20.01	J4105	2.91	150.2	1000	1054.93
J4110	6.79	138.76	1,000	-29.03	785.01	20.01	J4110	11.03	135.03	1000	966.82
J4127	0	85	1,000	66.31	1,647.26	20.03	J4127	0	85	1000	1878.9
J4200	0	123.75	1,000	40.77	1,200.77	20.01	J4200	0	120.22	1000	681.8
J4205	9.29	117.25	1,000	33.22	1,140.37	20.01	J4205	15.09	113.72	1000	692.19
J4210	1.79	136.74	1,000	22.8	1,020.80	20.01	J4210	2.91	133.21	1000	680
J4215	5.36	147.57	1,000	8.83	946.1	20.01	J4215	8.71	144.04	1000	685.8
J4220	3.22	108.57	1,000	-4.31	856.74	20.01	J4220	5.23	105.02	1000	584.64
J4225	3.22	125.9	1,000	-1.44	889.09	20.01	J4225	5.23	122.35	1000	584.64
J4230	1.79	82.57	1,000	-47.64	643.1	20	J4230	2.91	79.02	1000	541.02
J4300	0	76.07	1,000	-70.78	562.4	20	J4300	0	72.51	1000	505.78
J4305	0.36	76.07	1,000	-71.96	560.34	20	J4305	0.58	72.51	1000	505.97
J4310	0	76.06	1,000	-438.23	288.49	20	J4310	0	72.51	1000	504.76
J4315	1.79	47.86	1,000	-1,207.97	121.27	20	J4315	Limiting Node - excluded from scenario			
J4320	1.79	63.03	1,000	-1,106.85	160.83	20	J4320	Limiting Node - excluded from scenario			
J4325	1.08	80.35	1,000	-2,228.36	135.72	20	J4325	Limiting Node - excluded from scenario			
J4330	0	78.23	1,000	-72.31	567.56	20	J4330	0	74.68	1000	505.57
J4335	1.79	93.39	1,000	-1,008.75	225.91	20	J4335	2.91	89.84	1000	508.48
J4340	0.71	76.07	1,000	-70.99	562.69	20	J4340	1.15	72.51	1000	506.64
J4400	0	76	1,000	76	7,913.51	20.63	J4400	0	76	1000	8187.93
J4405	0	73.83	1,000	70.49	4,492.94	20.2	J4405	0	73.83	1000	3183.49
J4410	1.79	69.5	1,000	61.54	2,693.20	20.07	J4410	2.91	69.5	1000	2355.62
J4415	0.71	67.33	1,000	43.33	1,444.32	20.02	J4415	1.15	67.33	1000	1443.56
J4420	3.57	58.67	1,000	39.83	1,479.94	20.02	J4420	5.8	58.67	1000	1479.73
J4500	0	333.41	1,000	70	7,941.70	20.63	J4500	0	299.35	1000	8243.62
J4505	0	337.75	1,000	73.72	7,625.35	20.58	J4505	0	303.68	1000	7845.16
J4600	0	180	1,000	180	7,304.26	20.53	J4600	0	180	1000	7253.85
J4605	3.93	166.46	1,000	161.44	5,575.40	20.31	J4605	6.38	165.38	1000	2935.11
J4610	4.28	126.6	1,000	115.23	3,571.43	20.13	J4610	6.95	123.81	1000	1653.2
J4615	3.57	65.62	1,000	9.63	882.76	20.01	J4615	5.8	67.5	1000	1127.01
J4620	3.57	60	1,000	-9.84	659	20	J4620	5.8	62.49	1000	1069.12
J4625	5.72	52.6	1,000	-20.64	574.18	20	J4625	9.29	55.52	1000	1044.47
J4630	1.79	73.62	1,000	-27.12	732.47	20.01	J4630	2.91	77.18	1000	1025.41
J4635	3.22	94.82	1,000	-25.96	788.2	20.01	J4635	5.23	98.84	1000	1027.73
J4640	4.28	56.93	1,000	-20.49	597.97	20	J4640	6.95	59.85	1000	1042.13
J4645	2.14	35.23	1,000	-38.69	392.47	20	J4645	Limiting Node - excluded from scenario			
J4650	7.15	33.05	1,000	-40.75	372.4	20	J4650	Limiting Node - excluded from scenario			
J4655	3.57	42.76	1,000	-27.41	491.36	20	J4655	5.8	45	1000	909.74
J4660	5.36	33.05	1,000	-51.17	351.08	20	J4660	Limiting Node - excluded from scenario			
J4665	9.64	35.21	1,000	-59.05	362.7	20	J4665	Limiting Node - excluded from scenario			
J4670	4.28	13.55	1,000	-92.53	-285.06	20	J4670	Limiting Node - excluded from scenario			
J4675	0	6.12	1,000	-90.63	-3,624.80	19.87	J4675	Limiting Node - excluded from scenario			
J4700	4.28	65	1,000	27.45	1,090.83	20.01	J4700	6.95	64.63	1000	1215.94
J4705	1.79	71.39	1,000	33	1,147.35	20.01	J4705	2.91	71.13	1000	1222.96
J4710	2.5	64.89	1,000	-0.06	836.97	20.01	J4710	4.06	64.63	1000	999.18
J4715	3.57	85.91	1,000	44.12	1,257.59	20.02	J4715	5.8	86.31	1000	1295.29
J4720	3.57	61.56	1,000	19.5	997.23	20.01	J4720	5.8	62.5	1000	1200.86
J4725	6.44	72.28	1,000	19.48	1,001.08	20.01	J4725	10.46	73.06	1000	1155.87
J4730	3.57	48.54	1,000	10.67	859.34	20.01	J4730	5.8	50.6	1000	1083.58
J4735	4.28	87.51	1,000	65.54	2,036.14	20.04	J4735	6.95	91.88	1000	1603.05
J4740	7.15	87.51	1,000	65.98	2,080.46	20.04	J4740	11.61	91.93	1000	1620.99
J4745	3.57	89.68	1,000	74.65	2,794.93	20.08	J4745	5.8	94.25	1000	3274.32
J4750	0	85.35	1,000	75	3,567.15	20.13	J4750	0	90	1000	1646.25
J4800	0	36	1,000	19.48	994.64	20.01	J4800	0	36	1000	1145.4
J4805	4.65	44.62	1,000	23.25	1,034.30	20.01	J4805	7.55	44.56	1000	1152.96
J4810	1.79	72.78	1,000	18.66	993.71	20.01	J4810	2.91	72.72	1000	1077.85
J4815	5	96.61	1,000	11.06	964.7	20.01	J4815	8.12	96.54	1000	1021.9
J4820	3.57	25.03	1,000	-9.04	480.78	20	J4820	Limiting Node - excluded from scenario			
J4825	3.57	25.03	1,000	-9.79	468.85	20	J4825	Limiting Node - excluded from scenario			
J4830	1.43	68.35	1,000	29.97	1,071.70	20.01	J4830	2.32	68.15	1000	1024.12
J4835	1.43	57.52	1,000	9.73	932.98	20.01	J4835	2.32	57.32	1000	1014.7
J4840	6.79	53.13	1,000	5.08	905.68	20.01	J4840	11.03	52.93	1000	1016.18
J4845	0.71	94.29	1,000	41.62	1,126.56	20.01	J4845	1.15	94.08	1000	1018.82
J4850	1.43	92.13	1,000	36.04	1,092.58	20.01	J4850	2.32	91.92	1000	1019.99
J4855	3.93	100.79	1,000	47.12	1,158.29	20.01	J4855	6.38	100.58	1000	1027.84
J4860	2.5	115.95	1,000	43.53	1,115.07	20.01	J4860	4.06	115.75	1000	1025.52
J4865	10.72	111.62	1,000	59.46	1,233.44	20.01	J4865	17.41	111.41	1000	1046.5
J4870	1.79	113.78	1,000	52.96	1,174.41	20.01	J4870	2.91	113.58	1000	1039.93
J4875	6.79	74.79	1,000	18.49	997.79	20.01	J4875	11.03	74.58	1000	1056.98
J4880	3.57	81.29	1,000	12.73	965.02	20.01	J4880	5.8	81.08	1000	1051.76
J4885	1.79	96.45	1,000	38.1	1,101.89	20.01	J4885	2.91	96.25	1000	1043.17
J4890	7.86	85.62	1,000	35.77	1,103.84	20.01	J4890	12.77	85.42	1000	1048.21
J4895	5.72	61.8	1,000	12.28	955.45	20.01	J4895	9.29	61.61	1000	1059.87
J4900	8.58	57.45	1,000	-0.51	882.62	20.01	J4900	13.94	57.26	1000	1049.61
J5000	4.28	31.55	1,000	-2.85	518.03	20	J5000	Limiting Node - excluded from scenario			
J5005	5	42.26	1,000	-12.53	590.67	20	J5005	Limiting Node - excluded from scenario			
J5010	1.79	55.23	1,000	1.24	777.14	20.01	J5010	2.91	55.42	1000	1239.35
J5015	5	59.53	1,000	9.6	871.78	20.01	J5015	8.12	59.72	1000	1562.87
J5020	1.43	57.39	1,000	7.1	839.75	20.01	J5020	2.32	57.64	1000	1602.26
J5025	3.57	48.74	1,000	2.5	755.91	20.01	J5025	5.8	49.03	1000	1718.87
J5030	2.86	76.9	1,000	28.88	1,107.67	20.01	J5030	4.65	77.17	1000	1723.46
J5035	1.43	76.9	1,000	18.07	982.16	20.01	J5035	2.32	77.17	1000	1615.94

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results

Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J5040	3.22	85.56	1,000	3.14	880.56	20.01	J5040	5.23	85.83	1000	1147.2
J5045	2.14	81.23	1,000	-5.69	820.86	20.01	J5045	3.48	81.5	1000	1089.8
J5050	2.86	81.2	1,000	28.65	1,095.90	20.01	J5050	4.65	81.42	1000	1688.35
J5055	4.28	76.85	1,000	24.64	1,055.28	20.01	J5055	6.95	77.02	1000	1517.9
J5060	7.15	68.18	1,000	16.84	970.39	20.01	J5060	11.61	68.35	1000	1484.58
J5065	3.93	72.51	1,000	20.31	1,007.32	20.01	J5065	6.38	72.68	1000	1494.59
J5070	1.43	85.5	1,000	24.67	1,045.10	20.01	J5070	2.32	85.65	1000	1362.77
J5075	3.57	59.49	1,000	1.74	785.66	20.01	J5075	5.8	59.63	1000	1268.06
J5080	1.79	57.34	1,000	-1.79	759.65	20.01	J5080	2.91	57.49	1000	1193.81
J5085	10.72	74.63	1,000	14.97	960.71	20.01	J5085	17.41	74.73	1000	1440.62
J5100	0	60.78	1,000	29.36	1,093.82	20.01	J5100	0	60.72	1000	1757.13
J5105	5.72	80.28	1,000	50.27	1,297.17	20.02	J5105	9.29	80.21	1000	1764.21
J5110	6.44	84.62	1,000	57	1,371.70	20.02	J5110	10.46	84.55	1000	2476.36
J5115	0	56.45	1,000	30.67	1,118.95	20.01	J5115	0	56.38	1000	1677.23
J5120	2.5	86.78	1,000	58.8	1,381.14	20.02	J5120	4.06	86.72	1000	2473.05
J5125	4.28	86.8	1,000	57.82	1,367.99	20.02	J5125	6.95	86.75	1000	1688.48
J5130	0	50	1,000	21.92	1,021.07	20.01	J5130	0	50	1000	1580.35
J5135	5.72	95.46	1,000	64.87	1,417.20	20.02	J5135	9.29	95.41	1000	2406.45
J5140	2.86	127.95	1,000	92.99	1,586.58	20.03	J5140	4.65	127.88	1000	1752.11
J5145	3.57	130.12	1,000	93.7	1,579.19	20.02	J5145	5.8	130.05	1000	1735.26
J5150	1.79	117.12	1,000	84.77	1,551.41	20.02	J5150	2.91	117.05	1000	1743.32
J5155	3.57	117.11	1,000	84.74	1,552.83	20.02	J5155	5.8	117.05	1000	1719.1
J5160	4.28	97.62	1,000	68.39	1,454.39	20.02	J5160	6.95	97.55	1000	1721.61
J5165	1.79	106.28	1,000	51.57	1,211.97	20.01	J5165	2.91	106.21	1000	1602.26
J5170	4.65	106.28	1,000	35.86	1,095.89	20.01	J5170	7.55	106.21	1000	1299.7
J5200	0	110	1,000	110	6,457.26	20.42	J5200	0	110	1000	2750.14
J5205	1.79	99.16	1,000	79.85	2,181.39	20.05	J5205	2.91	99.14	1000	2020.79
J5210	2.5	92.65	1,000	62.1	1,607.77	20.03	J5210	4.06	92.63	1000	1573.55
J5215	4.28	90.49	1,000	56.72	1,498.98	20.02	J5215	6.95	90.47	1000	1492.77
J5220	3.57	114.31	1,000	31.65	1,078.03	20.01	J5220	5.8	114.28	1000	1072.93
J5225	2.14	114.31	1,000	10.89	953.09	20.01	J5225	3.48	114.28	1000	948.57
J5230	2.14	116.48	1,000	-3.03	892.03	20.01	J5230	3.48	116.45	1000	888.12
J5235	1.79	103.5	1,000	73.79	1,751.97	20.03	J5235	2.91	103.5	1000	773.35
J5240	0.71	114.33	1,000	55.94	1,296.98	20.02	J5240	1.15	114.33	1000	771.59
J5245	1.08	64.5	1,000	24.68	1,063.19	20.01	J5245	1.75	64.5	1000	659.11
J5250	1.08	58	1,000	13.41	917.91	20.01	J5250	1.75	58	1000	659.11
J5255	0	38.5	1,000	-13.3	572.19	20	J5255	0	38.5	1000	570.31
J5300	0.8	59.48	1,000	26.23	1,104.76	20.01	J5300	1.3	59.46	1000	954.51
J5305	0.8	50.82	1,000	13.61	896.44	20.01	J5305	1.3	50.79	1000	894.72
J5310	6.44	57.32	1,000	50.14	1,760.40	20.03	J5310	10.46	57.29	1000	2293.48
J5315	0	40	1,000	40	1,525.03	20.02	J5315	0	40	1000	1154.18
J5320	11.26	55.15	1,000	46.36	1,741.28	20.03	J5320	18.29	55.12	1000	1346.63
J5325	2.01	44.31	1,000	33.02	1,683.27	20.03	J5325	3.26	44.27	1000	1686.46
J5335	4.02	65.97	1,000	37.39	1,357.93	20.02	J5335	6.53	65.92	1000	897.56
J5340	1.2	74.63	1,000	34.54	1,209.65	20.01	J5340	1.95	74.59	1000	892.98
J5345	2.01	44.3	1,000	3.12	709.85	20	J5345	3.26	44.26	1000	708.4
J5405	1.2	39.81	1,000	-3.88	840.9	20.01	J5405	1.95	39.78	1000	1156.19
J5410	1.2	63.62	1,000	13.01	959.39	20.01	J5410	1.95	63.55	1000	1156.13
J5415	6.44	96.09	1,000	42.64	1,131.02	20.01	J5415	10.46	95.98	1000	1164.64
J5420	1.6	100.42	1,000	39.46	1,101.54	20.01	J5420	2.6	100.32	1000	1156.78
J5425	9.24	111.25	1,000	58.24	1,236.26	20.01	J5425	15.01	111.14	1000	1169.2
J5430	2.01	63.65	1,000	28.28	1,059.09	20.01	J5430	3.26	63.64	1000	1157.4
J5435	3.62	59.33	1,000	27.74	1,059.71	20.01	J5435	5.88	59.32	1000	1160.06
J5440	3.22	102.66	1,000	60.41	1,243.56	20.02	J5440	5.23	102.65	1000	1159.41
J5445	3.22	111.32	1,000	45.74	1,127.71	20.01	J5445	5.23	111.31	1000	1159.41
J5450	3.22	111.32	1,000	42.71	1,110.88	20.01	J5450	5.23	111.31	1000	1159.41
J5500	0	70	1,000	70	6,104.27	20.37	J5500	0	70	1000	2731.26
J5505	6.03	48.33	1,000	20.77	1,020.93	20.01	J5505	9.79	48.33	1000	1021.14
J5510	0	67.83	1,000	65.98	5,467.00	20.3	J5510	0	67.83	1000	2731.26
J5515	0	65.67	1,000	58.08	2,635.17	20.07	J5515	0	65.67	1000	2636.62
J5520	0	61.33	1,000	54	2,543.31	20.06	J5520	0	61.33	1000	2544.52
J5525	1.2	63.5	1,000	57	2,793.88	20.08	J5525	1.95	63.5	1000	2793.39
J5530	0.8	63.5	1,000	52.27	2,078.39	20.04	J5530	1.3	63.5	1000	2079.08
J5600	1.6	110	1,000	110	5,200.76	20.27	J5600	2.6	110	1000	2647.5
J5605	0	123	1,000	105	2,563.96	20.07	J5605	0	123	1000	2564.85
J5610	1.2	112.16	1,000	107.08	4,223.28	20.18	J5610	1.95	112.15	1000	2646.86
J5615	2.01	96.99	1,000	67.79	1,693.96	20.03	J5615	3.26	96.98	1000	1691.44
J5620	2.01	114.32	1,000	107.81	4,053.67	20.16	J5620	3.26	114.31	1000	3421.91
J5625	2.42	112.15	1,000	94.87	2,507.16	20.06	J5625	3.93	112.12	1000	2003.13
J5630	7.64	114.31	1,000	85.72	1,928.25	20.04	J5630	12.41	114.28	1000	1922.07
J5635	5.22	99.15	1,000	73.66	1,866.12	20.03	J5635	8.48	99.12	1000	1621.21
J5640	1.6	99.15	1,000	69.58	1,716.33	20.03	J5640	2.6	99.11	1000	1512.69
J5645	2.01	88.31	1,000	46.24	1,305.07	20.02	J5645	3.26	88.28	1000	1297.58
J5650	4.02	83.98	1,000	52.6	1,481.47	20.02	J5650	6.53	83.95	1000	1445.03
J5655	0.8	81.81	1,000	44.99	1,328.35	20.02	J5655	1.3	81.78	1000	1319.06
J5700	0	100	1,000	100	5,199.15	20.27	J5700	0	100	1000	2644.9
J5705	0.8	97.83	1,000	96.33	4,813.86	20.23	J5705	1.3	97.82	1000	2646.2
J5710	2.01	89.16	1,000	77.69	2,651.25	20.07	J5710	3.26	89.15	1000	2648.16
J5715	2.01	95.65	1,000	91.55	4,321.46	20.19	J5715	3.26	95.63	1000	3446.32
J5720	1.2	102.15	1,000	89.5	2,771.99	20.08	J5720	1.95	102.13	1000	2646.85
J5725	2.42	82.65	1,000	75.78	3,400.54	20.12	J5725	3.93	82.61	1000	2590.59
J5730	2.42	80.48	1,000	69.76	2,593.99	20.07	J5730	3.93	80.45	1000	2311.85
J5735	6.44	69.65	1,000	55.16	1,973.57	20.04	J5735	10.46	69.61	1000	1962.49
J5740	2.01	78.31	1,000	69.07	2,773.83	20.08	J5740	3.26	78.27	1000	2194.39
J5745	4.82	69.64	1,000	58.84	2,330.73	20.05	J5745	7.83	69.6	1000	2064.56
J5750	6.03	67.47	1,000	56.5	2,255.54	20.05	J5750	9.79	67.43	1000	2046.55
J5755	8.44	58.81	1,000	47.37	1,976.44	20.04	J5755	13.71	58.77	1000	1958.19
J5760	11.66	65.31	1,000	53.86	2,153.15	20.05	J5760	18.94	65.27	1000	1991.62
J5800	0	78	1,000	78	7,561.42	20.57	J5800	0	78	1000	2558.06
J5805	7.64	60.67	1,000	42.34	1,549.16	20.02	J5805	12.41	60.66	1000	1549.64
J5900	0	60.99	1,000	45	1,666.15	20.03	J5900	0	60.99	1000	1318.57

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results											
Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J5905	3.22	84.83	1,000	66.91	1,689.38	20.03	J5905	5.23	84.82	1000	1307.75
J5910	0.4	97.82	1,000	70.05	1,601.25	20.03	J5910	0.65	97.82	1000	1303.17
J5915	1.2	99.99	1,000	67	1,537.36	20.02	J5915	1.95	99.98	1000	1304.98
J5920	3.22	145.49	1,000	86.65	1,486.95	20.02	J5920	5.23	145.48	1000	1307.75
J5925	0.4	58.83	1,000	42.44	1,450.00	20.02	J5925	0.65	58.83	1000	1281.31
J5935	0.4	56.67	1,000	40.61	1,432.47	20.02	J5935	0.65	56.66	1000	1340.06
J5940	2.82	84.83	1,000	52.62	1,406.03	20.02	J5940	4.58	84.83	1000	1346.49
J6000	0	83	1,000	83	10,219.88	21.04	J6000	0	83	1000	3198.18
J6005	5.62	76.5	1,000	73.47	7,215.45	20.52	J6005	9.13	76.49	1000	3258.82
J6010	4.02	61.33	1,000	53.25	2,674.51	20.07	J6010	6.53	61.32	1000	2276.77
J6015	2.01	52.66	1,000	40.35	1,702.67	20.03	J6015	3.26	52.66	1000	1697.03
J6020	0	87.33	1,000	75	10,619.26	21.13	J6020	0	87.32	1000	3324.41
J6025	5.62	80.83	1,000	71.03	7,230.15	20.52	J6025	9.13	80.82	1000	3317.08
J6030	3.22	87.33	1,000	74.77	3,180.44	20.1	J6030	5.23	87.32	1000	3112.74
J6035	2.42	74.33	1,000	61.33	2,526.71	20.06	J6035	3.93	74.32	1000	2524.23
J6040	3.62	69.99	1,000	58.11	2,405.38	20.06	J6040	5.88	69.99	1000	2403.16
J6100	0	65	1,000	65	3,486.58	20.12	J6100	0	65	1000	2689.01
J6105	4.02	106.16	1,000	95.63	3,038.84	20.09	J6105	6.53	106.16	1000	2695.53
J6200	0	70	1,000	70	6,707.87	20.45	J6200	0	70	1000	2609.23
J6205	5.62	48.33	1,000	-37.23	553.66	20	J6205	9.13	48.32	1000	553.34
J6300	0	14.79	1,000	12.55	-2,651.62	19.93	J6300	Limiting Node - excluded from scenario			
J6305	0	270.85	1,000	-570.68	574.02	20	J6305	Limiting Node - excluded from scenario			
J6310	0	14.77	1,000	12.22	-331.72	20	J6310	Limiting Node - excluded from scenario			
J6315	0	270.84	1,000	-82.09	860.1	20.01	J6315	Limiting Node - excluded from scenario			
J6320	0	14.76	1,000	11.99	-222.77	20	J6320	Limiting Node - excluded from scenario			
J6325	0	270.82	1,000	204.85	1,772.35	20.03	J6325	Limiting Node - excluded from scenario			
J6330	0	58.14	1,000	54.65	3,220.66	20.1	J6330	916.67	57.07	1000	3784.9
J6335	0	14.18	1,000	9.18	-1,360.14	19.98	J6335	Limiting Node - excluded from scenario			
J6340	0	14.18	1,000	8.53	-1,243.93	19.98	J6340	Limiting Node - excluded from scenario			
J6345	0.47	38.58	1,000	18.51	959.88	20.01	J6345	0.76	38.42	1000	1920.69
J6350	0.22	38.61	1,000	15.97	900.53	20.01	J6350	0.36	38.45	1000	1647.33
J6355	0.47	51.65	1,000	27.44	1,154.81	20.01	J6355	0.76	51.51	1000	1810.9
J6360	0.47	69.02	1,000	36.42	1,245.64	20.02	J6360	0.76	68.88	1000	1517.23
J6365	0.26	69.02	1,000	2.91	851.39	20.01	J6365	0.42	68.88	1000	880.11
J6370	0.22	58.18	1,000	-39.61	602.85	20	J6370	0.36	58.05	1000	674.63
J6375	0.44	84.2	1,000	50.34	1,411.66	20.02	J6375	0.71	84.07	1000	1650.65
J6380	0.26	95.03	1,000	49.85	1,314.35	20.02	J6380	0.42	94.9	1000	1547.81
J6385	0.3	90.75	1,000	60.26	1,574.13	20.02	J6385	0.49	90.63	1000	1446.41
J6390	0.74	95.09	1,000	56.79	1,438.05	20.02	J6390	1.2	94.97	1000	1369.61
J6395	0.22	64.76	1,000	28.39	1,118.35	20.01	J6395	0.36	64.64	1000	1337.24
J6400	0.57	64.76	1,000	27.94	1,111.23	20.01	J6400	0.93	64.64	1000	1336.38
J6405	0.35	53.93	1,000	18.45	976.52	20.01	J6405	0.57	53.81	1000	1329
J6410	0.57	38.77	1,000	10.29	799.97	20.01	J6410	0.93	38.65	1000	1271.83
J6415	0.39	75.6	1,000	46.27	1,411.39	20.02	J6415	0.63	75.48	1000	1417.45
J6420	0.44	69.1	1,000	38.02	1,279.28	20.02	J6420	0.71	68.98	1000	1479.06
J6425	0.44	34.45	1,000	9.73	750.5	20.01	J6425	Limiting Node - excluded from scenario			
J6430	0.26	55.99	1,000	29.43	1,177.13	20.01	J6430	0.42	55.86	1000	1769.02
J6435	0.52	34.35	1,000	10.33	759.65	20.01	J6435	Limiting Node - excluded from scenario			
J6440	0.52	36.49	1,000	11.16	795.22	20.01	J6440	0.84	36.37	1000	1598.52
J6445	1.08	54.69	1,000	23.32	1,057.04	20.01	J6445	1.75	54.38	1000	1378.66
J6450	0.28	41.82	1,000	10.52	821.94	20.01	J6450	0.42	41.47	1000	1329.48
J6455	0.44	50.52	1,000	15.07	922.13	20.01	J6455	0.71	50.17	1000	1334.94
J6460	0.22	65.68	1,000	24.79	1,062.02	20.01	J6460	0.36	65.33	1000	1334.62
J6465	0.47	50.56	1,000	19.43	990.25	20.01	J6465	0.76	50.21	1000	1347.32
J6470	0.39	77.07	1,000	50.15	1,507.66	20.02	J6470	0.63	77.88	1000	1823.08
J6475	0.22	94.4	1,000	42.3	1,213.86	20.01	J6475	0.36	95.21	1000	1375.36
J6480	0.44	60.06	1,000	38.94	1,421.67	20.02	J6480	0.71	61.61	1000	1819.37
J6485	0.22	73.06	1,000	18.36	983.63	20.01	J6485	0.36	74.61	1000	1077.39
J6490	0.91	79.93	1,000	69.35	2,606.31	20.07	J6490	1.48	82.32	1000	3518.15
J6495	0.57	41.05	1,000	35.05	2,026.33	20.04	J6495	0.93	42.15	1000	2790
J6500	0.3	56.22	1,000	34.87	1,336.55	20.02	J6500	0.49	57.32	1000	1455.76
J6505	0.47	84.26	1,000	49.74	1,404.61	20.02	J6505	0.76	94.42	1000	2617.67
J6510	0.44	71.26	1,000	7.13	885.32	20.01	J6510	0.71	91.07	1000	2242.24
J6515	0.52	53.93	1,000	-35.01	590.85	20	J6515	0.84	81.84	1000	2147.63
J6520	0.22	47.43	1,000	-55.71	483.9	20	J6520	0.36	80	1000	1932.82
J6525	0.26	64.76	1,000	-47.56	605.75	20	J6525	0.42	97.33	1000	1932.88
J6530	2.56	63.44	1,000	-51.68	438.69	20	J6530	4.16	69.64	1000	1079.62
J6535	0	67.66	1,000	-48.75	466.23	20	J6535	Limiting Node - excluded from scenario			
J6540	0	67.65	1,000	-48.91	465.85	20	J6540	Limiting Node - excluded from scenario			
J6545	0	59.1	1,000	-56.65	400.1	20	J6545	0	65.3	1000	1065.35
J6550	0	72.1	1,000	-46.82	495.82	20	J6550	0	78.3	1000	1065.36
J6600	0	140.36	1,000	-6,573.75	197.84	20	J6600	Limiting Node - excluded from scenario			
J6610	0	151.18	1,000	114.34	1,891.93	20.04	J6610	0	147.77	1000	1639.96
J6615	0.69	144.55	1,000	111.09	1,935.21	20.04	J6615	1.12	141.01	1000	1740.21
J6620	0.66	148.74	1,000	115.18	1,975.29	20.04	J6620	1.07	145.2	1000	1138.9
J6625	0.61	131.25	1,000	104.69	2,058.22	20.04	J6625	0.99	127.68	1000	1142.84
J6630	0.52	126.76	1,000	95.36	1,875.22	20.04	J6630	0.84	121.88	1000	1125.17
J6635	0	126.76	1,000	95.35	1,874.86	20.04	J6635	0	121.78	1000	1123.07
J6640	0.52	120.19	1,000	89.64	1,844.51	20.03	J6640	0.84	115.28	1000	1118.04
J6645	0.61	102.73	1,000	78.61	1,887.09	20.04	J6645	0.99	97.95	1000	1103.56
J6650	0.47	122.59	1,000	96.83	2,002.63	20.04	J6650	0.76	119.12	1000	1142.41
J6655	0.35	120.39	1,000	94.98	1,994.92	20.04	J6655	0.57	116.96	1000	1142.69
J6660	0.22	113.89	1,000	81.24	1,710.16	20.03	J6660	0.36	110.46	1000	1141.56
J6665	0.39	94.02	1,000	78.64	2,210.39	20.05	J6665	0.63	91.04	1000	1134.52
J6670	0.69	91.85	1,000	67.9	1,760.11	20.03	J6670	1.12	88.21	1000	1126.57
J6675	0.39	94.01	1,000	74.91	2,003.70	20.04	J6675	0.63	89.28	1000	1552.21
J6680	0.87	76.62	1,000	57.92	1,770.55	20.03	J6680	1.41	71.67	1000	1069.41
J6685	0	76.62	1,000	57.36	1,744.51	20.03	J6685	0	71.58	1000	1068.39
J6690	0.35	76.6	1,000	58.46	1,799.15	20.03	J6690	0.57	72.05	1000	1055.48
J6695	0.22	76.6	1,000	47.3	1,411.08	20.02	J6695	0.36	72.05	1000	997.3
J6700	0.3	48.34	1,000	36.4	1,556.34	20.02	J6700	0.49	45.7	1000	951.29

Table B-1. Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results											
Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J6705	0.66	67.84	1,000	58.3	2,261.44	20.05	J6705	1.07	65.58	1000	1204.06
J6710	0	26.48	1,000	24.73	1,910.06	20.04	J6710	Limiting Node - excluded from scenario			
J6715	0.22	37.44	1,000	25.9	1,236.98	20.02	J6715	0.36	35.52	1000	831.24
J6800	0	84.82	1,000	78	2,103.99	20.04	J6800	0	78	1000	1123.07
J6805	1.18	102.16	1,000	89.79	2,115.30	20.04	J6805	1.92	94.93	1000	1120.94
J6810	0.26	108.66	1,000	85.15	1,847.05	20.03	J6810	0.42	101.43	1000	1119.07
J6815	0.47	95.66	1,000	65.06	1,663.05	20.03	J6815	0.76	86.25	1000	1139.94
J6820	0.52	110.82	1,000	63.78	1,465.51	20.02	J6820	0.84	101.42	1000	1140.02
J6825	0.44	86.99	1,000	52.74	1,484.71	20.02	J6825	0.71	76.32	1000	1179.25
J6830	0.47	110.82	1,000	76.42	1,709.87	20.03	J6830	0.76	99.3	1000	1372.95
J6835	0.57	119.49	1,000	87.84	1,820.73	20.03	J6835	0.93	106.81	1000	1453.73
J6840	0.47	86.99	1,000	63.24	1,734.51	20.03	J6840	0.76	79.87	1000	1158.97
J6845	0	35	1,000	35	1,788.15	20.03	J6845	0	35	1000	1068.38
J6900	0.13	80	1,000	80	1,859.67	20.03	J6900	0.21	80	1000	1607.28
J6905	0.74	60.5	1,000	51.83	1,543.70	20.02	J6905	1.2	60.5	1000	1149.63
J6910	0.44	69.17	1,000	50.34	1,455.18	20.02	J6910	0.71	69.17	1000	1149.15
J6915	0.57	84.33	1,000	65.99	1,557.49	20.02	J6915	0.93	84.33	1000	1149.93
J6920	0.83	103.83	1,000	36.36	1,125.26	20.01	J6920	1.35	103.83	1000	1122.07
J7000	0	80	1,000	80	3,073.27	20.09	J7000	0	100	1000	3160.29
J7005	0	75.67	1,000	75.24	3,011.55	20.09	J7005	0	95.67	1000	2658.79
J7010	2.72	82.16	1,000	46.24	1,350.15	20.02	J7010	4.42	102.15	1000	1162.87
J7015	0.43	79.99	1,000	41.17	1,267.46	20.02	J7015	0.7	99.99	1000	1154.45
J7020	0.67	97.33	1,000	15.36	969.49	20.01	J7020	1.09	117.32	1000	1095.93
J7025	0.08	82.16	1,000	41.18	1,254.28	20.02	J7025	0.13	102.15	1000	1079.11
J7030	1.61	75.66	1,000	30.31	1,119.32	20.01	J7030	2.62	95.65	1000	1081.79
J7035	2.88	79.99	1,000	37.4	1,207.51	20.01	J7035	4.68	99.98	1000	1059.98
J7040	0.77	47.5	1,000	-29.07	573.88	20	J7040	1.25	67.49	1000	769.7
J7100	0	221.37	1,000	-6,231.91	215.13	20	J7100	Limiting Node - excluded from scenario			
J7105	0	221.36	1,000	-1,401.47	423.85	20	J7105	Limiting Node - excluded from scenario			
J7110	0	216.96	1,000	197.25	3,134.02	20.1	J7110	0	216.77	1000	3227.37
J7115	0	216.96	1,000	196.33	3,073.27	20.09	J7115	0	216.77	1000	3160.29
J7120	0	203.73	1,000	185.93	3,182.85	20.1	J7120	0	203.6	1000	3238.67
J7125	0	190.53	1,000	174.36	3,213.93	20.1	J7125	0	190.35	1000	3328.75
J7130	0	131.2	1,000	122.19	3,477.19	20.12	J7130	0	131.06	1000	3594.19
J7135	0.08	118.2	1,000	108.55	3,165.83	20.1	J7135	0.13	118.07	1000	3308.72
J7140	0	111.52	1,000	104.14	3,488.63	20.12	J7140	0	111.37	1000	3654.12
J7145	0.17	78.68	1,000	74.37	3,688.57	20.14	J7145	0.28	78.55	1000	3186.34
J7150	0.43	76.5	1,000	72.28	3,650.23	20.13	J7150	0.7	76.34	1000	3323.12
J7155	0.77	69.91	1,000	50.73	1,673.71	20.03	J7155	1.25	69.73	1000	1525.12
J7160	0.77	78.51	1,000	53.43	1,584.02	20.02	J7160	1.25	78.3	1000	1198.57
J7165	0.43	76.34	1,000	44.8	1,370.09	20.02	J7165	0.7	76.13	1000	1198.02
J7170	1.19	93.56	1,000	63.54	1,647.17	20.03	J7170	1.93	93.35	1000	970.37
J7175	0.67	89.23	1,000	42.81	1,244.35	20.02	J7175	1.09	89.01	1000	769.85
J7180	1.19	82.73	1,000	28.35	1,082.16	20.01	J7180	1.93	82.51	1000	733.16
J7185	0.59	61.07	1,000	6.37	855.36	20.01	J7185	0.96	60.85	1000	704.03
J7190	0.59	50.23	1,000	-21.21	624.96	20	J7190	0.96	50.02	1000	617.06
J7195	1.1	95.72	1,000	65.59	1,670.45	20.03	J7195	1.79	95.51	1000	978.34
J7200	0	95.72	1,000	64.56	1,639.72	20.03	J7200	0	95.51	1000	976.55
J7205	1.1	119.54	1,000	90.14	1,953.95	20.04	J7205	1.79	119.34	1000	1157.23
J7210	1.28	106.54	1,000	79.62	1,890.94	20.04	J7210	2.08	106.34	1000	1359.52
J7215	0.43	97.86	1,000	78.74	2,148.07	20.05	J7215	0.7	97.68	1000	1378.14
J7220	0.59	97.86	1,000	78.51	2,134.81	20.05	J7220	0.96	97.68	1000	1338.55
J7225	0	115.19	1,000	69.54	1,489.63	20.02	J7225	0	115.01	1000	1337.59
J7230	0	115.19	1,000	69.08	1,481.64	20.02	J7230	0	115.01	1000	1337.6
J7235	0	117.36	1,000	69.31	1,466.64	20.02	J7235	0	117.17	1000	1337.59
J7240	3.31	65.36	1,000	42.41	1,453.44	20.02	J7240	5.38	65.18	1000	1167.59
J7245	0.51	54.52	1,000	29.35	1,188.69	20.01	J7245	0.83	54.34	1000	1039.09
J7250	3.81	71.86	1,000	41.52	1,343.19	20.02	J7250	6.19	71.67	1000	934.17
J7255	0.67	48.02	1,000	15.62	924.05	20.01	J7255	1.09	47.84	1000	836.06
J7260	0.77	41.53	1,000	8.43	790.38	20.01	J7260	1.25	41.34	1000	815.04
J7265	0.43	41.53	1,000	8.86	795.63	20.01	J7265	0.7	41.34	1000	822.27
J7270	0.67	35.03	1,000	2.69	656.18	20	J7270	Limiting Node - excluded from scenario			
J7275	1.28	74.02	1,000	48.76	1,513.71	20.02	J7275	2.08	73.84	1000	1446.14
J7280	2.03	76.19	1,000	51.73	1,574.18	20.02	J7280	3.3	76.01	1000	1736.41
J7285	1.87	63.19	1,000	8.25	878.95	20.01	J7285	3.04	63.01	1000	2372.53
J7290	0.43	41.52	1,000	-24.28	543.29	20	J7290	0.7	41.34	1000	1975.15
J7295	1.61	39.36	1,000	-26.4	513.85	20	J7295	2.62	39.18	1000	2002.53
J7300	2.12	43.7	1,000	34.77	1,695.63	20.03	J7300	3.44	43.54	1000	1987.36
J7305	1.28	80.53	1,000	60.43	1,821.64	20.03	J7305	2.08	80.35	1000	1554.12
J7310	1.95	28.52	1,000	20.33	1,023.14	20.01	J7310	Limiting Node - excluded from scenario			
J7315	1.28	26.3	1,000	24.57	1,871.46	20.03	J7315	Limiting Node - excluded from scenario			
J7320	0	8.67	1,000	8.61	-12,849.45	18.35	J7320	Limiting Node - excluded from scenario			
J7325	0	10.84	1,000	10.76	-10,547.49	18.89	J7325	Limiting Node - excluded from scenario			
J7330	0	10.84	1,000	10.75	-9,970.89	19.01	J7330	Limiting Node - excluded from scenario			
J7335	0.77	26.35	1,000	20.07	1,006.01	20.01	J7335	Limiting Node - excluded from scenario			
J7340	1.02	37.22	1,000	27.59	1,364.54	20.02	J7340	1.66	37.08	1000	1366.25
J7345	0.77	41.55	1,000	12.88	858.01	20.01	J7345	1.25	41.41	1000	839.66
J7350	0.43	37.22	1,000	24.44	1,173.60	20.01	J7350	0.7	37.08	1000	1168.73
J7355	0.77	37.22	1,000	24.05	1,155.05	20.01	J7355	1.25	37.08	1000	1125.06
J7360	1.1	37.22	1,000	24.06	1,156.00	20.01	J7360	1.79	37.08	1000	1109.98
J7365	1.19	45.97	1,000	37.57	1,828.47	20.03	J7365	1.93	45.81	1000	1619.08
J7370	1.02	35.1	1,000	23.69	1,163.31	20.01	J7370	1.66	34.93	1000	1106.62
J7375	1.02	67.86	1,000	55.46	2,040.62	20.04	J7375	1.66	67.73	1000	1942.29
J7380	0.93	52.71	1,000	36.85	1,471.13	20.02	J7380	1.51	52.57	1000	1502.07
J7385	0.85	52.73	1,000	34.98	1,388.82	20.02	J7385	1.38	52.58	1000	1443.77
J7390	1.52	72.23	1,000	54.89	1,807.32	20.03	J7390	2.47	72.08	1000	1580.6
J7395	1.19	70.1	1,000	60.73	2,463.96	20.06	J7395	1.93	69.94	1000	2331.86
J7400	1.02	89.6	1,000	70.4	2,009.49	20.04	J7400	1.66	89.43	1000	2629.71
J7405	1.19	109.09	1,000	84.07	1,990.64	20.04	J7405	1.93	108.92	1000	2514.77
J7410	0.08	130.76	1,000	93.75	1,810.18	20.03	J7410	0.13	130.59	1000	2144.72
J7415	1.44	72.26	1,000	44.46	1,410.29	20.02	J7415	2.34	72.09	1000	2243.21

Table B-1, Ebbetts Pass Water System Existing and Buildout Fireflows Scenario Hydraulic Modeling Results											
Existing Demands, Existing Pipes							Buildout Demands, Buildout Pipe Improvements				
ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow @Hydrant (gpm)	Available Flow Pressure (psi)	ID	Static Demand (gpm)	Static Pressure (psi)	Fire-Flow Demand (gpm)	Design Fire Flow (gpm)
J7420	1.1	36.14	1,000	23.77	1,158.65	20.01	J7420	1.79	36.04	1000	1171.02
J7425	1.02	11	1,000	11	827.44	20.01	J7425	Limiting Node - excluded from scenario			
J7430	0.93	72.25	1,000	5.8	877.97	20.01	J7430	1.51	72.07	1000	1664.66
J7435	1.52	44.09	1,000	-35.25	521.94	20	J7435	2.47	43.91	1000	1153.57
J7440	0.43	85.25	1,000	9.65	923.21	20.01	J7440	0.7	85.07	1000	1770.11
J7445	0.43	96.08	1,000	18.1	986.98	20.01	J7445	0.7	95.9	1000	1770.11
J7450	0.67	83.09	1,000	6.44	899.92	20.01	J7450	1.09	82.9	1000	1734.81
J7455	1.1	72.25	1,000	-8.62	789	20.01	J7455	1.79	72.07	1000	1648.54
J7460	0.51	63.59	1,000	-17.56	712.65	20	J7460	0.83	63.4	1000	1625.49
J7465	1.36	61.42	1,000	-23.57	676.62	20	J7465	2.21	61.24	1000	1432.37
J7470	1.44	50.59	1,000	-29.17	593.2	20	J7470	2.34	50.4	1000	1568.51
J7475	1.61	46.25	1,000	-35.14	539.65	20	J7475	2.62	46.07	1000	1857.21
J7480	0	33.26	1,000	-63.05	335.64	20	J7480	0	33.07	1000	4163
J7500	0.17	90	1,000	90	3,165.92	20.1	J7500	0.28	90	1000	3308.86
J7505	0.85	77	1,000	71.49	2,402.92	20.06	J7505	1.38	77	1000	2043.14
J7510	0.51	57.5	1,000	40.92	1,554.01	20.02	J7510	0.83	57.5	1000	1544.26
J7515	0.34	100.83	1,000	90.59	2,400.78	20.06	J7515	0.55	100.83	1000	2042.31
J7600	0.08	50	1,000	50	3,488.72	20.12	J7600	0.13	50	1000	3654.25
J7605	2.21	106.33	1,000	49.67	1,257.99	20.02	J7605	3.59	106.33	1000	1307.14
J7705	0	55.89	1,000	-8,565.09	94.57	20	J7705	Limiting Node - excluded from scenario			
J7710	0	58.06	1,000	53.5	3,181.21	20.1	J7710	0	58.05	1000	3091.88
J7715	1.29	86.22	1,000	82.12	4,584.14	20.21	J7715	2.1	86.21	1000	3289.63
J7720	0.37	86.22	1,000	81.28	4,130.52	20.17	J7720	0.6	86.21	1000	3314.85
J7725	0.37	79.72	1,000	74.97	3,998.17	20.16	J7725	0.6	79.71	1000	3387.52
J7730	0.9	79.72	1,000	75.83	4,475.93	20.2	J7730	1.46	79.71	1000	3394.44
J7735	0.68	55.88	1,000	52.32	3,578.00	20.13	J7735	1.1	55.88	1000	3462.78
J7740	1.29	55.88	1,000	52.82	3,933.87	20.15	J7740	2.1	55.87	1000	3784.35
J7745	1.29	55.88	1,000	53.08	4,166.66	20.17	J7745	2.1	55.87	1000	3837.49
J7750	0.6	77.54	1,000	59.57	1,883.53	20.04	J7750	0.97	77.54	1000	1583.32
J7755	0.6	53.15	1,000	20.97	1,018.38	20.01	J7755	0.97	53.23	1000	1131.75
J7760	1.06	79.71	1,000	77.84	6,972.01	20.49	J7760	1.72	79.71	1000	4044.84
J7765	0	77.55	1,000	74.62	5,157.81	20.27	J7765	0	77.54	1000	4043.12
J7770	0.46	71.05	1,000	69.38	6,782.29	20.46	J7770	0.75	71.04	1000	4042.17
J7775	0.53	42.89	1,000	13.67	876.41	20.01	J7775	0.86	42.88	1000	875.33
J7780	0.37	71.05	1,000	69.9	8,281.98	20.69	J7780	0.6	71.05	1000	4707.29
J7785	0.37	71.06	1,000	70.44	11,485.50	21.32	J7785	0.6	71.05	1000	6775.98
J7800	0	35	1,000	35	1,838.71	20.03	J7800	0	35	1000	976.55
J7805	1.52	52.31	1,000	39.09	1,657.13	20.03	J7805	2.47	52.26	1000	1340.85
J7810	1.1	60.97	1,000	46.2	1,773.37	20.03	J7810	1.79	60.92	1000	1344.83
J7815	0.51	65.31	1,000	41.58	1,432.24	20.02	J7815	0.83	65.26	1000	1343.87
J7820	1.44	60.97	1,000	47.21	1,847.92	20.03	J7820	2.34	60.92	1000	1356.48
J7825	2.37	89.13	1,000	74.22	2,074.65	20.04	J7825	3.85	89.07	1000	1400.89
J7830	0.51	102.13	1,000	78.06	1,915.66	20.04	J7830	0.83	102.07	1000	1397.87
J7835	0.08	106.46	1,000	76.76	1,795.93	20.03	J7835	0.13	106.41	1000	1397.17
J7840	0	110.8	1,000	78.94	1,778.43	20.03	J7840	0	110.74	1000	1397.05
J7845	1.61	104.29	1,000	88.92	2,163.48	20.05	J7845	2.62	104.23	1000	1468.74
J7850	0	56.63	1,000	55	1,855.30	20.03	J7850	0	56.56	1000	1409.34
J7855	0.26	132.45	1,000	92.49	1,756.63	20.03	J7855	0.42	132.37	1000	1464.96
J7900	0	38.33	1,000	35	2,045.82	20.04	J7900	0	38.32	1000	1417.51
J7905	1.19	42.66	1,000	38.39	2,085.26	20.04	J7905	1.93	42.65	1000	1422.58
J7910	1.1	72.99	1,000	66.47	2,226.71	20.05	J7910	1.79	72.98	1000	1430.28
J7915	1.02	81.66	1,000	75.14	2,283.06	20.05	J7915	1.66	81.65	1000	1432.21
J7920	0.67	60	1,000	60	2,157.32	20.05	J7920	1.09	60	1000	2220.87
J7925	0.93	98.99	1,000	91.95	2,368.21	20.06	J7925	1.51	98.98	1000	1427.01
J7930	0.85	98.99	1,000	85.82	2,206.32	20.05	J7930	1.38	98.98	1000	1428.42
J7935	0.43	90.32	1,000	61.9	1,683.69	20.03	J7935	0.7	90.31	1000	1427.79
J7940	0.85	109.82	1,000	90.3	2,123.69	20.04	J7940	1.38	109.81	1000	1429.26
J7945	0.08	109.82	1,000	85.99	2,038.18	20.04	J7945	0.13	109.81	1000	1428.01
J7950	1.28	131.49	1,000	109.11	2,174.86	20.05	J7950	2.08	131.48	1000	1430.45
J7955	0.08	131.49	1,000	99.07	1,988.90	20.04	J7955	0.13	131.48	1000	1428.5
J7960	1.28	98.99	1,000	82.18	2,126.18	20.05	J7960	2.08	98.98	1000	1431.55
J7965	1.1	150.99	1,000	128.65	2,268.27	20.05	J7965	1.79	150.98	1000	1430.69
J7970	0	146.65	1,000	121.82	2,196.21	20.05	J7970	0	146.64	1000	1428.9
J8000	0	70	1,000	70	2,196.21	20.05	J8000	0	70	1000	1428.9
J8005	0.77	115.5	1,000	67.74	1,455.05	20.02	J8005	1.25	115.5	1000	1076.64
J8010	0.43	100.33	1,000	28.13	1,059.75	20.01	J8010	0.7	100.33	1000	886.11
J8100	0	88	1,000	28.13	1,059.32	20.01	J8100	0	100	1000	885.49
J8105	0.43	84.17	1,000	-16.08	766.06	20.01	J8105	0.7	76.17	1000	771.7