Appendix A – Sudden Valley/Geneva Detailed Physical Capacity Analysis

Appendix A – Sudden Valley / Geneva Detailed Physical Capacity Analysis

This appendix provides a detailed physical capacity analysis for the Sudden Valley and Geneva area water systems (South Shore water system). It contains analyses of water demands, water rights, pump capacity, treatment capacity, storage capacity, distribution capacity, and distribution system leakage. It includes determinations of limiting factors and number of ERUs capable of being served based on existing infrastructure. Physical capacity of the existing infrastructure exceeds anticipated build-out of the Sudden Valley and Geneva areas, so this appendix also identifies what capacity is needed to meet demands for anticipated build-out.

Water Demands

Water Demands are determined separately for Geneva and Sudden Valley because the two areas have different characteristics and different water demands. Average Day Demand (ADD) and Maximum Day Demand (MDD) were determined in the 2016 LWWSD Water Use Efficiency Plan Update (Appendix B of this Water System Plan). These values were determined using source meter data, and therefore distribution system leakage is included in the values. Distribution system leakage was also quantified in the 2016 Water Use Efficiency Plan Update. The ADD and MDD values are listed below.

	Sudden Valley	**Geneva**
ADD (gpd/ERU)	150	175
MDD (gpd/ERU)	250	370

Source-Based Physical Capacity

Sources must provide MDD for the system. Equalizing storage in the reservoirs provides equalizing volume to meet peak hourly demands beyond MDD. Individual components that could limit the source production are addressed below. There is only one source for the water system, which is Lake Whatcom. There is an emergency intertie with the City of Bellingham in Geneva, but this intertie is for emergencies only and is not included in this capacity analysis.

Water Rights

Water rights for the South Shore water system are discussed in detail in the body of the Water System Plan, Section 3. After taking the periods of use of each of the water rights in to consideration, the instantaneous flow rate allowed is 3.4 cubic feet per second (cfs) at all points throughout the year. The total volume allowed from December 1 through March 31 is 540 acre-feet per year, and the total volume allowed from April 1 through November 30 is 1260 acre-feet per year. These sum to 1800 acre-feet per year.

In order to quantify the number of ERUs that could ultimately be served by the water rights, an assumption needs to be made about the proportion of ERUs designated to each Sudden Valley and Geneva. An assumption will be that the anticipated build-out numbers for each will represent that proportion. Given the anticipated build-out number (from Section 2 of the water system plan) for

Sudden Valley of 3267 ERUs and 1239 ERUs for Geneva, an assumed ratio of Sudden Valley to Geneva ERUs is 2.64.

Given the above information, the following two equations were used to solve for the maximum number of ERUs based on the instantaneous water right.

$$Instantaneous\ Water\ Right\ = \#\ SV\ ERUs * MDD_{SV} + \#\ Gen\ ERUs * MDD_{Gen}$$

$$\#\ SV\ ERUs = 2.64 * \#\ Gen\ ERUs$$

The maximum number of ERUs based on the annual total water right is calculated using the following equation and the Sudden Valley to Geneva ERU ratio.

$$Annual\ Water\ Right\ = \#\ SV\ ERUs * ADD_{SV} + \#\ Gen\ ERUs * ADD_{Gen}$$

After taking unit conversions in to account, the algebraic solutions are shown below.

	Sudden Valley	**Geneva**
Capacity based on Instantaneous water right (ERUs)	5631	2133
Capacity based on Annual water right (ERUs)	7429	2814

The above table indicates that the instantaneous water right is more limiting for the system than the annual water right, but still exceeds the anticipated build-out for the service area.

Pump Capacity

The installed pump capacity for the South Shore water system source includes the raw water pumps, the transfer pumps that pump filtered water from the clearwell to the CT reservoir, and the transmission pumps that pump from the CT reservoir to fill the Division 7 and Division 22 reservoirs.

The raw water pumping system consists of two variable speed pumps in parallel. Each pump was designed for a flow rate of 1400 gpm at a TDH of approximately 38 ft. This provided the treatment plant the full 2 MGD capacity with 100% redundancy. The VFDs on the raw water pumps are currently set such that the operational flow rate is 700 gpm, but the originally designed flow rate of 1400 gpm is still available with 100% redundancy. Flow meters in the treatment plant confirm the operational flow rate.

There are two transfer pumps in parallel that pump filtered water from the clearwell to the CT reservoir. These pumps alternate in operation and turn on and off based on the water level in the clearwell. These pumps are constant speed and run at 1400 gpm until the level in the clearwell reaches the off setpoint. The design point of each of these pumps is 1400 gpm at a TDH of approximately 39 ft. The configuration provides 100% redundancy.

The transmission pumps that pump water from the CT reservoir to the Division 7 and Division 22 reservoirs are configured with two parallel pumps to pump to each reservoir (4 pumps total). Each of the Division 7 transmission pumps is designed for a flow rate of 700 gpm at a TDH of approximately 418 ft, and each of the Division 22 transmission pumps is designed for a flow rate of 700 gpm at a TDH of approximately 606 ft. These provide 100% redundancy. Actual measured flow rates under operational conditions is 840 gpm for the Division 7 pumps and 725 gpm for the Division 22 pumps.

As the above information conveys, the smallest pumping capacity of the pumping system is 1400 gpm. This pumping capacity was used with the following two equations to determine the maximum number of ERUs that could be supported by the pumping capacity.

$$Pump\ capacity\ flow\ rate\ = \#\ SV\ ERUs * MDD_{SV} + \#\ Gen\ ERUs * MDD_{Gen}$$

$$\#\ SV\ ERUs = 2.64 * \#\ Gen\ ERUs$$

After taking unit conversions in to account, the algebraic solutions are shown below.

	Sudden Valley	Geneva
Capacity based on pumping capacity (ERUs)	5167	1957

Since these values are lower, the pumping capacity is more limiting to capacity than the water rights, but still exceeds the anticipated build-out for the service area.

Treatment Capacity

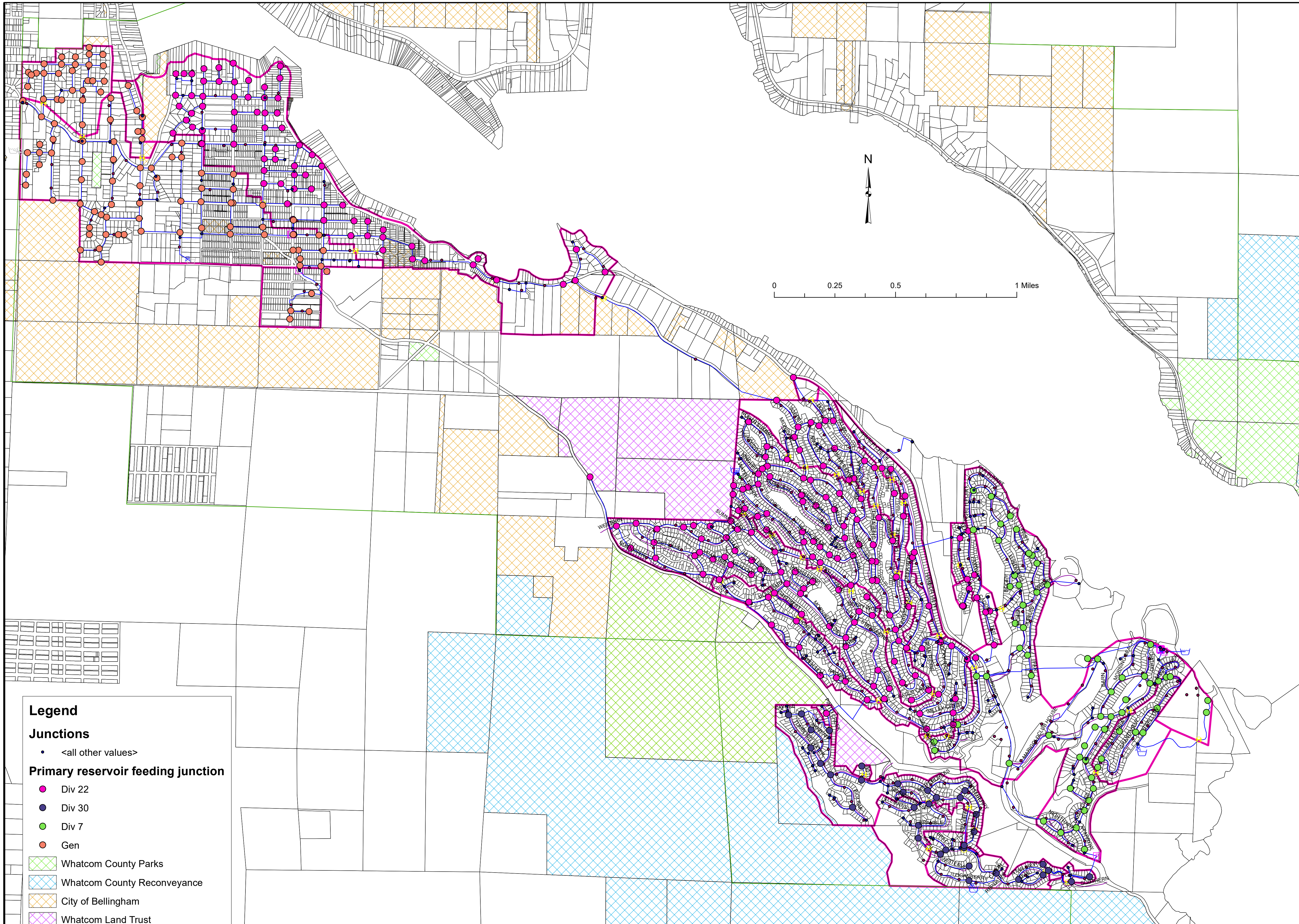
The Sudden Valley water treatment plant has a capacity of 1400 gpm. It is currently operated at 700 gpm but is capable of treating a flow of 1400 gpm, as described in Section 3.3.1 of the water system plan. There is a small amount of treatment plant down-time needed for backwash and filter-to-waste. For this analysis, it is conservatively assumed that the treatment plant can produce its capacity of water 90% of the time. The ERUs below represent this (pumping capacity ERUs x 0.9).

	Sudden Valley	Geneva
Capacity based on treatment capacity (ERUs)	4650	1761

Storage Capacity

This section will analyze the ultimate capacity for the number of ERUs that could be served by each reservoir assuming the treatment plant and pumping was operating at full capacity (1400 gpm).

Figure A-1 shows the service areas of each reservoir. This operation is different from how the system has been previously operated because prior to the construction of the new Division 22 reservoir, a portion of that service area needed to be served by the Division 30 reservoir (via the Division 7 reservoir) to provide sufficient storage. Now that the new Division 22 reservoir is online, more area can be served by the Division 22 reservoirs. This results in a more efficient operation because the Division 22 reservoirs are at a lower elevation than the Division 30 reservoir and therefore pumping costs will be lower by serving the maximum number of connections from Division 22.



LAKE WHATCOM WATER AND SEWER DISTRICT

WHATCOM COUNTY WASHINGTON

FIGURE A–1
SOUTH SHORE RESERVOIR FEED AREAS

DATE	SCALE	JOB NUMBER	SHEET	OF
JULY 2017	As Shown	2016–096	1	1

Coordinate System:
State Plane Washington North
North American Datum 1983

Data Source:
City of Bellingham Public Works Dept.,
Whatcom County Planning & Assessor

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Table A-1 demonstrates the ultimate number of ERUs that could be served by each reservoir. There are seven items in Table A-1 that should be noted about the set-up and assumptions that went in to this table.

1. It is assumed that there is no dead storage beyond the physical raised outlet that is 0.5 ft above the base of each reservoir. No additional dead storage to provide the minimum 20 psi once all storage components have been depleted has been assumed in previous reports because of the District's Resolution 410 (and Resolutions 721, 778, Administrative Code 4.2.1) that provides a credit for a booster pump for those lots too close to distribution reservoirs to provide sufficient gravity pressure. Note that these lots were platted before the minimum required pressure at the service meter was raised from 20 psi to 30 psi under conditions where equalizing storage is depleted.
2. Table A-1 assumes that the Standby Storage for the Division 30 reservoir is allocated to the Division 7 reservoir. This has been previously justified because the pumping system to provide water to Division 30 from Division 7 is fully redundant and has an on-site backup generator to keep it pumping in case of a power outage.
3. Fire suppression storage for all the South Shore reservoirs (except Div 30) is nested within the much larger standby storage volume. This is acceptable per WAC 246-290-235(4).
4. Note that the supply capacities to the Division 7 and Division 22 reservoirs is 700 gpm. This is based on the treatment and pumping capacity of 1400 gpm.
5. Note that Division 22 serves both Sudden Valley and Geneva ERUs. The ratio of the capacities of ERUs to each was set based on the anticipated build-out ratio of ERUs served by the Division 22 reservoirs. Anticipated build-out of Sudden Valley ERUs served by Division 22 is 1978 ERUs and anticipated build-out of Geneva ERUs served by Division 22 is 515 ERUs, for a Sudden Valley to Geneva ratio of 3.84.
6. Peak hourly demand (PHD), equalizing storage, standby storage and fire suppression storage were calculated using the appropriate equations from the Washington Department of Health Water System Design Manual.
7. Operating storage shown represents current operating levels. If additional capacity were needed, operating storage could be decreased.

Table A-1: Sudden Valley and Geneva Reservoir Maximum Storage ERU Capacities

					Operating Storage		MDD (gpd/ERU)		Maximum ERUs		PHD for Reservoir (gpm)					Equalizing Storage		ADD (gpd/ERU)		Standby Storage		Fire Suppression Storage		Dead Storage	
Reservoir	Base Elevation (ft NAVD88)	Reservoir Height to Overflow (ft)	Reservoir Diameter (ft)	Reservoir storage per foot (gal/ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Geneva	Sudden Valley	Geneva Contribution	Sudden Valley Contribution	Flow out to other reservoirs (gpm)	Total PHD for Reservoir (gpm)	Supply Capacities (gpm)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)
Division 7	670.45	35	70	28,786	230,291	27		250		1740		540	165	705	700	809	26.97		150	762,000	0.50	45,000	25.41	14,393	0.00
Division 22	804.65	35	50	14,687	117,496	27	370	250	537	2060	297	629	250	1176	700	71,380	24.84	175	150	805,950	0.50	45,000	23.49	7,343	0.00
Division 22 New	805	35	56	18,423	147,386	27											24.84				0.50		23.49	9,212	0.00
Division 30	1027.98	40	25	3,672	18,359	35		250		800		279	0	279	165	17,143	30.33		150	0	30.33	30,000	22.16	1,836	21.66
Geneva	661.12	32	52	15,885	31,771	30	370		1201		570		0	570	250	47,934	26.98	175		420,350	0.52	45,000	24.15	7,943	0.02

Summary:

		Maximum ERUs			
Reservoir	Existing capacity (gallons)	Geneva	Sudden Valley	Sum of required storage (gallons)	Surplus of storage (gallons)
Division 7	1,007,524		1740	1,007,494	31
Division 22	1,158,859	537	2060	1,158,767	92
Division 22 New					
Division 30	146,869		800	67,337	79,532
Geneva	508,333	1201		507,997	336

In analyzing Table A-1, note that the number of Division 30 ERUs shown does not appear to be the maximum, as there is still a surplus of 79,532 gallons. The reason for this is that the standby storage for the Division 30 ERUs is included in the Division 7 storage. If Division 30 ERUs were increased more, the Division 7 ERUs would need to decrease. The given ERU distribution between Division 30 and Division 7 is a reasonable distribution.

Table A-1 shows that the total ERU capacities for each Sudden Valley and Geneva based on storage capacity are shown below.

	Sudden Valley	**Geneva**
Capacity based on storage capacity (ERUs)	4600	1738

The distribution of these ERUs is limited to the reservoirs as shown in Table A-1. Anticipated build-out in the areas served by each reservoir is addressed below, and the maximum ERU capacity for each reservoir well exceeds anticipated build-out, as discussed in more detail below.

Distribution System Physical Capacity

The physical capacity of the South Shore water system distribution system is analyzed within the hydraulic modeling section of the water system plan. As explained in that section, the limitation on the distribution system is its ability to provide fire flow rates while maintaining adequate system pressure. The distribution system's ability to provide peak hourly flow is not a limiting factor, and therefore the distribution system does not limit the physical capacity of the water system.

Build-Out Analysis

All of the above analysis indicates that the existing physical capacity of the South Shore water system exceeds anticipated build-out within this system. The demands per ERU (ADD and MDD) have been decreasing over time and are anticipated to only continue to decrease as water conservation efforts continue to show results. The decrease over time explains why existing physical capacity exceeds anticipated build-out. Build-out analysis accounts for existing vacant lots but does not necessarily account for future schools or other institutions that may be developed because there are no current plans for development such as this.

Because existing capacity exceeds anticipated build-out, an analysis was performed to show the capacity of each component that would be required for anticipated build-out. This analysis may be useful when any of the existing facilities need to be replaced.

An analysis of anticipated build-out for each reservoir service area indicates that the physical capacity of each reservoir is not distributed proportionally to anticipated build-out ERUs in the service area of each reservoir. A comparison of this is shown below.

Reservoir Service Area	Existing Physical Capacity (ERUs)		Anticipated Build-Out (ERUs)	
	Sudden Valley	Geneva	Sudden Valley	Geneva
Division 7	1740		815	
Division 22	2060	537	1978	515
Division 30	800		474	
Geneva		1201		724

The above table shows that the existing physical capacity of the Division 7 reservoir greatly exceeds anticipated build-out of lots in its service area. It demonstrates that the Division 22 reservoirs are appropriately sized with a small amount of excess capacity beyond anticipated build-out. Division 30 capacity well exceeds anticipated build-out, but this is primarily because its standby storage is allocated from excess storage in Division 7, as discussed previously. The Geneva reservoir is somewhat oversized beyond anticipated build-out, but this allows for flexibility in operating levels and potentially having the ability to serve the lower pressure zone in Geneva instead of that area being served by the Division 22 reservoirs.

Based on anticipated build-out, Table A-2 below was developed to show how much storage volume would be needed to serve anticipated build-out. Division 30 standby storage continues to come from the Division 7 reservoir. Reservoir heights in Table A-2 were left at their existing heights and the diameters were adjusted to approximately match the required storage for the anticipated build-out ERUs. The equalizing storage is calculated based on supply capacities of 700 gpm to Division 22 and Division 7. If future flow rates from treatment and pumping are lowered (as discussed below), equalizing storage would increase slightly. This scenario is addressed in Table A-3.

Table A-2: Reservoir sizing requirements to meet anticipated build-out based on existing treatment/pumping capacity

					Operating Storage		MDD (gpd/ERU)		Build-out ERUs		PHD for Reservoir (gpm)					Equalizing Storage		ADD (gpd/ERU)		Standby Storage		Fire Suppression Storage		Dead Storage	
Reservoir	Base Elevation (ft NAVD88)	Reservoir Height to Overflow (ft)	Adjusted Reservoir Diameter (ft)	Adjusted Reservoir storage per foot (gal/ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Geneva	Sudden Valley	Geneva Contribution	Sudden Valley Contribution	Flow out to other reservoirs (gpm)	Total PHD for Reservoir (gpm)	Supply Capacities (gpm)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)
Division 7	670.45	35	49.9	14,628	117,026	27		250		815		283	165	448	700	0	27.00		150	386,700	0.56	45,000	23.92	7,314	0.06
Division 22	804.65	35	50	14,687	117,496	27	370	250	515	1978	288	607	250	1144	700	66,606	24.90	175	150	773,650	0.54	45,000	23.49	7,343	0.04
Division 22 New	805	35	53.9	17,067	136,540	27											24.90				0.54		23.49	8,534	0.04
Division 30	1027.98	40	12.9	978	4,888	35		250		474		188	0	188	165	3,424	31.50		150	0	31.50	30,000	0.81	489	0.31
Geneva	661.12	32	39.7	9,259	18,518	30	370		724		373		0	373	250	18,519	28.00	175		253,400	0.63	45,000	23.14	4,630	0.13

Summary:

		Build-out ERUs			
Reservoir	Existing capacity (gallons)	Geneva	Sudden Valley	Sum of required storage (gallons)	Surplus of storage (gallons)
Division 7	1,007,524		815	511,040	496,484
Division 22	1,158,859	515	1978	1,110,169	48,690
Division 22 New					
Division 30	146,869		474	38,801	108,069
Geneva	508,333	724		295,066	213,266

To analyze the treatment and pumping capacity needed for anticipated build-out of the South Shore water system, the following equation was used.

$$Pump/treatment\ capacity\ flow\ rate\ = \#\ SV\ ERUs * MDD_{SV} + \#\ Gen\ ERUs * MDD_{Gen}$$

With this equation and the following anticipated build-out information, the pump/treatment capacity needed is shown below.

# Sudden Valley ERUs	3267
# Geneva ERUs	1239
MDD SV (gpd/ERU)	250
MDD Gen (gpd/ERU)	370
Pump/Treatment capacity flow rate (gpm)	886

A treatment and pumping capacity of 886 gpm would meet anticipated build-out of the South Shore system, assuming the treatment plant could produce water 100% of the time during Maximum Day Demand. Because of the need for backwashing and filter-to-waste, a conservative assumption is that the treatment plant could produce water 90% of the time. This would require a treatment and pumping capacity of 984 gpm. This is significantly less than the current capacity of 1400 gpm. If the pumping and treatment capacity was lowered to this flow rate, the transmission pumps could be designed so that they split the 984 proportionally to Division 7 and Division 22 based on anticipated MDD served by each based on multiplying the build-out ERUs by the appropriate MDD (including those reservoirs fed from Division 7 and Division 22). In this scenario, Division 7 would be ultimately serving 25% of the MDD flow, and Division 22 would be serving 75% of the MDD flow. Therefore, the transmission pumps could be sized for a flow rate of the following.

Division 22 transmission pump flow rate (gpm)	738
Division 7 transmission pump flow rate (gpm)	246

Based on these transmission pump flow rates, the reservoir sizing table was re-analyzed and is shown in Table A-3. Table A-3 was set up in the same way as Table A-2 with Division 30 standby storage allocated in Division 7, and reservoir diameters were adjusted to approximately match required storage.

Table A-3: Reservoir sizing requirements to meet anticipated build-out based on treatment/pumping capacity appropriate for anticipated build-out

					Operating Storage		MDD (gpd/ERU)		ERUs		PHD for Reservoir (gpm)					Equalizing Storage		ADD (gpd/ERU)		Standby Storage		Fire Suppression Storage		Dead Storage	
Reservoir	Base Elevation (ft NAVD88)	Reservoir Height to Overflow (ft)	Adjusted Reservoir Diameter (ft)	Adjusted Reservoir storage per foot (gal/ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Geneva	Sudden Valley	Geneva Contribution	Sudden Valley Contribution	Flow out to other reservoirs (gpm)	Total PHD for Reservoir (gpm)	Supply Capacities (gpm)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)
Division 7	670.45	35	51.8	15,763	126,108	27		250		815		283	165	448	246	30,368	25.07		150	386,700	0.54	45,000	22.22	7,882	0.04
Division 22	804.65	35	50	14,687	117,496	27	370	250	515	1978	288	607	250	1144	738	60,906	25.07	175	150	773,650	0.51	45,000	23.64	7,343	0.01
Division 22 New	805	35	53.5	16,815	134,521	27											25.07				0.51		23.64	8,408	0.01
Division 30	1027.98	40	12.9	978	4,888	35		250		474		188	0	188	165	3,424	31.50		150	0	31.50	30,000	0.81	489	0.31
Geneva	661.12	32	39.7	9,259	18,518	30	370		724		373		0	373	250	18,519	28.00	175		253,400	0.63	45,000	23.14	4,630	0.13

Summary:

		Build-out ERUs			
Reservoir	Existing capacity (gallons)	Geneva	Sudden Valley	Sum of required storage (gallons)	Surplus of storage (gallons)
Division 7	1,007,524		815	551,057	456,468
Division 22	1,158,859	515	1978	1,102,324	56,535
Division 22 New					
Division 30	146,869		474	38,801	108,069
Geneva	508,333	724		295,066	213,266

Table A-3 shows that with the treatment/pumping capacity and transmission pump capacity appropriate for anticipated build-out, the Division 7 reservoir has slightly less surplus than what is shown in Table A-2 because the equalizing storage requirement is higher. The Division 22 reservoir has slightly more surplus than what is shown in Table A-2 because the supply capacity is slightly higher and less equalizing storage is needed. Division 30 and Geneva reservoir required storage remains unchanged from Table A-2.

Conclusions

Existing Physical Capacity Conclusion

The physical capacity analysis above shows that the limiting factor in physical capacity of the existing South Shore system when looking at the overall system is the storage capacity. This limits the overall system to the following ERUs.

	Sudden Valley	**Geneva**
Capacity based on most limiting factor [storage] (ERUs)	4600	1738

The distribution of these ERUs is constrained by the geographical distribution of the service areas of each reservoir, as shown in Table A-1. The physical capacity of the existing system exceeds anticipated build-out of each reservoir's service area. Anticipated build-out is addressed in more detail below.

Build-out Physical Capacity

Any proposed changes to the physical capacity of the storage or pumping/treatment capacity in the south shore water system should be designed with this information in mind and analyze the impact to the overall system physical capacity. It is anticipated that distribution system leakage and overall water demand per ERU will continue to decrease over the years. If changes to storage or pumping/treatment capacity are made many years beyond 2017, the Maximum Day and Average Day Demand should be re-assessed, as it is likely that the capacity needed to serve anticipated build-out may decrease. If projects to change these system components are undertaken in the near future, the information in Table A-3 can be used for sizing system components.

Appendix B – Water Use Efficiency Plan

LAKE WHATCOM WATER AND SEWER DISTRICT

WATER USE EFFICIENCY PLAN
2015 UPDATE

FEBRUARY 2016

LAKE WHATCOM WATER AND SEWER DISTRICT

WATER USE EFFICIENCY PLAN
2015 UPDATE

Prepared for:

Lake Whatcom Water and Sewer District

By:

Wilson Engineering, LLC

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LAKE WHATCOM WATER AND SEWER DISTRICT

WATER USE EFFICIENCY PLAN - 2015 UPDATE

The Water Use Efficiency (WUE) Program is designed to promote the goal of ensuring safe and reliable drinking water in our communities. In 2003, the Municipal Water Law was passed by Washington State Legislature. This law addresses the increasing demand on our state's water resources and directs the state Department of Health (DOH) to adopt an enforceable WUE program. This WUE program became effective January 22, 2007, and is intended to achieve a consistently high level of stewardship among all municipal water suppliers.

Lake Whatcom Water and Sewer District (LWWSD) is committed to providing safe, reliable water to their customers and work to ensure that state water resources remain reliable and adequate for future generations. LWWSD has been very active in their pursuit of conservation and system reliability measures. This WUE plan summarizes the progress to date and updates the goals and measures adopted by LWWSD to ensure that all DOH requirements are met.

A. <u>WATER USE DATA COLLECTION REQUIREMENTS</u>

Lake Whatcom Water and Sewer District currently supplies water to four distinct areas: Sudden Valley, Geneva, North Shore/Eagleridge, and North Shore Wells/Agate Heights. The total number of connections served by the District is about 3597, representing 3916 equivalent residential units (as of 12/31/2014).

The District is primarily residential. The District rate structure is based on Equivalent Residential Units (ERUs) with a water allowance for a base bi-monthly fee. Water use above the allowance is charged at a per cubic foot rate with a two tier block rate structure. Multi-family and commercial customers are assigned a number of ERUs and charged the base rate times that number of ERUs.

The District has been collecting water use data for each of the four areas separately. The best available water use data for 2010 through 2014 are included in Appendix A. The District does not sell wholesale water and therefore does not collect data on wholesale water sold.

The District collects customer meter use data by the listed customer classes and is investigating methods for reporting this data. The number of non-residential customers in the District is very small. The water use data by customer class listed in Appendix A, Exhibit 1 is based on an assumption of equal use per ERU throughout the customer classes.

Water use efficiency data will be analyzed once per year and include the following:

- Number of water services renovated/replaced
- Frequency of water conservation bill inserts
- Average Daily Demand (ADD) for each distinct area
- Maximum Daily Demand (MDD) for each distinct area
- Distribution system losses for each distinct area

B. WATER DEMAND FORECAST

The projected future populations used for the Sudden Valley and Geneva Study Areas were based on the projected growth analysis prepared by the District in conjunction with its connection fee analysis. The projected future populations for the North Shore are discussed in detail in the North Shore sections below. Water demand forecast data can be found in Appendix A, Exhibit 2. ADD and MDD were re-evaluated for each area because demand per ERU has decreased significantly in all service areas since the 2010 analysis. New ADD and MDD analysis is described below.

Sudden Valley Area

The Sudden Valley Study Area is a residential area with a golf course and a small strip mall. There are no projected agricultural or industrial water needs. The Sudden Valley Community Association has its own water source for irrigation of the golf course.

The table in Exhibit 2, Appendix A, summarizes the water demand forecasting for the Sudden Valley Study Area. We selected a low population growth projection as growth in the District is slowing. The District holds Surface water rights equivalent to 3.4 cfs maximum instantaneous withdrawal, and an average annual withdrawal of 1,800 acre-feet.

The ADD that was used in the 2010 Water Use Efficiency Plan for Sudden Valley was 207 gpd/ERU. This came from the 1994 Reduced Criteria for average day demand study. ADD since that time in Sudden Valley has decreased. Exhibit 5 shows that the annual ADD from 2012-2014 decreased each year, from 131 gpd/ERU in 2012 to 119 gpd/ERU in 2014. Therefore, an ADD value of 150 gpd/ERU is used for future projections because it is closer to recent demands but remains conservative.

Sudden Valley MDD in the 2010 Plan was 335 gpd/ERU, based on the 1994 study. Exhibit 3 shows that the MDD from 2014-2015 was 175 gpd/ERU, which is significantly lower than the previously used value. 175 gpd/ERU represents an actual MDD:ADD ratio of 1.34, which is relatively low compared to many water systems. This shows that summer demand in the Sudden Valley service area does not increase dramatically. To remain conservative, the historical MDD:ADD ratio of 1.62 was used to approximate an MDD of 250 gpd/ERU. This is used for future Sudden Valley projections. This remains conservative but is closer to recent demands than the previously used value.

Water rights for Sudden Valley are shared with Geneva, and water rights are discussed below with respect to future demand.

Geneva Area

The Geneva area is primarily residential but has two schools and a church complex. There are no projected agricultural or industrial water needs.

The table in Exhibit 2, Appendix A, summarizes the water demand forecasting for the Geneva Study Area. Again, we used the projected growth analysis prepared by the District in conjunction with its connection fee analysis.

In the 2010 Water Use Efficiency Plan, the Geneva area ADD was 245 gpd/ERU. This was based on the 1997 Reduced Criteria study. Similar to Sudden Valley, Geneva has seen decreased ADD since that time. Exhibit 5 shows that annual ADD from 2012-2014 was fairly constant and ranged from 148 to 152 gpd/ERU. To remain conservative but use a value closer to actual recent demand, an ADD of 175 gpd/ERU is used for future projections.

Geneva MDD in the 2010 plan was 500 gpd/ERU from the 1997 Reduced Criteria study. MDD in Geneva has also decreased since then, with the highest MDD from 2014-2015 being 322 gpd/ERU (Exhibit 3). This represents an actual MDD:ADD ratio of 2.12. To maintain a similar MDD:ADD ratio and remain conservative but realistic, MDD for future projections is 370 gpd/ERU.

The demand forecasting shown in the Exhibit 2 table incorporates these reduced criteria. The third table in Exhibit 2 shows the forecast for the combined Sudden Valley and Geneva systems. It can be seen that under the combined full build-out for both systems, annual and instantaneous demands can easily be met with the existing water rights.

North Shore/Eagleridge Area

The Eagleridge Water System services a residential area. There are no Urban Growth Areas in the District's North Shore area and the zoning previously ranged from RR2 to R5A. Whatcom County has imposed restrictions requiring that all new subdivided properties have a minimum of 5 acres. Therefore, any new development will be rural in nature.

The District serves the Eagleridge development and adjacent residences with the existing Eagleridge Water System. This currently consists of 68 developed residences, with a potential to increase to 71 developed residences. There are no projected non-residential water needs. There are no sources for non-revenue water.

The table in Exhibit 2, Appendix A, summarizes the water demand forecasting for the North Shore/Eagleridge Area. There are currently 68 connections, and there are only 3 potential future residences within the service area. The forecast conservatively assumes that these three lots will be developed before 2021.

ADD used in the 2010 Water Use Efficiency Plan for the Eagleridge system was 400 gpd/ERU without conservation savings and 300 gpd/ERU with conservation savings. Average demand in this system has decreased significantly over time, and ADD values for 2012-2014 ranged from 216 to 231 gpd/ERU (Exhibit 5). To remain conservative but more realistic, an ADD value of 250 gpd/ERU is used for future projections (without conservation savings). Considering that there is still room for conservation savings, a projected ADD with conservation savings is 210 gpd/ERU.

Eagleridge MDD in the 2010 Water Use Efficiency Plan was 800 gpd/ERU without conservation savings and 600 gpd/ERU with conservation savings. Typical MDD has decreased in this system, and the highest normal MDD for 2014 and 2015 was 659 GPD/ERU (see Exhibit 3). There was an anomalously high demand day on July 17, 2014, which can be seen in the MDD-July 2014 graph. Demand on this day was more than 2.5 times the demand of any other summer day in 2014 or 2015. There is no clear explanation for demand on this day, as no leaks were reported. Possibilities include problems with the meter or water being pulled from a fire hydrant. Another possibility is an inconsistency in timing of when the meter was read (perhaps it was read early in the day on July 16 and late in the day on July 17). With this in mind, the three-day average demand for July 16-July 18, 2014 was calculated to be 841.09 gpd/ERU. Overall, MDD for Eagleridge is trending toward lower values compared to historical trends, but because of this anomalous day, MDD for Eagleridge will conservatively remain at the previous value of 800 gpd/ERU for future projections without conservation. MDD with projected conservation savings remains 600 gpd/ERU.

The water usage and MDD:ADD ratio in Eagleridge is higher per connection than in other District service areas. This may be due in part to larger lot sizes and more landscaping since the highest water use is during the summer. The District has already seen a substantial reduction in MDD (MDD in 2007 was 818 GPD/ERU) and intends to target Eagleridge for further conservation savings. Eagleridge represents less than 2% of the District's connections.

The demand forecasting shown in the Exhibit 2 table incorporates the reduced criteria for the Eagleridge system. It shows the forecast for Eagleridge demand can easily be met from the existing City Connection with or without conservation savings.

Agate Heights Area

The Agate Heights (Wells) System is also rural residential in nature. The initial system was designed to supply 42 connections (with storage for 52 connections).

The table in Exhibit 2, Appendix A, summarizes the water demand forecasting for the North Shore/Agate Heights Well System Area. The Agate Heights system currently serves 45 residences. Full build-out for this system, as is, would consist of 52 residences. For the forecast, it was conservatively assumed that the additional 7 residences will be developed by 2021. This system may be expanded along Northshore Road to serve potential connections that include approximately 141 ERUs associated with the failed

1995 ULID W-6, 70 properties with pending residential surface water right applications, two small Group A water systems and four Group B water systems. Many of these ERUs represent existing residences that currently draw water directly from Lake Whatcom or private wells.

The ADD used in the 2010 Water Use Efficiency Plan for the Agate Heights system was 300 gpd/ERU without conservation savings and 250 gpd/ERU with conservation savings. Demand in this system has decreased somewhat over time, and ADD values for 2012-2014 ranged from 204 to 209 gpd/ERU (Exhibit 5). To remain conservative but more realistic, an ADD value of 230 gpd/ERU is used for future projections (without conservation savings). Considering that there is still room for conservation savings, a projected ADD with conservation savings is 200 gpd/ERU.

Agate Heights MDD in the 2010 Water Use Efficiency Plan was 800 gpd/ERU without conservation savings and 600 gpd/ERU with conservation savings. MDD has decreased in this system, and MDD for 2014 and 2015 was 446 GPD/ERU (see Exhibit 3). This represents an actual MDD:ADD ratio of 2.13. To maintain a similar MDD:ADD ratio and remain conservative but realistic, MDD for future projections without conservation savings is 500 gpd/ERU. MDD with projected conservation savings is 420 gpd/ERU.

The Agate Heights (Wells) System is supplied by a well with a 60 gpm water right permit (G1-22681P), a 360 gpm water right permit (G1-22763P), and an 18 gpm water right certificate (G1-23449C). The G1-22763P water right permit was tied to the Agate Heights Well System through a water right transfer which was completed in 2003. The G1-23449C water right certificate was tied to the Agate Heights Well System through a water right transfer in 2010 from the Lake Whatcom Residential and Treatment Center. The number of buildout connections does not necessarily represent existing zoning for the original Agate Heights Well System service area since there is the possibility that the Agate Heights system could be expanded to include: the Eagleridge system, at least 141 ERUs associated with the failed 1995 ULID W-6, 70 residential surface water right applications, two small Group A water systems and four Group B water systems in the vicinity of Agate Heights. As can be seen from the Eagleridge and Agate Heights demands, the Agate Heights Well System easily has sufficient water rights to serve Eagleridge and many additional connections. Exhibit 2 shows calculated ERUs that could be served based on the annual and instantaneous water rights and the ADD and MDD, respectively, of the Agate Heights system. Demand for new connections would need to be assessed to determine the number of additional connections that could be served from the Agate Heights Wells System.

C. WATER USE EFFICIENCY GOALS

The District developed Water Use Efficiency goals in conjunction with public input. The following goals were presented for public comment before being incorporated into the WUE Plan.

2010 Goals and Results:

1. Reduce distribution system losses in South Shore and Agate Heights service areas. The near-term (<2 years)goal is to have less than 15% apparent distribution system losses for each system; the long term (2-5 years) goal is to meet the WUE 10% distribution system loss standard.
    a. This goal was proposed after analyzing and reviewing water distribution system losses. Ideally, the losses would be less than 10% in all service areas. This goal is designed to help reduce supply side demand by reducing unaccounted for losses, which not only reduces the physical quantity of water required, but also helps to fine tune the pumping system and maximize pumping efficiency.
    b. Measured distribution system losses for the South Shore for 2012-2014 were trending down with a trend such that it was on target to meet the goal by 2015 (2015 data was not yet available). Measured distribution system losses for Agate Heights for 2012-2014 averaged 2.8%, well below the 10% loss standard.
2. Reduce residential consumption in Eagleridge service area during summer months by 10% (from 820 gpd to 738 gpd, average of three years).
    a. This goal was proposed after analyzing water use data for maximum day demand (see Exhibit 3 in Appendix A). The data shows that Eagleridge has an abnormally high consumption rate during summer months. This is most likely due to the large lot size in the area.
    b. Summer usage for Eagleridge, Sudden Valley, and Geneva was below the flow rate target set by this goal (Agate Heights was not). But average usage throughout the year for these areas also decreased, so the summer peak as a percentage did not reach the goals.

3. Maintain residential consumption levels in other service areas at 207 gpd to 250 gpd per connection.
    a. This goal was proposed after analyzing water use data from the past 3 years. It was determined that the current consumption levels were low and maintaining them is an appropriate goal.
    b. Usage decreased substantially from 2007-2009 averages to 2012-2014 averages in all areas except Agate Heights.
        i. Sudden Valley usage decreased by 25.4%
        ii. Geneva usage decreased by 21.7%
        iii. Agate Heights usage increased by 5.9%
        iv. Eagleridge usage decreased by 16.3%

2015 Goals:

1. Reduce Distribution System Losses in South Shore (Geneva and Sudden Valley) service areas. The goal is to reach and maintain less than 10% losses in all service areas.
2. Reduce high peak residential consumption in all service areas. Goal sets target summer peak usage by service area by 2020:

Summer Peak Targets	2020 Target Summer Usage per Capita (GPD)
SUDDEN VALLEY	55
GENEVA	65
AGATE HEIGHTS	75
EAGLERIDGE	100

3. Reduce the 3-year average annual per capita usage in Sudden Valley and Geneva by 2% and annual per capita usage in Eagleridge and Agate Heights by 10% by 2020, as shown below:

3-yr Average Annual Targets	Current Annual Usage per Capita (GPD)	2020 Target Annual Usage per Capita (GPD)
SUDDEN VALLEY	44.0	43.2
GENEVA	47.6	46.6
AGATE HEIGHTS	69.2	62.3
EAGLERIDGE	74.5	67.0

D. WATER USE EFFICIENCY MEASURES

1. The District is required to implement the following WUE Measures:

- Install production (source) meters – *Complete*
- Install consumption (service) meters – *Complete*
- Perform Meter Calibration – *Ongoing*
- Implement a water loss control action plan to control leakage – *Plan implemented; progress is good*
- Educate customers about water use efficiency practices – *Ongoing; bimonthly bills contain water conservation information*

2. The District has identified several (additional) supply-side WUE Measures it plans to implement:

- Improve record-keeping of non-metered authorized consumption (hydrant flushing, construction, gravity sewer flushing, Fire Department training, quantify known leaks, etc.). – *Ongoing*
- Replace service meters (age, failure); track progress. – *Ongoing*
  2010 – 20; 2011 – 22; 2012 – 60;
  2013 – 64; 2014 – 74; 2015 – 49
- Replace malfunctioning and obsolete fire hydrants. – *Ongoing*
- Control unauthorized use of water. – *Ongoing*
- Monitor overnight tank levels for unusual drops. – *Ongoing*

3. The District is required to implement a minimum of 6 consumption-side WUE Measures. Since measures are implemented for all 4 customer classes, the WUE rule counts each as 4 measures:

- Conservation Rate Structure (+4) – Each customer class (4) counts as a measure
- Water bill showing consumption history (+4)
- Customer conservation education (see Appendix B) (newsletter, bill stuffers) (+4)
- Customer leak education (See Appendix B) (+4)
- Participate in Regional water conservation programs and/or measures (+1)
  Total: 17 WUE Measures

E. DISTRIBUTION SYSTEM LEAKAGE

Distribution system losses have been reduced in all District service areas. A summary of the improvements are listed below. Detailed data is attached Exhibit 4 in Appendix A.

Sudden Valley Area

The Sudden Valley water system has a history of high levels of distribution system losses. The three-year average distribution system losses in 2005-2007 were 27.59%. The 2012-2014 three-year average is 12.86%, with 2014 being the lowest rate at 10.95%. The District also maintains a program to estimate and track system leaks in an effort to correlate events with fluctuations in unaccounted for water.

Geneva Area

The three-year average distribution system losses in Geneva for 2005-2007 were 10.97%. The 2012-2014 three-year average is 9.1%, with 2014 being the lowest rate at 8.61%. The District recently replaced about 1300 feet of AC water main and all associated service lines in Geneva. The majority of the new mains were ductile iron, with about 1,000 feet of HDPE in challenging construction locations. This may have a positive impact toward reducing distribution system losses. There are no major non-revenue water users.

The District reports on these two service areas in a single WUE report for the South Shore Water System. The combined 2012-2014 three-year average leakage from the data used in this report is 11.61%. There is a slight discrepancy between this and the 2012-2014 average leakage reported on the annual Water Use Efficiency report (12.1%). The difference is likely due to a small difference in the time that the meters were read.

North Shore/Eagleridge Area
Distribution system losses in this system remain minimal, averaging 2.87% from 2012 to 2014.

Agate Heights Area
The distribution system losses in 2005-2007 ranged from 4.4% to 46.1%. There were several data anomalies in this system that may have been due to water testing or other un-metered use. These have been corrected and/or accounted for, and the 2012-2014 three-year average is 2.83%.

F. RATE STRUCTURES

The current rate structure for Lake Whatcom Water and Sewer District is an inclining block rate, as follows:

Current Rates for 2015 – Every Two Months

Every Two Months	
Water	$52.68
Sewer	$148.03
Total Basic Rate	$200.71

Water per cubic ft. over 600 CF up to 2,500 CF	$7.48 / 100 CF
Water per cubic ft. over 2,500 CF	$9.35 / 100 CF

The basic rate of $52.68 includes a usage allocation of 600 cu ft. Any usage over 600 cu ft but less than 2,500 cu ft is billed at $7.48 per 100 cu ft. Any usage over 2,500 cu ft is billed at $9.35 per 100 cu ft. This is a stepped rate structure with two steps. The rate structure encourages water conservation and is considered a conservative rate structure. The District adopted this new two-tier rate structure in 2014 and implemented it in January 2015. The District will evaluate the effectiveness of this rate structure in encouraging more water conservation.

G. RECLAIMED WATER OPPORTUNITIES

Lake Whatcom Water and Sewer District currently sends all sewerage collected to the City of Bellingham for wastewater treatment. Since the District does not have any facilities to process wastewater, and the City's treatment plant is over 8 miles from the District's service areas, there are no immediate opportunities for implementing reclaimed water projects within the District. The City currently has no plans to implement any reclaimed water projects. It is unlikely that the District will pursue any reclaimed water projects in the next six years.

The District did include advanced wastewater treatment as one of the alternatives evaluated in the Final Environmental Impact Statement for South Shore Sewage Disposal Alternatives (August 1997) although this alternative was not ultimately selected. The advanced wastewater plant would have produced up to 1 MGD of reclaimed quality water.

The most obvious potential consumer of reclaimed water in the District service area would be the Sudden Valley Community Association (SVCA) golf course. However, SCVA holds water rights for withdrawals from Lake Louise which they use for irrigating the golf course. They do not purchase water from the District for irrigating the golf course.

H. <u>WATER SUPPLY CHARACTERISTICS</u>

1) **Source(s) description:**
   The two sources of water for Lake Whatcom Water and Sewer District are Lake Whatcom and the Squalicum Aquifer, both located in the Lake Whatcom Watershed. The Watershed receives 45-60 inches of rain annually, which aids the recharge of both the aquifer and the lake.

2) **Name and location of the source(s)**
   Lake Whatcom – Whatcom County, just East of Bellingham, Whatcom County
   Squalicum Aquifer – Located just North of Lake Whatcom, Whatcom County

3) **Production Capacity** Lake Whatcom holds roughly 250 Billion gallons, and is replenished by water from the Nooksack River (via diversion) and multiple streams. The Districts Agate Heights well has a production capacity of 465 gpm, and Water Rights for 438 gpm.

4) **Seasonal Variability**
   Seasonal weather changes do not impact the District's ability to provide water to their customers, and the sources have shown little change in capacity. However, the District strongly encourages limited out-door water use during dry months.

5) **Water rights**
   The District has surface water rights and reservoir rights of 1526 gpm instantaneous and 1800 afy (acre-feet per year) annual from Lake Whatcom. The District has ground water rights of 438 gpm instantaneous and 506.9 afy (acre-feet per year) annual from the Squalicum Aquifer.

6) **Legal Constraints**
   Both sources are shared with multiple parties, the most notable being the City of Bellingham. This does not limit the District's use of the water in any significant way.

For more information about Lake Whatcom, see http://www.lakewhatcom.whatcomcounty.org/about-the-lake.

APPENDIX A: WATER USE DATA TABLES

(note: the Sudden Valley Water System is on a different billing cycle than the other water systems, and as such will have unique monthly cycles)

EXHIBIT 1

2014 WATER USE PER CUSTOMER CLASS

Total Bi-Monthly Volume in Cubic Feet (CF), assuming equal use per ERU

SUDDEN VALLEY WATER SYSTEM

	Volume (CF)					
CUSTOMER CLASS	**DEC/JAN**	**FEB/MAR**	**APR/MAY**	**JUN/JUL**	**AUG/SEP**	**OCT/NOV**
Single Family Residences	1,886,937	1,840,164	1,836,093	2,249,422	2,390,495	1,928,201
Multi-family Residences	198,412	193,494	192,983	236,324	250,930	202,317
Recreational Services (Campsites, RV Sites, Spigots)	4,859	4,739	4,726	5,788	6,145	4,955
Institutional, Commercial, or Industrial Services	63,978	62,392	62,227	76,203	80,912	65,237
Total Residential CF	2,085,349	2,033,658	2,029,076	2,485,746	2,641,426	2,130,518
Total Non-Residential CF	68,837	67,130	66,953	81,990	87,057	70,191
Total Volume (CF)	**2,154,186**	**2,100,788**	**2,096,029**	**2,567,736**	**2,728,483**	**2,200,709**

GENEVA WATER SYSTEM

	Volume (CF)					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	1,043,149	915,741	1,129,403	1,528,291	1,114,990	954,076
Multi-family Residences	57,145	49,867	61,320	82,814	60,359	51,648
Recreational Services (Campsites, RV Sites, Spigots)	1,039	907	1,115	1,506	1,097	939
Outdoors	1,039	907	1,115	1,506	1,097	939
Institutional, Commercial, or Industrial Services	66,496	58,027	71,354	96,365	70,236	60,099
Total Residential CF	1,100,293	965,608	1,190,723	1,611,104	1,175,349	1,005,724
Total Non-Residential CF	68,574	59,841	73,584	99,377	72,430	61,977
Total Volume (CF)	**1,168,867**	**1,025,449**	**1,264,307**	**1,710,481**	**1,247,779**	**1,067,701**

AGATE HEIGHTS WATER SYSTEM

	Volume (CF)					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	58,903	52,398	68,739	76,174	62,955	54,793
Institutional, Commercial, or Industrial Services (LWRTC)	10,851	9,652	12,663	14,032	11,597	10,093
Total Residential CF	58,903	52,398	68,739	76,174	62,955	54,793
Total Non-Residential CF	10,851	9,652	12,663	14,032	11,597	10,093
Total Volume (CF)	**69,754**	**62,050**	**81,402**	**90,206**	**74,552**	**64,886**

JOHNSON WELLS WATER SYSTEM

	Volume (CF)					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	2,640	2,158	2,682	3,709	2,736	2,274

EAGLERIDGE WATER SYSTEM

	Volume (CF)					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	81,351	68,586	110,181	220,421	145,832	75,747

EXHIBIT 1

2014 WATER USE PER CUSTOMER CLASS

Number of Equivalent Residential Units (ERUs)

SUDDEN VALLEY WATER SYSTEM

	ERU					
CUSTOMER CLASS	**DEC/JAN**	**FEB/MAR**	**APR/MAY**	**JUN/JUL**	**AUG/SEP**	**OCT/NOV**
Single Family Residences	2,330	2,330	2,331	2,332	2,334	2,335
Multi-family Residences	245	245	245	245	245	245
Recreational Services (Campsites, RV Sites, Spigots)	6	6	6	6	6	6
Institutional, Commercial, or Industrial Services	79	79	79	79	79	79
Total Residential ERUs	2,575	2,575	2,576	2,577	2,579	2,580
Total Non-Residential ERUs	85	85	85	85	85	85
Total ERUs	**2,660**	**2,660**	**2,661**	**2,662**	**2,664**	**2,665**

GENEVA WATER SYSTEM

	ERU					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	1,004	1,010	1,013	1,015	1,016	1,016
Multi-family Residences	55	55	55	55	55	55
Recreational Services (Campsites, RV Sites, Spigots)	1	1	1	1	1	1
Outdoors	1	1	1	1	1	1
Institutional, Commercial, or Industrial Services	64	64	64	64	64	64
Total Residential ERUs	1,059	1,065	1,068	1,070	1,071	1,071
Total Non-Residential ERUs	66	66	66	66	66	66
Total ERUs	**1,125**	**1,131**	**1,134**	**1,136**	**1,137**	**1,137**

AGATE HEIGHTS WATER SYSTEM

	ERU					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	38	38	38	38	38	38
Institutional, Commercial, or Industrial Services (LWRTC)	7	7	7	7	7	7
Total Residential ERUs	38	38	38	38	38	38
Total Non-Residential ERUs	7	7	7	7	7	7
Total ERUs	**45**	**45**	**45**	**45**	**45**	**45**

JOHNSON WELLS WATER SYSTEM

	ERU					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	2	2	2	2	2	2

EAGLERIDGE WATER SYSTEM

	ERU					
CUSTOMER CLASS	**JAN/FEB**	**MAR/APR**	**MAY/JUN**	**JUL/AUG**	**SEP/OCT**	**NOV/DEC**
Single Family Residences	67	67	67	67	67	67

EXHIBIT 1

2014 AVERAGE DAILY WATER USE PER SYSTEM

Gallons per day per ERU

SUDDEN VALLEY WATER SYSTEM

GPD/ERU

	DEC/JAN	FEB/MAR	APR/MAY	JUN/JUL	AUG/SEP	OCT/NOV	ANNUAL AVG
Average Usage/ERU	99	97	97	118	126	101	106

GENEVA WATER SYSTEM

GPD/ERU

	JAN/FEB	MAR/APR	MAY/JUN	JUL/AUG	SEP/OCT	NOV/DEC	ANNUAL AVG
Average Usage/ERU	134	113	139	188	139	119	139

AGATE HEIGHTS WATER SYSTEM

GPD/ERU

	JAN/FEB	MAR/APR	MAY/JUN	JUL/AUG	SEP/OCT	NOV/DEC	ANNUAL AVG
Average Usage/ERU	200	172	226	250	210	183	207

JOHNSON WELLS WATER SYSTEM

GPD/ERU

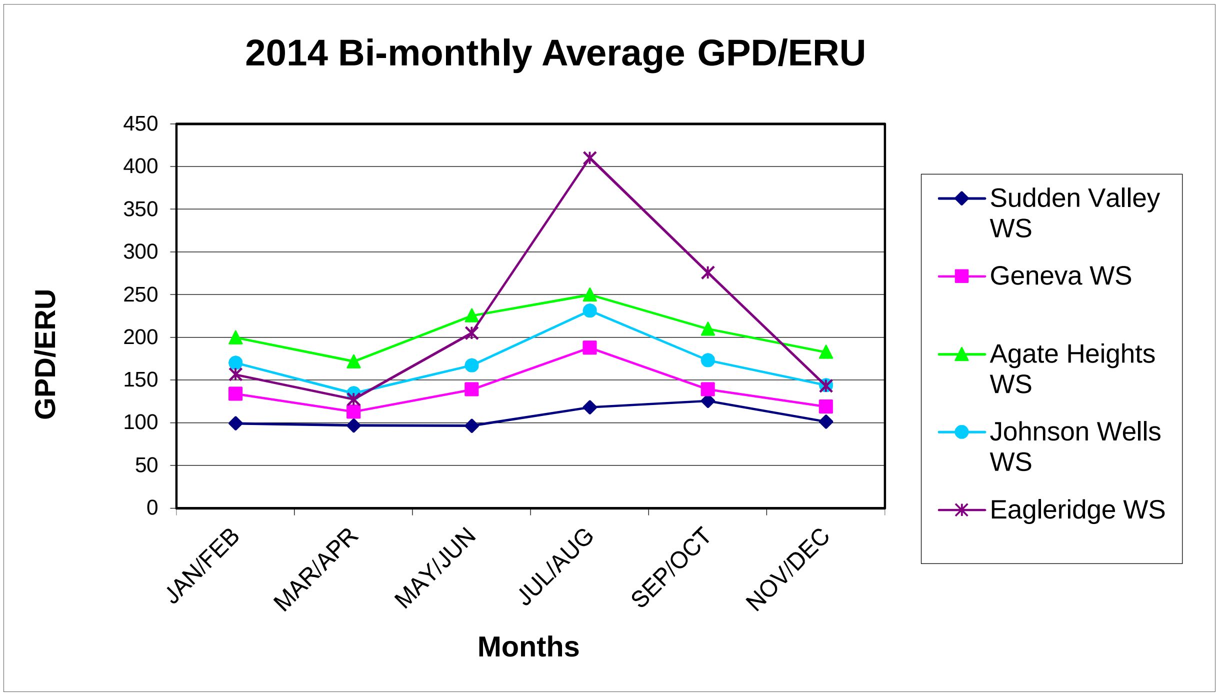
	JAN/FEB	MAR/APR	MAY/JUN	JUL/AUG	SEP/OCT	NOV/DEC	ANNUAL AVG
Average Usage/ERU	170	135	167	231	173	144	171

EAGLERIDGE WATER SYSTEM

GPD/ERU

	JAN/FEB	MAR/APR	MAY/JUN	JUL/AUG	SEP/OCT	NOV/DEC	ANNUAL AVG
Average Usage/ERU	157	128	205	410	276	143	221

EXHIBIT 1



2014 Bi-monthly Average GPD/ERU
GPD/ERU
450
400
350
300
250
200
150
100
50
0
JAN/FEB
MAR/APR
MAY/JUN
JUL/AUG
SEP/OCT
NOV/DEC
Months
Sudden Valley WS
Geneva WS
Agate Heights WS
Johnson Wells WS
Eagleridge WS

EXHIBIT 2

Water Demand Forecasting

SUDDEN VALLEY WATER SYSTEM

Water Demand Forecasting	ERUs	With Conservation Savings	
		Total Average Volume -GPD *(based on ADD= 150 gpd/ERU)*	**Maximum Daily Volume-GPD** *(based on MDD= 250 gpd/ERU)*
Current - 2015	2667	400,050	666,750
Six years - 2021	2721	408,150	680,250
20 years - 2035	2847	427,050	711,750
Full build-out	**3267**	490,050	816,750
Water Rights – Annual / Instant. (shared with Geneva)		Annual (Daily Avg) = 1,607,178 GPD Instantaneous = 2,197,472 GPD	

GENEVA WATER SYSTEM

Water Demand Forecasting	ERUs	With Conservation Savings	
		Total Average Volume -GPD *(based on ADD= 175 gpd/ERU)*	**Maximum Daily Volume-GPD** *based on MDD= 370 gpd/ERU)*
Current - 2015	1139	199,325	421,430
Six years - 2021	1181	206,675	436,970
20 years - 2035	1230	215,250	455,100
Full build-out	**1543**	270,025	570,910
Water Rights – Annual / Instant. (shared with Sudden Valley)		Annual (Daily Avg) = 1,607,178 GPD Instantaneous = 2,197,472 GPD	

COMBINED SUDDEN VALLEY/GENEVA WATER SYSTEMS

Water Demand Forecasting	ERUs	With Conservation Savings	
		Total Average Volume *(GPD)*	**Maximum Daily Volume** *(GPD)*
Current - 2015	3806	599,375	1,088,180
Six years - 2021	3902	614,825	1,117,220
20 years - 2035	4077	642,300	1,166,850
Sudden Valley full build-out	3267	490,050	816,750
Geneva full build-out	1543	270,025	570,910
Combined full build-out	**4810**	**760,075**	**1,387,660**
Water Rights – Annual / Instant.		Annual (Daily Avg) = 1,607,178 GPD Instantaneous = 2,197,472 GPD	

* ADD and MDD values are based on source data which includes distribution system leakage.

EXHIBIT 2

Water Demand Forecasting

NORTH SHORE /EAGLERIDGE WATER SYSTEM

Water Demand Forecasting	ERUs	**Without Conservation Savings**	
		Total Average Volume -GPD *(based on ADD= 250 gpd/ERU)*	**Maximum Daily Volume-GPD** *(based on MDD= 800 gpd/ERU)*
Current - 2015	68	17,000	54,400
Six years - 2021	71	17,750	56,800
20 years - 2035	71	17,750	56,800
Full build-out**	71	17,750	56,800
City Connection – 150 gpm	*270*	216,000 gpd	

NORTH SHORE /EAGLERIDGE WATER SYSTEM

Water Demand Forecasting	ERUs	**With Conservation Savings**	
		Total Average Volume -GPD *(based on ADD= 210 gpd/ERU)*	**Maximum Daily Volume-GPD** *(based on MDD= 600 gpd/ERU)*
Current - 2015	68	14,280	40,800
Six years - 2021	71	14,910	42,600
20 years - 2035	71	14,910	42,600
Full build-out **	71	14,910	42,600
City Connection – 150 gpm	*360*	216,000 gpd	

* ADD and MDD values are based on source data which includes distribution system leakage.
** Based on including all vacant lots to determine maximum potential connections. Will require ULID for construction of additional water sytem facilities.

EXHIBIT 2

Water Demand Forecasting

NORTH SHORE /AGATE HEIGHTS WELL SYSTEM

Water Demand Forecasting		Without Conservation Savings	
	ERUs	**Total Average Volume -GPD** *(based on ADD= 230 gpd/ERU)*	**Maximum Daily Volume-GPD** *(based on MDD= 500 gpd/ERU)*
Current - 2015	45	10,350	22,500
Six years - 2021	52	11,960	26,000
20 years - 2035	52	11,960	26,000
Full build-out**	52	11,960	26,000
Water Rights – Annual	*1968*	Annual (Daily Avg) = 452,530 GPD	
Water Rights – Instantaneous	*1261*	Instantaneous = 630,720 GPD (438 GPM)	

NORTH SHORE /AGATE HEIGHTS WELL SYSTEM

Water Demand Forecasting		With Conservation Savings	
	ERUs	**Total Average Volume -GPD** *(based on ADD= 200 gpd/ERU)*	**Maximum Daily Volume-GPD** *(based on MDD= 420 gpd/ERU)*
Current - 2015	45	9,000	18,900
Six years - 2021	52	10,400	21,840
20 years - 2035	52	10,400	21,840
Full build-out**	52	10,400	21,840
Water Rights – Annual	*2263*	Annual (Daily Avg) = 452,530 GPD	
Water Rights – Instantaneous	*1502*	Instantaneous = 630,720 GPD (438 GPM)	

* ADD and MDD values are based on source data which includes distribution system leakage.
** Based on including all vacant lots to determine maximum potential connections. Will require ULID for construction of additional water sytem facilities.

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2014

SUDDEN VALLEY

July 2014 Date	Plant Production (100's CF)	Days Elapsed	Geneva Volume (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Jul	609.4	1	27,400.00	33,540.00	250,895.97	94.07
2-Jul	602.4	1	32,500.00	27,740.00	207,509.07	77.81
3-Jul	**858.2**	**1**	**30,200.00**	**55,620.00**	**416,065.41**	**156.01**
4-Jul	655.8	1	31,475.00	34,105.00	255,122.45	95.66
5-Jul	630.9	1	31,475.00	31,615.00	236,496.01	88.67
6-Jul	656.2	1	31,475.00	34,145.00	255,421.67	95.77
7-Jul	686.8	1	31,475.00	37,205.00	278,312.00	104.35
8-Jul	666.0	1	35,600.00	31,000.00	231,895.50	86.95
9-Jul	887.9	1	37,500.00	51,290.00	383,674.85	143.86
10-Jul	634.5	1	34,500.00	28,950.00	216,560.48	81.20
11-Jul	619.2	1	25,800.00	36,120.00	270,195.66	101.31
12-Jul	744.6	1	37,633.33	36,826.67	275,481.88	103.29
13-Jul	712.4	1	37,633.33	33,606.67	251,394.67	94.26
14-Jul	834.3	1	37,633.33	45,796.67	342,581.97	128.45
15-Jul	619.9	1	40,800.00	21,190.00	158,511.80	59.43
16-Jul	742.2	1	36,600.00	37,620.00	281,416.41	105.52
17-Jul	643.5	1	39,800.00	24,550.00	183,646.28	68.86
18-Jul	833.7	1	41,300.00	42,070.00	314,704.64	118.00
19-Jul	610.9	1	25,833.33	35,256.67	263,737.50	98.89
20-Jul	558.2	1	25,833.33	29,986.67	224,315.26	84.11
21-Jul	614.4	1	25,833.33	35,606.67	266,355.67	99.87
22-Jul	606.1	1	29,600.00	31,010.00	231,970.31	86.98
23-Jul	581.2	1	28,500.00	29,620.00	221,572.41	83.08
24-Jul	565.5	1	19,200.00	37,350.00	279,396.68	104.76
25-Jul	548.2	1	24,200.00	30,620.00	229,052.91	85.88
26-Jul	559.7	1	26,500.00	29,470.00	220,450.34	82.66
27-Jul	613.6	1	26,500.00	34,860.00	260,770.23	97.78
28-Jul	687.1	1	26,500.00	42,210.00	315,751.91	118.39
29-Jul	592.1	1	33,200.00	26,010.00	194,567.81	72.95
30-Jul	787.6	1	27,700.00	51,060.00	381,954.33	143.21
31-Jul	637.2	1	39,200.00	24,520.00	183,421.86	68.77
			Max Day Demand	55620.00	416065.41	156.01

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2014

GENEVA

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
30-Jun	991301					
1-Jul	991575	1	274	27,400.00	204,965.70	179.95
2-Jul	991900	1	325	32,500.00	243,116.25	213.45
3-Jul	992202	1	302	30,200.00	225,911.10	198.34
7-Jul	993461	4	1259	31,475.00	235,448.74	206.72
8-Jul	993817	1	356	35,600.00	266,305.80	233.81
9-Jul	994192	1	375	37,500.00	280,518.75	246.29
10-Jul	994537	1	345	34,500.00	258,077.25	226.58
11-Jul	994795	1	258	25,800.00	192,996.90	169.44
14-Jul	995924	3	1129	37,633.33	281,516.15	247.16
15-Jul	996332	1	408	40,800.00	305,204.40	267.96
16-Jul	996698	1	366	36,600.00	273,786.30	240.37
17-Jul	997096	1	398	39,800.00	297,723.90	261.39
18-Jul	**997509**	**1**	**413**	**41,300.00**	**308,944.65**	**271.24**
21-Jul	998284	3	775	25,833.33	193,246.25	169.66
22-Jul	998580	1	296	29,600.00	221,422.80	194.40
23-Jul	998865	1	285	28,500.00	213,194.25	187.18
24-Jul	999057	1	192	19,200.00	143,625.60	126.10
25-Jul	999299	1	242	24,200.00	181,028.10	158.94
28-Jul	1000094	3	795	26,500.00	198,233.25	174.04
29-Jul	1000426	1	332	33,200.00	248,352.60	218.04
30-Jul	1000703	1	277	27,700.00	207,209.85	181.92
31-Jul	1001095	1	392	39,200.00	293,235.60	257.45
			Max Day Demand	41300.00	308944.65	271.24

EAGLERIDGE

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU	
30-Jun	53026						
1-Jul	53071	1	45	4,500.00	33,662.25	502.42	
2-Jul	53127	1	56	5,600.00	41,890.80	**625.24**	
3-Jul	53177	1	50	5,000.00	37,402.50	558.25	
7-Jul	53313	4	136	3,400.00	25,433.70	379.61	
8-Jul	53345	1	32	3,200.00	23,937.60	357.28	
9-Jul	53394	1	49	4,900.00	36,654.45	547.08	
10-Jul	53445	1	51	5,100.00	38,150.55	569.41	
11-Jul	53496	1	51	5,100.00	38,150.55	569.41	
14-Jul	53533	3	37	1,233.33	9,225.95	137.70	
15-Jul	53567	1	34	3,400.00	25,433.70	379.61	3-day avg.
16-Jul	53607	1	40	4,000.00	29,922.00	446.60	GPD/ERU
17-Jul	**53758**	**1**	**151**	**15,100.00**	**112,955.55**	**1,685.90**	**841.09**
18-Jul	53793	1	35	3,500.00	26,181.75	390.77	
21-Jul	53883	3	90	3,000.00	22,441.50	334.95	
22-Jul	53918	1	35	3,500.00	26,181.75	390.77	
23-Jul	53950	1	32	3,200.00	23,937.60	357.28	
24-Jul	53974	1	24	2,400.00	17,953.20	267.96	
25-Jul	54004	1	30	3,000.00	22,441.50	334.95	
28-Jul	54104	3	100	3,333.33	24,935.00	372.16	
29-Jul	54135	1	31	3,100.00	23,189.55	346.11	
30-Jul	54171	1	36	3,600.00	26,929.80	401.94	
31-Jul	54205	1	34	3,400.00	25,433.70	379.61	
	Max Day Demand other than July 17			5600.00	41890.80	625.24	

*17-Jul was an anomalously high reading

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2014

AGATE HEIGHTS

Date	Meter Reading (Gallons)	Days Elapsed	Volume Change (Gallons)	Average Daily Volume (Gal.)		GPD/ERU	Three Day Average
30-Jun	2306456						
2-Jul	2326229	2	19773	9,886.50		224.69	224.69
4-Jul	2346676	2	20447	10,223.50		232.35	229.80
6-Jul	2365407	2	18731	9,365.50		212.85	219.35
7-Jul	2371978	1	6571	6,571.00		149.34	191.68
8-Jul	2390838	1	18860	18,860.00		428.64	263.61
10-Jul	2413270	2	22432	11,216.00		254.91	312.82
11-Jul	2415128	1	1858	1,858.00		42.23	184.02
12-Jul	2437528	1	22400	22,400.00		509.09	268.74
14-Jul	2463951	2	26423	13,211.50		300.26	369.87
15-Jul	2471231	1	7280	7,280.00		165.45	255.33
16-Jul	**2495702**	**1**	**24471**	**24,471.00**		**556.16**	340.63
17-Jul	2501911	1	6209	6,209.00		141.11	287.58
18-Jul	2525138	1	23227	23,227.00		527.89	**408.39**
20-Jul	2544710	2	19572	9,786.00		222.41	324.23
22-Jul	2564743	2	20033	10,016.50		227.65	225.90
24-Jul	2582834	2	18091	9,045.50		205.58	212.94
26-Jul	2601981	2	19147	9,573.50		217.58	213.58
28-Jul	2625836	2	23855	11,927.50		271.08	253.25
30-Jul	2647696	2	21860	10,930.00		248.41	255.97
			Max Day Demand	24,471.00		556.16	408.39

JOHNSON WELL

Date	Meter Reading (CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Jul	101480					
9-Jul	**101945**	**8**	**465**	**58.13**	**434.80**	**217.40**
15-Jul	102278	6	333	55.50	415.17	207.58
23-Jul	102739	8	461	57.63	431.06	215.53
30-Jul	103060	7	321	45.86	343.03	171.52
			Max Day Demand	58.13	434.80	217.40

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2014

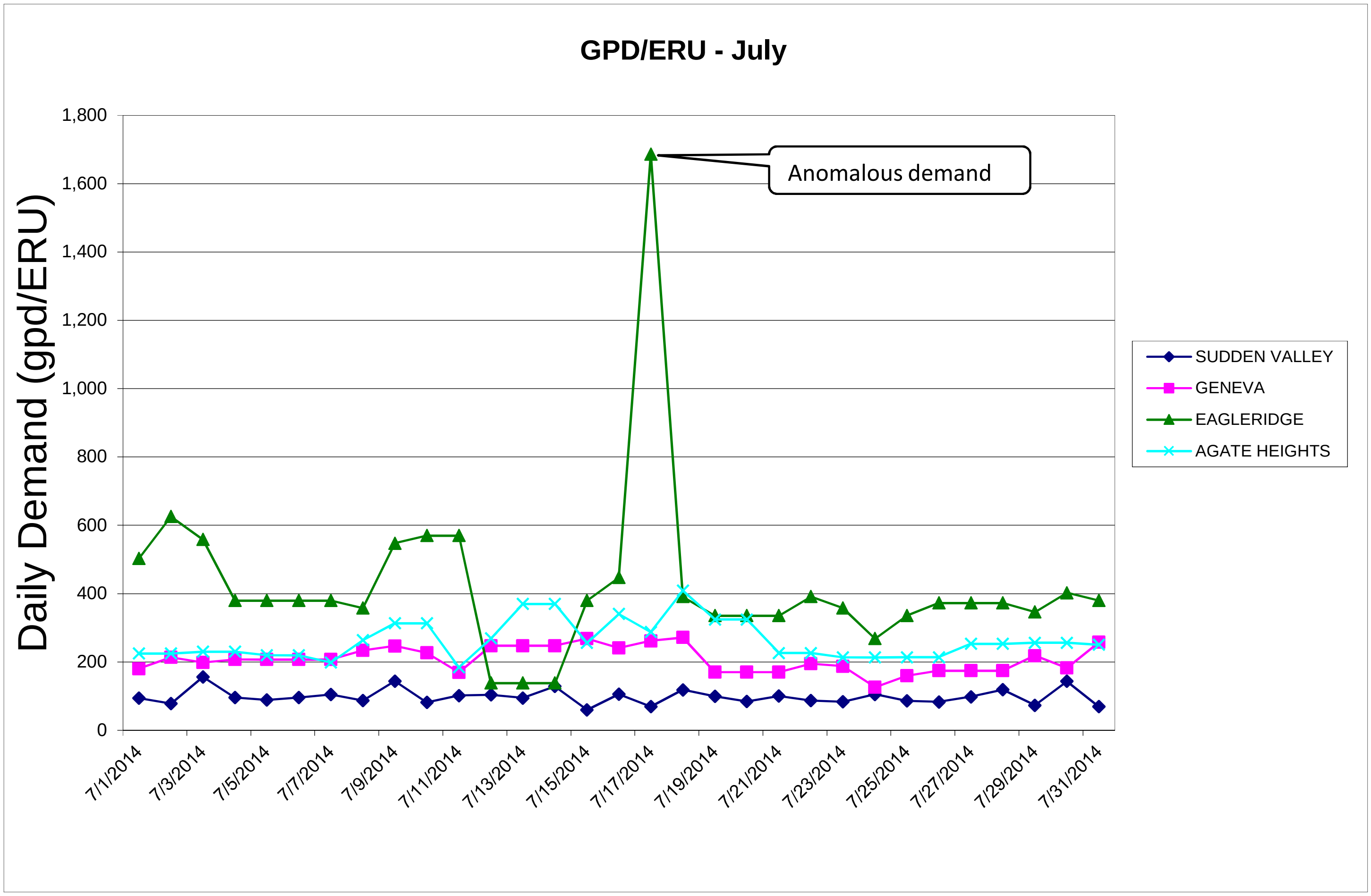


EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2014

SUDDEN VALLEY

Aug 2015 Date	Plant Production (100's CF)	Days Elapsed	Geneva Volume (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Aug	678.00	1	27,600.00	40,200.00	300,716.10	112.67
2-Aug	629.60	1	34,666.67	28,293.33	211,648.28	79.30
3-Aug	**902.70**	**1**	**34,666.67**	**55,603.33**	**415,940.74**	**155.84**
4-Aug	709.70	1	34,666.67	36,303.33	271,567.09	101.75
5-Aug	707.50	1	35,200.00	35,550.00	265,931.78	99.64
6-Aug	599.50	1	31,100.00	28,850.00	215,812.43	80.86
7-Aug	843.70	1	31,400.00	52,970.00	396,242.09	148.46
8-Aug	711.30	1	34,600.00	36,530.00	273,262.67	102.38
9-Aug	669.70	1	34,566.67	32,403.33	242,393.14	90.82
10-Aug	666.30	1	34,566.67	32,063.33	239,849.77	89.87
11-Aug	794.20	1	34,566.67	44,853.33	335,525.36	125.71
12-Aug	693.30	1	30,100.00	39,230.00	293,460.02	109.95
13-Aug	563.90	1	31,300.00	25,090.00	187,685.75	70.32
14-Aug	608.70	1	19,900.00	40,970.00	306,476.09	114.83
15-Aug	544.30	1	24,900.00	29,530.00	220,899.17	82.76
16-Aug	562.30	1	25,100.00	31,130.00	232,867.97	87.25
17-Aug	614.40	1	24,900.00	36,540.00	273,337.47	102.41
18-Aug	629.00	1	24,900.00	38,000.00	284,259.00	106.50
19-Aug	612.10	1	29,800.00	31,410.00	234,962.51	88.03
20-Aug	663.30	1	27,600.00	38,730.00	289,719.77	108.55
21-Aug	615.10	1	28,900.00	32,610.00	243,939.11	91.40
22-Aug	521.40	1	19,200.00	32,940.00	246,407.67	92.32
23-Aug	722.70	1	29,166.67	43,103.33	322,434.49	120.81
24-Aug	650.70	1	29,166.67	35,903.33	268,574.89	100.63
25-Aug	647.50	1	29,166.67	35,583.33	266,181.13	99.73
26-Aug	726.60	1	28,200.00	44,460.00	332,583.03	124.61
27-Aug	648.00	1	32,700.00	32,100.00	240,124.05	89.97
28-Aug	608.20	1	26,300.00	34,520.00	258,226.86	96.75
29-Aug	566.80	1	28,500.00	28,180.00	210,800.49	78.98
30-Aug	684.60	1	25,100.00	43,360.00	324,354.48	121.53
31-Aug	589.20	1	25,100.00	33,820.00	252,990.51	94.79

Max Day Demand	55,603.33	415,940.74	155.84

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2014

GENEVA

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Jul	1115					
1-Aug	1391	1	276	27,600.00	206,461.80	182.55
4-Aug	2431	3	1,040	34,666.67	259,324.00	229.29
5-Aug	**2783**	**1**	**352**	**35,200.00**	**263,313.60**	**232.81**
6-Aug	3094	1	311	31,100.00	232,643.55	205.70
7-Aug	3408	1	314	31,400.00	234,887.70	207.68
8-Aug	3754	1	346	34,600.00	258,825.30	228.85
11-Aug	4791	3	1,037	34,566.67	258,575.95	228.63
12-Aug	5092	1	301	30,100.00	225,163.05	199.08
13-Aug	5405	1	313	31,300.00	234,139.65	207.02
14-Aug	5604	1	199	19,900.00	148,861.95	131.62
15-Aug	5853	1	249	24,900.00	186,264.45	164.69
18-Aug	6606	3	753	25,100.00	187,760.55	166.01
19-Aug	6904	1	298	29,800.00	222,918.90	197.10
20-Aug	7180	1	276	27,600.00	206,461.80	182.55
21-Aug	7469	1	289	28,900.00	216,186.45	191.15
22-Aug	7661	1	192	19,200.00	143,625.60	126.99
25-Aug	8536	3	875	29,166.67	218,181.25	192.91
26-Aug	8818	1	282	28,200.00	210,950.10	186.52
27-Aug	9145	1	327	32,700.00	244,612.35	216.28
28-Aug	9408	1	263	26,300.00	196,737.15	173.95
29-Aug	9693	1	285	28,500.00	213,194.25	188.50
			Max Day Demand	35,200.00	263,313.60	232.81

EAGLERIDGE

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Jul	54205					
1-Aug	54240	1	35	3,500.00	26,181.75	390.77
4-Aug	54350	3	110	3,666.67	27,428.50	409.38
5-Aug	54385	1	35	3,500.00	26,181.75	390.77
6-Aug	54424	1	39	3,900.00	29,173.95	435.43
7-Aug	54463	1	39	3,900.00	29,173.95	435.43
8-Aug	54499	1	36	3,600.00	26,929.80	401.94
11-Aug	54619	3	120	4,000.00	29,922.00	446.60
12-Aug	54644	1	25	2,500.00	18,701.25	279.12
13-Aug	54673	1	29	2,900.00	21,693.45	323.78
14-Aug	54697	1	24	2,400.00	17,953.20	267.96
15-Aug	54721	1	24	2,400.00	17,953.20	267.96
18-Aug	54805	3	84	2,800.00	20,945.40	312.62
19-Aug	54836	1	31	3,100.00	23,189.55	346.11
20-Aug	**54878**	**1**	**42**	**4,200.00**	**31,418.10**	**468.93**
21-Aug	54906	1	28	2,800.00	20,945.40	312.62
22-Aug	54943	1	37	3,700.00	27,677.85	413.10
25-Aug	55049	3	106	3,533.33	26,431.10	394.49
26-Aug	55085	1	36	3,600.00	26,929.80	401.94
27-Aug	55117	1	32	3,200.00	23,937.60	357.28
28-Aug	55149	1	32	3,200.00	23,937.60	357.28
29-Aug	55187	1	38	3,800.00	28,425.90	424.27
			Max Day Demand	4,200.00	31,418.10	468.93

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2014

AGATE HEIGHTS

Date	Meter Reading (Gallons)	Days Elapsed	Volume Change (Gallons)	Average Daily Volume (Gal.)		GPD/ERU	Three Day Average
30-Jul	2647696						
1-Aug	2670084	2	22,388	11,194.00		254.41	252.41
2-Aug	2682297	1	12,213	12,213.00		277.57	262.13
3-Aug	2701618	1	19,321	19,321.00		439.11	323.70
4-Aug	2709610	1	7,992	7,992.00		181.64	299.44
5-Aug	2729028	1	19,418	19,418.00		441.32	354.02
7-Aug	2752901	2	23,873	11,936.50		271.28	327.96
9-Aug	2778837	2	25,936	12,968.00		294.73	286.91
10-Aug	2780852	1	2,015	2,015.00		45.80	211.75
11-Aug	**2806747**	**1**	**25,895**	**25,895.00**		**588.52**	309.68
12-Aug	2809720	1	2,973	2,973.00		67.57	233.96
13-Aug	2831083	1	21,363	21,363.00		485.52	**380.54**
15-Aug	2846665	2	15,582	7,791.00		177.07	279.89
17-Aug	2864640	2	17,975	8,987.50		204.26	195.20
19-Aug	2884132	2	19,492	9,746.00		221.50	215.75
20-Aug	2889975	1	19,492	19,492.00		443.00	295.33
22-Aug	2912992	2	5,843	2,921.50		66.40	191.93
23-Aug	2917409	1	23,017	23,017.00		523.11	218.64
24-Aug	2937742	1	4,417	4,417.00		100.39	229.97
25-Aug	2938874	1	20,333	20,333.00		462.11	361.87
26-Aug	2959501	1	1,132	1,132.00		25.73	196.08
28-Aug	2981366	2	20,627	10,313.50		234.40	164.84
30-Aug	3001870	2	21,865	10,932.50		248.47	243.78
			Max Day Demand	25,895.00		588.52	380.54

JOHNSON WELL

Date	Meter Reading (CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
30-Jul	103060					
4-Aug	103386	5	326	65.20	487.73	243.86
5-Aug	103439	1	53	53.00	396.47	198.23
13-Aug	**104208**	**8**	**769**	**96.13**	**719.06**	**359.53**
20-Aug	104536	7	328	46.86	350.51	175.26
27-Aug	104871	7	335	47.86	358.00	179.00
			Max Day Demand	96.13	719.06	359.53

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2014

GENEVA

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Jul	1115					
1-Aug	1391	1	276	27,600.00	206,461.80	182.55
4-Aug	2431	3	1,040	34,666.67	259,324.00	229.29
5-Aug	**2783**	**1**	**352**	**35,200.00**	**263,313.60**	**232.81**
6-Aug	3094	1	311	31,100.00	232,643.55	205.70
7-Aug	3408	1	314	31,400.00	234,887.70	207.68
8-Aug	3754	1	346	34,600.00	258,825.30	228.85
11-Aug	4791	3	1,037	34,566.67	258,575.95	228.63
12-Aug	5092	1	301	30,100.00	225,163.05	199.08
13-Aug	5405	1	313	31,300.00	234,139.65	207.02
14-Aug	5604	1	199	19,900.00	148,861.95	131.62
15-Aug	5853	1	249	24,900.00	186,264.45	164.69
18-Aug	6606	3	753	25,100.00	187,760.55	166.01
19-Aug	6904	1	298	29,800.00	222,918.90	197.10
20-Aug	7180	1	276	27,600.00	206,461.80	182.55
21-Aug	7469	1	289	28,900.00	216,186.45	191.15
22-Aug	7661	1	192	19,200.00	143,625.60	126.99
25-Aug	8536	3	875	29,166.67	218,181.25	192.91
26-Aug	8818	1	282	28,200.00	210,950.10	186.52
27-Aug	9145	1	327	32,700.00	244,612.35	216.28
28-Aug	9408	1	263	26,300.00	196,737.15	173.95
29-Aug	9693	1	285	28,500.00	213,194.25	188.50
			Max Day Demand	35,200.00	263,313.60	232.81

EAGLERIDGE

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Jul	54205					
1-Aug	54240	1	35	3,500.00	26,181.75	390.77
4-Aug	54350	3	110	3,666.67	27,428.50	409.38
5-Aug	54385	1	35	3,500.00	26,181.75	390.77
6-Aug	54424	1	39	3,900.00	29,173.95	435.43
7-Aug	54463	1	39	3,900.00	29,173.95	435.43
8-Aug	54499	1	36	3,600.00	26,929.80	401.94
11-Aug	54619	3	120	4,000.00	29,922.00	446.60
12-Aug	54644	1	25	2,500.00	18,701.25	279.12
13-Aug	54673	1	29	2,900.00	21,693.45	323.78
14-Aug	54697	1	24	2,400.00	17,953.20	267.96
15-Aug	54721	1	24	2,400.00	17,953.20	267.96
18-Aug	54805	3	84	2,800.00	20,945.40	312.62
19-Aug	54836	1	31	3,100.00	23,189.55	346.11
20-Aug	**54878**	**1**	**42**	**4,200.00**	**31,418.10**	**468.93**
21-Aug	54906	1	28	2,800.00	20,945.40	312.62
22-Aug	54943	1	37	3,700.00	27,677.85	413.10
25-Aug	55049	3	106	3,533.33	26,431.10	394.49
26-Aug	55085	1	36	3,600.00	26,929.80	401.94
27-Aug	55117	1	32	3,200.00	23,937.60	357.28
28-Aug	55149	1	32	3,200.00	23,937.60	357.28
29-Aug	55187	1	38	3,800.00	28,425.90	424.27
			Max Day Demand	4,200.00	31,418.10	468.93

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2014

AGATE HEIGHTS

Date	Meter Reading (Gallons)	Days Elapsed	Volume Change (Gallons)	Average Daily Volume (Gal.)		GPD/ERU	Three Day Average
30-Jul	2647696						
1-Aug	2670084	2	22,388	11,194.00		254.41	252.41
2-Aug	2682297	1	12,213	12,213.00		277.57	262.13
3-Aug	2701618	1	19,321	19,321.00		439.11	323.70
4-Aug	2709610	1	7,992	7,992.00		181.64	299.44
5-Aug	2729028	1	19,418	19,418.00		441.32	354.02
7-Aug	2752901	2	23,873	11,936.50		271.28	327.96
9-Aug	2778837	2	25,936	12,968.00		294.73	286.91
10-Aug	2780852	1	2,015	2,015.00		45.80	211.75
11-Aug	**2806747**	**1**	**25,895**	**25,895.00**		**588.52**	309.68
12-Aug	2809720	1	2,973	2,973.00		67.57	233.96
13-Aug	2831083	1	21,363	21,363.00		485.52	**380.54**
15-Aug	2846665	2	15,582	7,791.00		177.07	279.89
17-Aug	2864640	2	17,975	8,987.50		204.26	195.20
19-Aug	2884132	2	19,492	9,746.00		221.50	215.75
20-Aug	2889975	1	19,492	19,492.00		443.00	295.33
22-Aug	2912992	2	5,843	2,921.50		66.40	191.93
23-Aug	2917409	1	23,017	23,017.00		523.11	218.64
24-Aug	2937742	1	4,417	4,417.00		100.39	229.97
25-Aug	2938874	1	20,333	20,333.00		462.11	361.87
26-Aug	2959501	1	1,132	1,132.00		25.73	196.08
28-Aug	2981366	2	20,627	10,313.50		234.40	164.84
30-Aug	3001870	2	21,865	10,932.50		248.47	243.78
			Max Day Demand	25,895.00		588.52	380.54

JOHNSON WELL

Date	Meter Reading (CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
30-Jul	103060					
4-Aug	103386	5	326	65.20	487.73	243.86
5-Aug	103439	1	53	53.00	396.47	198.23
13-Aug	**104208**	**8**	**769**	**96.13**	**719.06**	**359.53**
20-Aug	104536	7	328	46.86	350.51	175.26
27-Aug	104871	7	335	47.86	358.00	179.00
			Max Day Demand	96.13	719.06	359.53

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2014

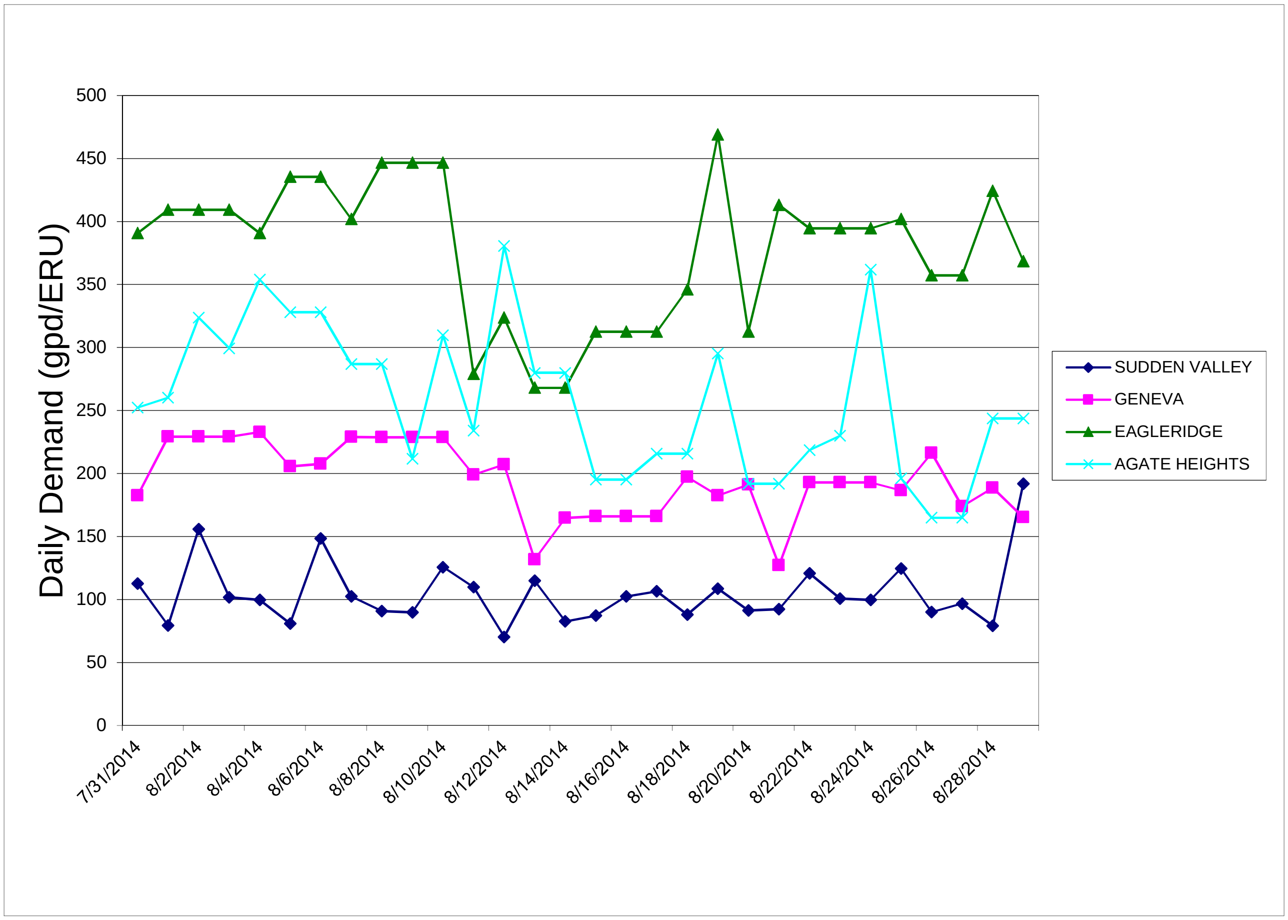


EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2014

SUDDEN VALLEY

Date	Plant Production (100's CF)	Days Elapsed	Geneva Volume (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Sep	579.20	1	25,100.00	32,820.00	245,510.01	91.99
2-Sep	707.70	1	25,100.00	45,670.00	341,634.44	128.00
3-Sep	561.30	1	25,100.00	31,030.00	232,119.92	86.97
4-Sep	546.50	1	25,100.00	29,550.00	221,048.78	82.82
5-Sep	571.60	1	23,000.00	34,160.00	255,533.88	95.74
6-Sep	564.10	1	26,500.00	29,910.00	223,741.76	83.83
7-Sep	582.50	1	16,800.00	41,450.00	310,066.73	116.17
8-Sep	464.70	1	24,133.33	22,336.67	167,089.44	62.60
9-Sep	**704.90**	**1**	**24,133.33**	**46,356.67**	**346,771.05**	**129.93**
10-Sep	571.00	1	24,133.33	32,966.67	246,607.15	92.40
11-Sep	544.30	1	23,400.00	31,030.00	232,119.92	86.97
12-Sep	527.80	1	26,900.00	25,880.00	193,595.34	72.53
13-Sep	672.10	1	22,000.00	45,210.00	338,193.41	126.71
14-Sep	586.30	1	25,800.00	32,830.00	245,584.82	92.01
15-Sep	553.50	1	27,400.00	27,950.00	209,079.98	78.34
16-Sep	619.30	1	27,400.00	34,530.00	258,301.67	96.78
17-Sep	559.60	1	27,400.00	28,560.00	213,643.08	80.05
18-Sep	522.10	1	23,700.00	28,510.00	213,269.06	79.91
19-Sep	500.10	1	16,000.00	34,010.00	254,411.81	95.32
20-Sep	522.50	1	26,000.00	26,250.00	196,363.13	73.57
21-Sep	552.30	1	12,900.00	42,330.00	316,649.57	118.64
22-Sep	563.10	1	23,166.67	33,143.33	247,928.71	92.89
23-Sep	505.50	1	20,500.00	30,050.00	224,789.03	84.22
24-Sep	507.10	1	26,600.00	24,110.00	180,354.86	67.57
25-Sep	521.20	1	20,600.00	31,520.00	235,785.36	88.34
26-Sep	497.30	1	17,300.00	32,430.00	242,592.62	90.89
27-Sep	489.80	1	17,300.00	31,680.00	236,982.24	88.79
28-Sep	553.60	1	17,300.00	38,060.00	284,707.83	106.67
29-Sep	617.70	1	21,000.00	40,770.00	304,979.99	114.27
30-Sep	532.60	1	21,600.00	31,660.00	236,832.63	88.73
			Max Day Demand	46,356.67	346,771.05	129.93

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2014

GENEVA

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
29-Aug	9693					
2-Sep	10697	4	1,004	25,100.00	187,760.55	165.14
3-Sep	10927	1	230	23,000.00	172,051.50	151.32
4-Sep	11192	1	265	26,500.00	198,233.25	174.35
5-Sep	11360	1	168	16,800.00	125,672.40	110.53
8-Sep	12084	3	724	24,133.33	180,529.40	158.78
9-Sep	12318	1	234	23,400.00	175,043.70	153.95
10-Sep	12587	1	269	26,900.00	201,225.45	176.98
11-Sep	12807	1	220	22,000.00	164,571.00	144.74
12-Sep	13065	1	258	25,800.00	192,996.90	169.74
15-Sep	**13887**	**3**	**822**	**27,400.00**	**204,965.70**	**180.27**
16-Sep	14124	1	237	23,700.00	177,287.85	155.93
17-Sep	14284	1	160	16,000.00	119,688.00	105.27
18-Sep	14544	1	260	26,000.00	194,493.00	171.06
19-Sep	14673	1	129	12,900.00	96,498.45	84.87
22-Sep	15368	3	695	23,166.67	173,298.25	152.42
23-Sep	15573	1	205	20,500.00	153,350.25	134.87
24-Sep	15839	1	266	26,600.00	198,981.30	175.01
25-Sep	16045	1	206	20,600.00	154,098.30	135.53
26-Sep	16218	1	173	17,300.00	129,412.65	113.82
29-Sep	16848	3	630	21,000.00	157,090.50	138.16
30-Sep	17064	1	216	21,600.00	161,578.80	142.11
			Max Day Demand	27,400.00	204,965.70	180.27

EAGLERIDGE

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
29-Aug	55187					
2-Sep	55319	4	132	3,300.00	24,685.65	368.44
3-Sep	55345	1	26	2,600.00	19,449.30	290.29
4-Sep	55374	1	29	2,900.00	21,693.45	323.78
5-Sep	55403	1	29	2,900.00	21,693.45	323.78
8-Sep	55494	3	91	3,033.33	22,690.85	338.67
9-Sep	55522	1	28	2,800.00	20,945.40	312.62
10-Sep	55549	1	27	2,700.00	20,197.35	301.45
11-Sep	55570	1	21	2,100.00	15,709.05	234.46
12-Sep	**55612**	**1**	**42**	**4,200.00**	**31,418.10**	**468.93**
15-Sep	55706	3	94	3,133.33	23,438.90	349.83
16-Sep	55737	1	31	3,100.00	23,189.55	346.11
17-Sep	55765	1	28	2,800.00	20,945.40	312.62
18-Sep	55795	1	30	3,000.00	22,441.50	334.95
19-Sep	55819	1	24	2,400.00	17,953.20	267.96
22-Sep	55887	3	68	2,266.67	16,955.80	253.07
23-Sep	55905	1	18	1,800.00	13,464.90	200.97
24-Sep	55930	1	25	2,500.00	18,701.25	279.12
25-Sep	55947	1	17	1,700.00	12,716.85	189.80
26-Sep	55961	1	14	1,400.00	10,472.70	156.31
29-Sep	56011	3	50	1,666.67	12,467.50	186.08
30-Sep	56025	1	14	1,400.00	10,472.70	156.31
			Max Day Demand	4,200.00	31,418.10	468.93

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2014

AGATE HEIGHTS

Date	Meter Reading (Gallons)	Days Elapsed	Volume Change (Gallons)	Average Daily Volume (Gal.)		GPD/ERU	Three Day Average
30-Aug	3001870						
1-Sep	3024139	2	22,269	11,134.50		253.06	251.53
2-Sep	3025670	1	1,531	1,531.00		34.80	180.30
3-Sep	3041830	1	16,160	16,160.00		367.27	218.38
5-Sep	3062474	2	20,644	10,322.00		234.59	278.82
7-Sep	3082369	2	19,895	9,947.50		226.08	228.92
8-Sep	3082832	1	463	463.00		10.52	154.23
9-Sep	**3100073**	**1**	**17,241**	**17,241.00**		**391.84**	209.48
11-Sep	3122593	2	22,520	11,260.00		255.91	**301.22**
13-Sep	3142217	2	19,624	9,812.00		223.00	233.97
15-Sep	3166161	2	23,944	11,972.00		272.09	255.73
17-Sep	3185769	2	19,608	9,804.00		222.82	239.24
19-Sep	3201408	2	15,639	7,819.50		177.72	192.75
21-Sep	3220632	2	19,224	9,612.00		218.45	204.88
23-Sep	3238319	2	17,687	8,843.50		200.99	206.81
26-Sep	3259217	3	20,898	6,966.00		158.32	158.32
27-Sep	3268766	1	9,549	9,549.00		217.02	177.89
29-Sep	3294797	2	26,031	13,015.50		295.81	269.55
30-Sep	3297676	1	2,879	2,879.00		65.43	219.02
			Max Day Demand	17,241.00		391.84	301.22

JOHNSON WELL

Date	Meter Reading (CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
27-Aug	104871					
2-Sep	105136	6	265	44.17	330.39	165.19
3-Sep	105180	1	44	44.00	329.14	164.57
10-Sep	105486	7	306	43.71	327.00	163.50
16-Sep	105827	6	341	56.83	425.14	212.57
23-Sep	**106226**	**7**	**399**	**57.00**	**426.39**	**213.19**
			Max Day Demand	57.00	426.39	213.19

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2014

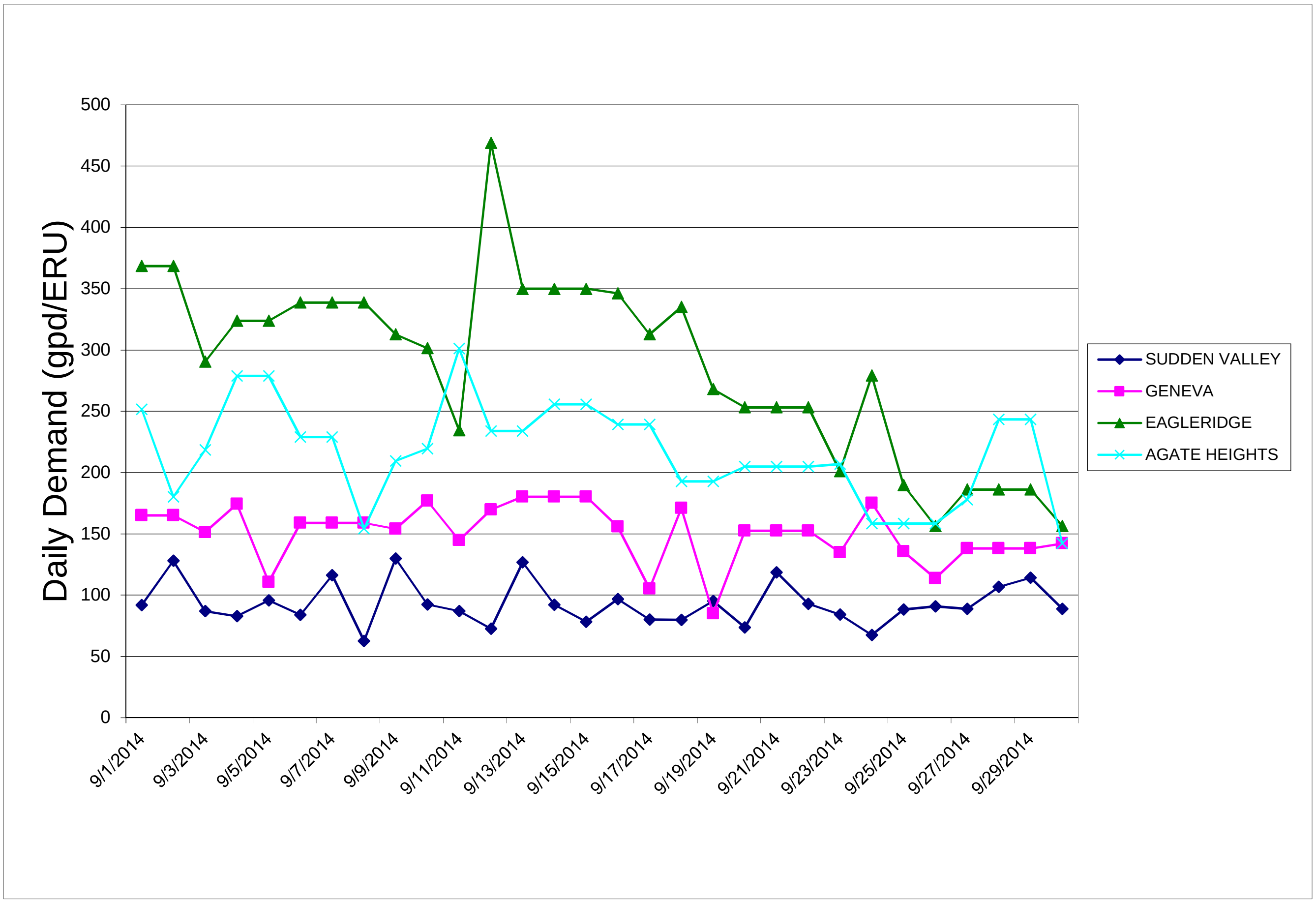


EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2015

SUDDEN VALLEY

July 2015 Date	Plant Production (100's CF)	Days Elapsed	Geneva Volume (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Jul	766.2	1	40800.00	35820.00	267951.51	100.47
2-Jul	648.2	1	33200.00	31620.00	236533.41	88.69
3-Jul	822.6	1	43000.00	39260.00	293684.43	110.12
4-Jul	**935.5**	**1**	**43000.00**	**50550.00**	**378139.28**	**141.78**
5-Jul	718.1	1	43000.00	28810.00	215513.21	80.81
6-Jul	778.4	1	39900.00	37940.00	283810.17	106.42
7-Jul	660.3	1	39900.00	26130.00	195465.47	73.29
8-Jul	733.3	1	38700.00	34630.00	259049.72	97.13
9-Jul	710.4	1	33300.00	37740.00	282314.07	105.85
10-Jul	767.3	1	41000.00	35730.00	267278.27	100.22
11-Jul	666.8	1	41000.00	25680.00	192099.24	72.03
12-Jul	692.8	1	41000.00	28280.00	211548.54	79.32
13-Jul	637.3	1	31600.00	32130.00	240348.47	90.12
14-Jul	571.1	1	25900.00	31210.00	233466.41	87.54
15-Jul	660.7	1	28400.00	37670.00	281790.44	105.66
16-Jul	658.3	1	33100.00	32730.00	244836.77	91.80
17-Jul	714.4	1	43200.00	28240.00	211249.32	79.21
18-Jul	716.8	1	43200.00	28480.00	213044.64	79.88
19-Jul	746.6	1	43200.00	31460.00	235336.53	88.24
20-Jul	736.5	1	38566.67	35083.33	262440.88	98.40
21-Jul	674.8	1	24100.00	43380.00	324504.09	121.67
22-Jul	700.6	1	34500.00	35560.00	266006.58	99.74
23-Jul	700.7	1	41500.00	28570.00	213717.89	80.13
24-Jul	596.1	1	41800.00	17810.00	133227.71	49.95
25-Jul	607.1	1	41800.00	18910.00	141456.26	53.04
26-Jul	615.2	1	41800.00	19720.00	147515.46	55.31
27-Jul	634.8	1	28733.33	34746.67	259922.44	97.46
28-Jul	625.7	1	29600.00	32970.00	246632.09	92.48
29-Jul	676.2	1	33500.00	34120.00	255234.66	95.70
30-Jul	703.5	1	28200.00	42150.00	315303.08	118.22
31-Jul	775.1	1	43500.00	34010.00	254411.81	95.39
			Max Day Demand	50550.00	378139.28	141.78

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2015

GENEVA

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
30-Jun	74851					
1-Jul	75259	1	408	40,800.00	305,204.40	267.96
2-Jul	75591	1	332	33,200.00	248,352.60	218.04
3-Jul	76021	1	430	43,000.00	321,661.50	282.41
6-Jul	77218	3	1197	39,900.00	298,471.95	262.05
7-Jul	77617	1	399	39,900.00	298,471.95	262.05
8-Jul	78004	1	387	38,700.00	289,495.35	254.17
9-Jul	78337	1	333	33,300.00	249,100.65	218.70
10-Jul	78747	1	410	41,000.00	306,700.50	269.27
13-Jul	79695	3	948	31,600.00	236,383.80	207.54
14-Jul	79954	1	259	25,900.00	193,744.95	170.10
15-Jul	80238	1	284	28,400.00	212,446.20	186.52
16-Jul	80569	1	331	33,100.00	247,604.55	217.39
17-Jul	81001	1	432	43,200.00	323,157.60	283.72
20-Jul	82158	3	1157	38,566.67	288,497.95	253.29
21-Jul	82399	1	241	24,100.00	180,280.05	158.28
22-Jul	82744	1	345	34,500.00	258,077.25	226.58
23-Jul	83159	1	415	41,500.00	310,440.75	272.56
24-Jul	83577	1	418	41,800.00	312,684.90	274.53
27-Jul	84439	3	862	28,733.33	214,939.70	188.71
28-Jul	84735	1	296	29,600.00	221,422.80	194.40
29-Jul	85070	1	335	33,500.00	250,596.75	220.01
30-Jul	85352	1	282	28,200.00	210,950.10	185.21
31-Jul	**85787**	**1**	**435**	**43,500.00**	**325,401.75**	**285.69**
			Max Day Demand	43,500.00	325,401.75	285.69

EAGLERIDGE

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
30-Jun	60751					
1-Jul	60797	1	46	4,600.00	34,410.30	513.59
2-Jul	60848	1	51	5,100.00	38,150.55	569.41
3-Jul	**60907**	**1**	**59**	**5,900.00**	**44,134.95**	**658.73**
6-Jul	61046	3	139	4,633.33	34,659.65	517.31
7-Jul	61082	1	36	3,600.00	26,929.80	401.94
8-Jul	61129	1	47	4,700.00	35,158.35	524.75
9-Jul	61171	1	42	4,200.00	31,418.10	468.93
10-Jul	61207	1	36	3,600.00	26,929.80	401.94
13-Jul	61326	3	119	3,966.67	29,672.65	442.88
14-Jul	61360	1	34	3,400.00	25,433.70	379.61
15-Jul	61404	1	44	4,400.00	32,914.20	491.26
16-Jul	61441	1	37	3,700.00	27,677.85	413.10
17-Jul	61486	1	45	4,500.00	33,662.25	502.42
20-Jul	61629	3	143	4,766.67	35,657.05	532.19
21-Jul	61658	1	29	2,900.00	21,693.45	323.78
22-Jul	61709	1	51	5,100.00	38,150.55	569.41
23-Jul	61734	1	25	2,500.00	18,701.25	279.12
24-Jul	61760	1	26	2,600.00	19,449.30	290.29
27-Jul	61882	3	122	4,066.67	30,420.70	454.04
28-Jul	61917	1	35	3,500.00	26,181.75	390.77
29-Jul	61950	1	33	3,300.00	24,685.65	368.44
30-Jul	61990	1	40	4,000.00	29,922.00	446.60
31-Jul	62045	1	55	5,500.00	41,142.75	614.07
			Max Day Demand	5,900.00	44,134.95	658.73

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2015

AGATE HEIGHTS

Date	Meter Reading (Gallons)	Days Elapsed	Volume Change (Gallons)	Average Daily Volume (Gal.)		GPD/ERU	Three Day Average
1-Jul	5998526						
2-Jul	6023217	1	24691	24,691.00		561.16	
3-Jul	6025934	1	2717	2,717.00		61.75	
4-Jul	6047138	1	21204	21,204.00		481.91	160.64
5-Jul	6058810	1	11672	11,672.00		265.27	269.64
6-Jul	6081437	1	22627	22,627.00		514.25	420.48
7-Jul	6089230	1	7793	7,793.00		177.11	318.88
8-Jul	6106389	1	17159	17,159.00		389.98	360.45
9-Jul	6112095	1	5706	5,706.00		129.68	232.26
10-Jul	**6147218**	**1**	**35123**	**35,123.00**		**798.25**	439.30
12-Jul	6170488	2	23270	11,635.00		264.43	442.37
13-Jul	6174001	1	3513	3,513.00		79.84	202.90
14-Jul	6197828	1	23827	23,827.00		541.52	295.27
16-Jul	6224686	2	26858	13,429.00		305.20	383.98
17-Jul	6226008	1	1322	1,322.00		30.05	213.48
18-Jul	6251717	1	25709	25,709.00		584.30	306.52
19-Jul	6252651	1	934	934.00		21.23	211.86
20-Jul	6276171	1	23520	23,520.00		534.55	380.02
21-Jul	6288181	1	12010	12,010.00		272.95	276.24
22-Jul	6311428	1	23247	23,247.00		528.34	**445.28**
23-Jul	6318107	1	6679	6,679.00		151.80	317.70
24-Jul	6339146	1	21039	21,039.00		478.16	386.10
26-Jul	6358591	2	19445	9,722.50		220.97	306.70
28-Jul	6384271	2	25680	12,840.00		291.82	268.20
30-Jul	6408787	2	24516	12,258.00		278.59	283.00
31-Jul	6411978	1	3191	3,191.00		72.52	209.90
			Max Day Demand	35,123.00		798.25	445.28

JOHNSON WELL

Date	Meter Reading (CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
6-Jul	120952					
14-Jul	121670	8	718	89.75	671.37	335.69
17-Jul	**122323**	**3**	**653**	**217.67**	**1,628.26**	**814.13**
29-Jul	122440	12	117	9.75	72.93	36.47
			Max Day Demand	217.67	1,628.26	814.13

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - JULY 2015

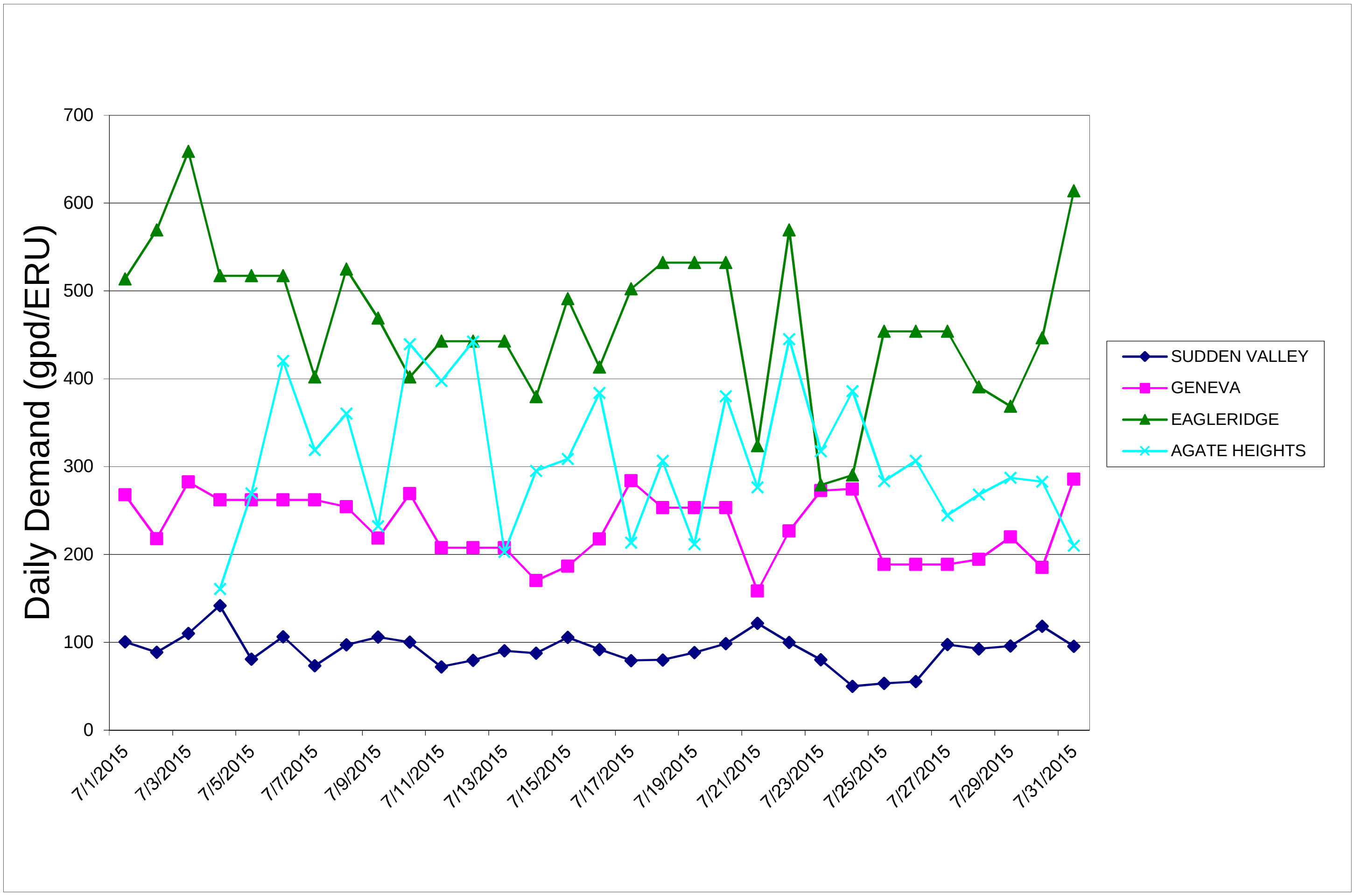


EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2015

SUDDEN VALLEY

Aug 2015 Date	Plant Production (100's CF)	Days Elapsed	Geneva Volume (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Aug	755.40	1	37,400.00	38,140.00	285,306.27	106.90
2-Aug	783.50	1	37,400.00	40,950.00	306,326.48	114.77
3-Aug	656.10	1	37,400.00	28,210.00	211,024.91	79.07
4-Aug	757.20	1	35,700.00	40,020.00	299,369.61	112.17
5-Aug	657.10	1	36,100.00	29,610.00	221,497.61	82.99
6-Aug	538.80	1	23,600.00	30,280.00	226,509.54	84.87
7-Aug	738.60	1	31,400.00	42,460.00	317,622.03	119.00
8-Aug	788.40	1	33,866.67	44,973.33	336,423.02	126.05
9-Aug	730.40	1	33,866.67	39,173.33	293,036.12	109.79
10-Aug	781.30	1	33,866.67	44,263.33	331,111.87	124.06
11-Aug	677.70	1	38,200.00	29,570.00	221,198.39	82.88
12-Aug	764.20	1	40,600.00	35,820.00	267,951.51	100.39
13-Aug	633.60	1	24,000.00	39,360.00	294,432.48	110.32
14-Aug	646.90	1	34,700.00	29,990.00	224,340.20	84.05
15-Aug	545.20	1	27,200.00	27,320.00	204,367.26	76.57
16-Aug	600.50	1	27,200.00	32,850.00	245,734.43	92.07
17-Aug	678.40	1	27,200.00	40,640.00	304,007.52	113.90
18-Aug	684.20	1	33,600.00	34,820.00	260,471.01	97.59
19-Aug	654.70	1	35,000.00	30,470.00	227,930.84	85.40
20-Aug	700.10	1	22,300.00	47,710.00	356,894.66	133.72
21-Aug	587.10	1	32,500.00	26,210.00	196,063.91	73.46
22-Aug	639.80	1	24,333.33	39,646.67	296,576.89	111.12
23-Aug	691.50	1	24,333.33	44,816.67	335,251.08	125.61
24-Aug	825.80	1	24,333.33	58,246.67	435,714.19	163.25
25-Aug	729.00	1	49,100.00	23,800.00	178,035.90	66.71
26-Aug	687.10	1	32,900.00	35,810.00	267,876.71	100.37
27-Aug	632.80	1	29,500.00	33,780.00	252,691.29	94.68
28-Aug	603.80	1	25,200.00	35,180.00	263,163.99	98.60
29-Aug	552.60	1	19,366.67	35,893.33	268,500.08	100.60
30-Aug	669.00	1	19,366.67	47,533.33	355,573.10	133.22
31-Aug	**780.50**	**1**	**19,366.67**	**58,683.33**	**438,980.68**	**164.47**
			Max Day Demand	58,683.33	438,980.68	164.47

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2015

GENEVA

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Jul	85787					
3-Aug	86909	3	1,122	37,400.00	279,770.70	245.63
4-Aug	87266	1	357	35,700.00	267,053.85	234.46
5-Aug	87627	1	361	36,100.00	270,046.05	237.09
6-Aug	87863	1	236	23,600.00	176,539.80	155.00
7-Aug	88177	1	314	31,400.00	234,887.70	206.22
10-Aug	89193	3	1,016	33,866.67	253,339.60	222.42
11-Aug	89575	1	382	38,200.00	285,755.10	250.88
12-Aug	89981	1	406	40,600.00	303,708.30	266.64
13-Aug	90221	1	240	24,000.00	179,532.00	157.62
14-Aug	90568	1	347	34,700.00	259,573.35	227.90
17-Aug	91384	3	816	27,200.00	203,469.60	178.64
18-Aug	91720	1	336	33,600.00	251,344.80	220.67
19-Aug	92070	1	350	35,000.00	261,817.50	229.87
20-Aug	92293	1	223	22,300.00	166,815.15	146.46
21-Aug	92618	1	325	32,500.00	243,116.25	213.45
24-Aug	93348	3	730	24,333.33	182,025.50	159.81
25-Aug	**93839**	**1**	**491**	**49,100.00**	**367,292.55**	**322.47**
26-Aug	94168	1	329	32,900.00	246,108.45	216.07
27-Aug	94463	1	295	29,500.00	220,674.75	193.74
28-Aug	94715	1	252	25,200.00	188,508.60	165.50
31-Aug	95296	3	581	19,366.67	144,872.35	127.19
			Max Day Demand	49,100.00	367,292.55	322.47

EAGLERIDGE

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Jul	62045					
3-Aug	62162	3	117	3,900.00	29,173.95	435.43
4-Aug	62200	1	38	3,800.00	28,425.90	424.27
5-Aug	62244	1	44	4,400.00	32,914.20	491.26
6-Aug	62287	1	43	4,300.00	32,166.15	480.09
7-Aug	62331	1	44	4,400.00	32,914.20	491.26
10-Aug	62443	3	112	3,733.33	27,927.20	416.82
11-Aug	62474	1	31	3,100.00	23,189.55	346.11
12-Aug	**62523**	**1**	**49**	**4,900.00**	**36,654.45**	**547.08**
13-Aug	62565	1	42	4,200.00	31,418.10	468.93
14-Aug	62600	1	35	3,500.00	26,181.75	390.77
17-Aug	62697	3	97	3,233.33	24,186.95	361.00
18-Aug	62732	1	35	3,500.00	26,181.75	390.77
19-Aug	62778	1	46	4,600.00	34,410.30	513.59
20-Aug	62819	1	41	4,100.00	30,670.05	457.76
21-Aug	62852	1	33	3,300.00	24,685.65	368.44
24-Aug	62960	3	108	3,600.00	26,929.80	401.94
25-Aug	62990	1	30	3,000.00	22,441.50	334.95
26-Aug	63030	1	40	4,000.00	29,922.00	446.60
27-Aug	63065	1	35	3,500.00	26,181.75	390.77
28-Aug	63103	1	38	3,800.00	28,425.90	424.27
31-Aug	63176	3	73	2,433.33	18,202.55	271.68
			Max Day Demand	4,900.00	36,654.45	547.08

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2015

AGATE HEIGHTS

Date	Meter Reading (Gallons)	Days Elapsed	Volume Change (Gallons)	Average Daily Volume (Gal.)		GPD/ERU	Three Day Average
31-Jul	6411978						
1-Aug	**6444333**	**1**	**32,355**	**32,355.00**		**735.34**	362.15
2-Aug	6444632	1	299	299.00		6.80	271.55
3-Aug	6470834	1	26,202	26,202.00		595.50	**445.88**
4-Aug	6478964	1	8,130	8,130.00		184.77	262.36
5-Aug	6501168	1	22,204	22,204.00		504.64	428.30
6-Aug	6510382	1	9,214	9,214.00		209.41	299.61
8-Aug	6538455	2	28,073	14,036.50		319.01	282.48
9-Aug	6540024	1	1,569	1,569.00		35.66	224.56
10-Aug	6565201	1	25,177	25,177.00		572.20	308.96
11-Aug	6570479	1	5,278	5,278.00		119.95	242.61
12-Aug	6593449	1	22,970	22,970.00		522.05	404.73
13-Aug	6596649	1	3,200	3,200.00		72.73	238.24
14-Aug	6619494	1	22,845	22,845.00		519.20	371.33
15-Aug	6626187	1	6,693	6,693.00		152.11	248.02
16-Aug	6651066	1	24,879	24,879.00		565.43	412.25
17-Aug	6651968	1	902	902.00		20.50	246.02
18-Aug	6675417	1	23,449	23,449.00		532.93	372.95
19-Aug	6679091	1	3,674	3,674.00		83.50	212.31
20-Aug	6702336	1	23,245	23,245.00		528.30	381.58
22-Aug	6723435	2	21,099	10,549.50		239.76	335.94
23-Aug	6729713	1	6,278	6,278.00		142.68	207.40
24-Aug	6753802	1	24,089	24,089.00		547.48	309.97
25-Aug	6757484	1	3,682	3,682.00		83.68	257.95
26-Aug	6783115	1	25,631	25,631.00		582.52	404.56
27-Aug	6784285	1	1,170	1,170.00		26.59	230.93
28-Aug	6804748	1	20,463	20,463.00		465.07	358.06
30-Aug	6819249	2	14,501	7,250.50		164.78	264.88
			Max Day Demand	32,355.00		735.34	445.88

JOHNSON WELL

Date	Meter Reading (CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
29-Jul	122440					
3-Aug	123008	5	568	113.60	849.78	424.89
5-Aug	**123236**	**2**	**228**	**114.00**	**852.78**	**426.39**
12-Aug	123629	7	393	56.14	419.98	209.99
19-Aug	123910	7	281	40.14	300.29	150.14
1-Sep	125114	13	1,204	92.62	692.81	346.40
			Max Day Demand	114.00	852.78	426.39

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - AUGUST 2014

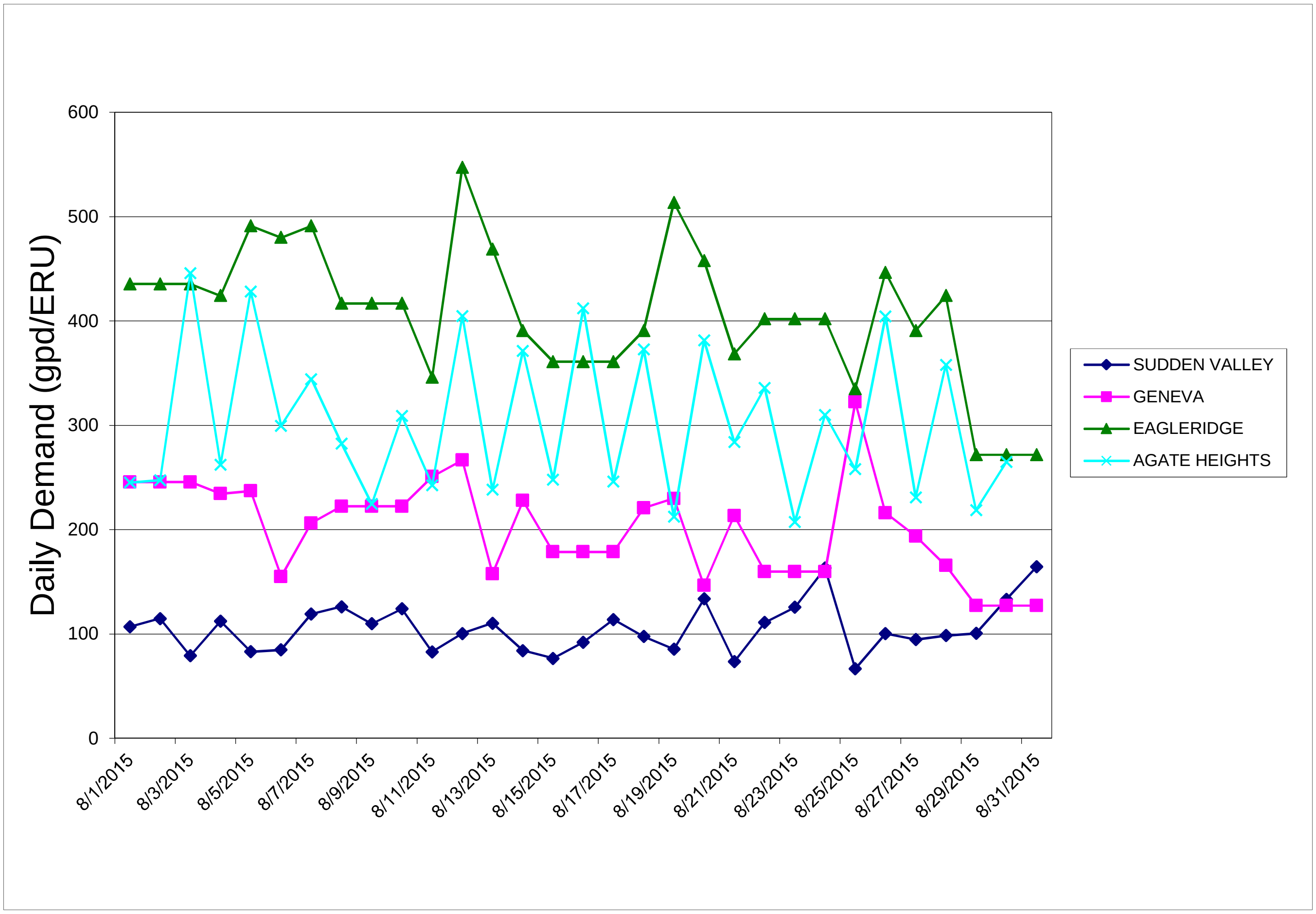


EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2015

SUDDEN VALLEY

Date	Plant Production (100's CF)	Days Elapsed	Geneva Volume (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Sep	599.40	1	21,300.00	38,640.00	289,046.52	108.30
2-Sep	**818.50**	**1**	**19,600.00**	**62,250.00**	**465,661.13**	**174.47**
3-Sep	600.90	1	22,700.00	37,390.00	279,695.90	104.79
4-Sep	538.10	1	28,100.00	25,710.00	192,323.66	72.06
5-Sep	554.50	1	19,550.00	35,900.00	268,549.95	100.62
6-Sep	591.30	1	19,550.00	39,580.00	296,078.19	110.93
7-Sep	593.60	1	19,550.00	39,810.00	297,798.71	111.58
8-Sep	625.40	1	19,550.00	42,990.00	321,586.70	120.49
9-Sep	547.00	1	27,100.00	27,600.00	206,461.80	77.36
10-Sep	519.50	1	19,500.00	32,450.00	242,742.23	90.95
11-Sep	560.20	1	22,100.00	33,920.00	253,738.56	95.07
12-Sep	610.00	1	21,866.67	39,133.33	292,736.90	109.68
13-Sep	608.90	1	21,866.67	39,023.33	291,914.05	109.37
14-Sep	649.20	1	21,866.67	43,053.33	322,060.46	120.67
15-Sep	565.60	1	22,000.00	34,560.00	258,526.08	96.86
16-Sep	563.50	1	32,700.00	23,650.00	176,913.83	66.28
17-Sep	657.40	1	11,900.00	53,840.00	402,750.12	150.90
18-Sep	588.30	1	25,600.00	33,230.00	248,577.02	93.13
19-Sep	486.00	1	25,466.67	23,133.33	173,048.90	64.84
20-Sep	628.30	1	25,466.67	37,363.33	279,496.42	104.72
21-Sep	620.30	1	25,466.67	36,563.33	273,512.02	102.48
22-Sep	618.00	1	30,000.00	31,800.00	237,879.90	89.13
23-Sep	647.60	1	27,700.00	37,060.00	277,227.33	103.87
24-Sep	514.60	1	21,500.00	29,960.00	224,115.78	83.97
25-Sep	575.30	1	18,100.00	39,430.00	294,956.12	110.51
26-Sep	498.70	1	21,666.67	28,203.33	210,975.04	79.05
27-Sep	590.20	1	21,666.67	37,353.33	279,421.61	104.69
28-Sep	507.60	1	21,666.67	29,093.33	217,632.68	81.54
29-Sep	544.60	1	23,200.00	31,260.00	233,840.43	87.61
30-Sep	532.50	1	24,700.00	28,550.00	213,568.28	80.02
			Max Day Demand	62,250.00	465,661.13	174.47

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2015

GENEVA

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Aug	95296					
1-Sep	95509	1	213	21,300.00	159,334.65	140.14
2-Sep	95705	1	196	19,600.00	146,617.80	128.95
3-Sep	95932	1	227	22,700.00	169,807.35	149.35
4-Sep	96213	1	281	28,100.00	210,202.05	184.87
8-Sep	96995	4	782	19,550.00	146,243.78	128.62
9-Sep	97266	1	271	27,100.00	202,721.55	178.30
10-Sep	97461	1	195	19,500.00	145,869.75	128.29
11-Sep	97682	1	221	22,100.00	165,319.05	145.40
14-Sep	98338	3	656	21,866.67	163,573.60	143.86
15-Sep	98558	1	220	22,000.00	164,571.00	144.74
16-Sep	**98885**	**1**	**327**	**32,700.00**	**244,612.35**	**215.14**
17-Sep	99004	1	119	11,900.00	89,017.95	78.29
18-Sep	99260	1	256	25,600.00	191,500.80	168.43
21-Sep	100024	3	764	25,466.67	190,503.40	167.55
22-Sep	100324	1	300	30,000.00	224,415.00	197.37
23-Sep	100601	1	277	27,700.00	207,209.85	182.24
24-Sep	100816	1	215	21,500.00	160,830.75	141.45
25-Sep	100997	1	181	18,100.00	135,397.05	119.08
28-Sep	101647	3	650	21,666.67	162,077.50	142.55
29-Sep	101879	1	232	23,200.00	173,547.60	152.64
30-Sep	102126	1	247	24,700.00	184,768.35	162.51
			Max Day Demand	32,700.00	244,612.35	215.14

EAGLERIDGE

Date	Meter Reading (100's CF)	Days Elapsed	Volume Change (100's CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
31-Aug	63176					
1-Sep	63196	1	20	2,000.00	14,961.00	223.30
2-Sep	63218	1	22	2,200.00	16,457.10	245.63
3-Sep	63231	1	13	1,300.00	9,724.65	145.14
4-Sep	**63254**	**1**	**23**	**2,300.00**	**17,205.15**	**256.79**
8-Sep	63318	4	64	1,600.00	11,968.80	178.64
9-Sep	63335	1	17	1,700.00	12,716.85	189.80
10-Sep	63353	1	18	1,800.00	13,464.90	200.97
11-Sep	63371	1	18	1,800.00	13,464.90	200.97
14-Sep	63431	3	60	2,000.00	14,961.00	223.30
15-Sep	63449	1	18	1,800.00	13,464.90	200.97
16-Sep	63466	1	17	1,700.00	12,716.85	189.80
17-Sep	63486	1	20	2,000.00	14,961.00	223.30
18-Sep	63501	1	15	1,500.00	11,220.75	167.47
21-Sep	63549	3	48	1,600.00	11,968.80	178.64
22-Sep	63561	1	12	1,200.00	8,976.60	133.98
23-Sep	63578	1	17	1,700.00	12,716.85	189.80
24-Sep	63592	1	14	1,400.00	10,472.70	156.31
25-Sep	63610	1	18	1,800.00	13,464.90	200.97
28-Sep	63658	3	48	1,600.00	11,968.80	178.64
29-Sep	63676	1	18	1,800.00	13,464.90	200.97
30-Sep	63690	1	14	1,400.00	10,472.70	156.31
			Max Day Demand	2,300.00	17,205.15	256.79

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2015

AGATE HEIGHTS

Date	Meter Reading (Gallons)	Days Elapsed	Volume Change (Gallons)	Average Daily Volume (Gal.)		GPD/ERU	Three Day Average
30-Aug	6819249						
1-Sep	6833921	2	14,672	7,336.00		166.73	166.08
3-Sep	6851552	2	17,631	8,815.50		200.35	189.14
5-Sep	6868274	2	16,722	8,361.00		190.02	193.47
7-Sep	6888344	2	20,070	10,035.00		228.07	**215.39**
9-Sep	6905511	2	17,167	8,583.50		195.08	206.08
11-Sep	6920790	2	15,279	7,639.50		173.63	180.78
13-Sep	6940661	2	19,871	9,935.50		225.81	208.41
15-Sep	6958989	2	18,328	9,164.00		208.27	214.12
17-Sep	6973337	2	14,348	7,174.00		163.05	178.12
19-Sep	6990717	2	17,380	8,690.00		197.50	186.02
21-Sep	7008272	2	17,555	8,777.50		199.49	198.83
23-Sep	7025258	2	16,986	8,493.00		193.02	195.18
25-Sep	7043084	2	17,826	8,913.00		202.57	199.39
28-Sep	7064154	3	21,070	7,023.33		159.62	159.62
29-Sep	7068470	1	4,316	4,316.00		98.09	118.60
30-Sep	**7085254**	**1**	**16,784**	**16,784.00**		**381.45**	213.06
			Max Day Demand	16,784.00		381.45	215.39

JOHNSON WELL

Date	Meter Reading (CF)	Days Elapsed	Volume Change (CF)	Average Daily Volume (CF)	Gallons Per Day	GPD/ERU
1-Sep	125,114					
2-Sep	**125,172**	**1**	**58**	**58.00**	**433.87**	**216.93**
10-Sep	125,556	8	384	48.00	359.06	179.53
15-Sep	125,702	5	146	29.20	218.43	109.22
23-Sep	125,899	8	197	24.63	184.21	92.10
30-Sep	126,098	7	199	28.43	212.66	106.33
			Max Day Demand	58.00	433.87	216.93

EXHIBIT 3

MAXIMUM DAY DEMAND DATA - SEPTEMBER 2015

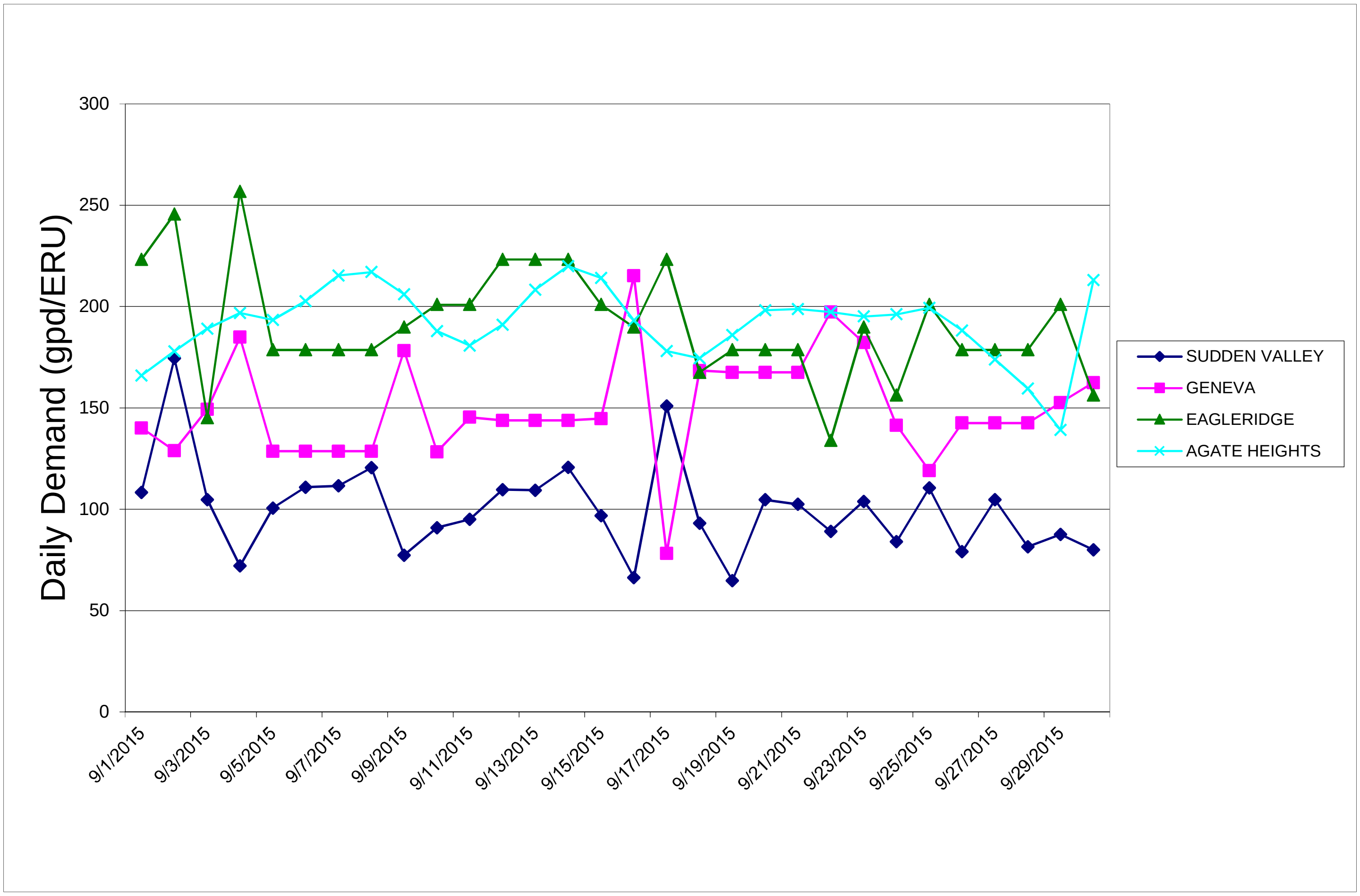


EXHIBIT 3

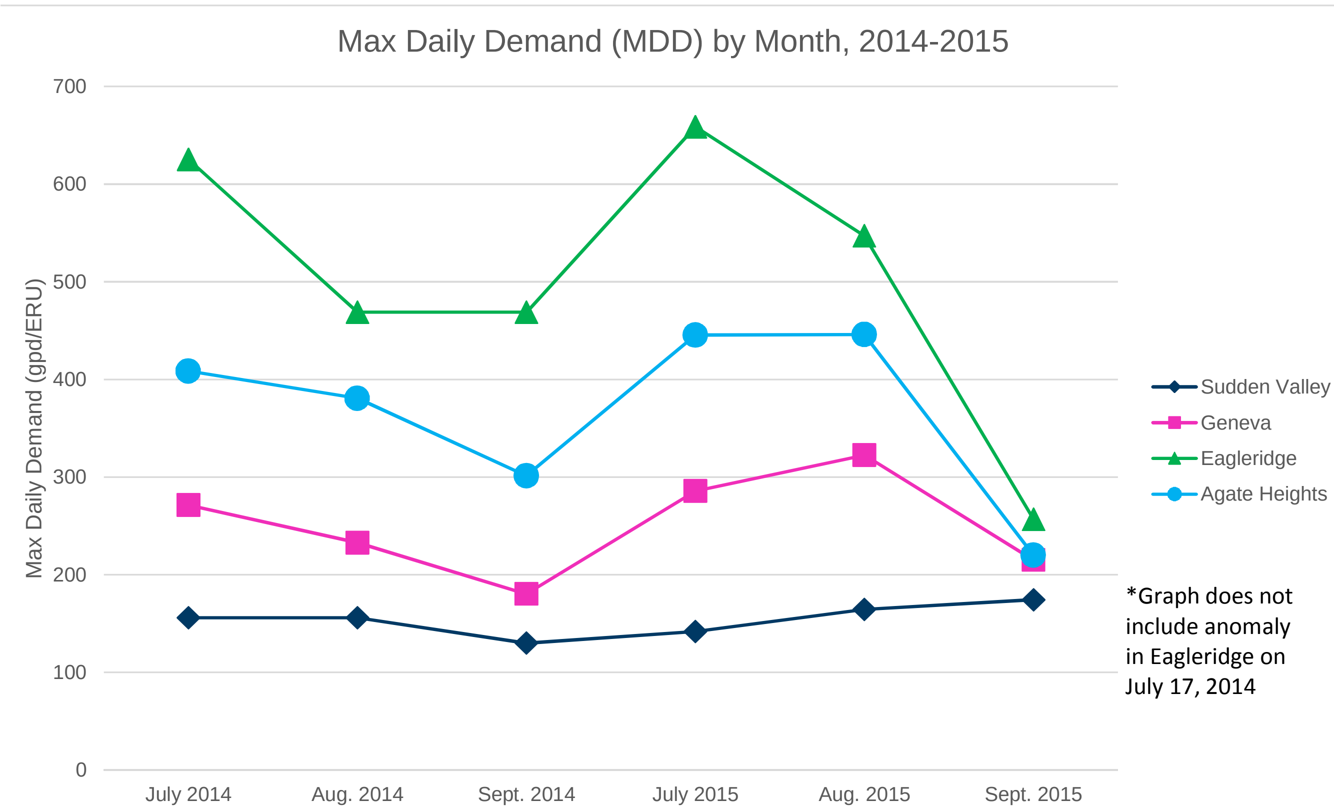

Max Daily Demand (MDD) by Month, 2014-2015
700
600
500
400
300
200
100
0
Max Daily Demand (gpd/ERU)
July 2014
Aug. 2014
Sept. 2014
July 2015
Aug. 2015
Sept. 2015
Sudden Valley
Geneva
Eagleridge
Agate Heights
*Graph does not include anomaly in Eagleridge on July 17, 2014

EXHIBIT 4

LWWSD DISTRIBUTION SYSTEM LOSSES
THREE-YEAR RUNNING AVERAGE

SUDDEN VALLEY WATER SYSTEM

Month	Gross Production (CU. FT.)	Metered Residential Consumption (CU. FT.)	Distribution System Leakage (CU. FT.)	% of Water Consumed	Net % of Distribution System Leakage
TOTAL 2012	17,022,912	14,347,314	2,675,598	84.28%	15.72%
TOTAL 2013	16,525,245	14,557,478	1,967,767	88.09%	11.91%
TOTAL 2014	15,549,961	13,847,931	1,702,030	89.05%	10.95%
3-YR AVG	**16,366,039**	**14,250,908**	**2,115,131**	**87.14%**	**12.86%**

GENEVA WATER SYSTEM

Month	Gross Production (CU. FT.)	Metered Residential Consumption (CU. FT.)	Distribution System Leakage (CU. FT.)	% of Water Consumed	Net % of Distribution System Leakage
TOTAL 2012	8,271,074	7,543,016	728,058	91.20%	8.80%
TOTAL 2013	8,347,682	7,522,909	824,773	90.12%	9.88%
TOTAL 2014	8,189,665	7,484,584	705,081	91.39%	8.61%
3-YR AVG	**8,269,474**	**7,516,836**	**752,637**	**90.90%**	**9.10%**

AGATE HEIGHTS WATER SYSTEM

Month	Gross Production (CU. FT.)	Metered Residential Consumption (CU. FT.)	Distribution System Leakage (CU. FT.)	% of Water Consumed	Net % of Distribution System Leakage
TOTAL 2012	440,447	424,094	16,353	96.29%	3.71%
TOTAL 2013	457,076	452,172	4,904	98.93%	1.07%
TOTAL 2014	460,315	443,280	17,035	96.30%	3.70%
3-YR AVG	**452,613**	**439,849**	**12,764**	**97.17%**	**2.83%**

EXHIBIT 4

LWWSD DISTRIBUTION SYSTEM LOSSES
THREE-YEAR RUNNING AVERAGE

JOHNSON WELLS WATER SYSTEM

Month	Gross Production (CU. FT.)	Metered Residential Consumption (CU. FT.)	Distribution System Leakage (CU. FT.)	% of Water Consumed	Net % of Distribution System Leakage
TOTAL 2012	18,154	18,397	(243)	101.34%	-1.34%
TOTAL 2013	15,844	16,775	(931)	105.88%	-5.88%
TOTAL 2014	15,309	16,199	(890)	105.81%	-5.81%
3-YR AVG	**16,436**	**17,124**	**(688)**	**104.34%**	**-4.34%**

EAGLERIDGE WATER SYSTEM

Month	Gross Production (CU. FT.)	Metered Residential Consumption (CU. FT.)	Distribution System Leakage (CU. FT.)	% of Water Consumed	Net % of Distribution System Leakage
TOTAL 2012	742,967	710,408	32,559	95.62%	4.38%
TOTAL 2013	706,345	696,358	9,987	98.59%	1.41%
TOTAL 2014	722,539	702,118	20,421	97.17%	2.83%
3-YR AVG	**723,950**	**702,961**	**20,989**	**97.13%**	**2.87%**

EXHIBIT 5

AVERAGE DAILY DEMAND - 2012

SUDDEN VALLEY WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
DEC/JAN12	21,381,519	2,662	100%	61	**132**	2.5	**53**
FEB/MAR 12	16,123,083	2,662	100%	60	**101**	2.5	**40**
APR/MAY 12	21,213,757	2,662	100%	61	**131**	2.5	**52**
JUN/JUL 12	23,921,055	2,663	100%	61	**147**	2.5	**59**
AUG/SEP 12	25,235,678	2,663	100%	61	**155**	2.5	**62**
OCT/NOV 12	19,464,798	2,664	100%	61	**120**	2.5	**48**
2012 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**131**		**52**

GENEVA WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 12	8,302,876	1,120	100%	60	**124**	2.9	**43**
MAR/APR 12	9,629,633	1,120	100%	61	**141**	2.9	**49**
MAY/JUN 12	9,503,796	1,121	100%	61	**139**	2.9	**48**
JUL/AUG 12	12,349,849	1,121	100%	61	**181**	2.9	**62**
SEP/OCT 12	12,708,330	1,122	100%	61	**186**	2.9	**64**
NOV/DEC 12	9,377,286	1,122	100%	61	**137**	2.9	**47**
2012 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**151**		**52**

AGATE HEIGHTS WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 12	481,940	44	100%	60	**183**	2.9	**63**
MAR/APR 12	524,063	44	100%	61	**195**	2.9	**67**
MAY/JUN 12	543,946	44	100%	61	**203**	2.9	**70**
JUL/AUG 12	613,440	44	100%	61	**229**	2.9	**79**
SEP/OCT 12	668,841	45	100%	61	**244**	2.9	**84**
NOV/DEC 12	462,543	45	100%	61	**169**	2.9	**58**
2012 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**204**		**70**

EXHIBIT 5

AVERAGE DAILY DEMAND - 2012

JOHNSON WELLS WATER SYSTEM

Month	Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 12	20,734	2	100%	60	**173**	2.9	**60**
MAR/APR 12	17,420	2	100%	61	**143**	2.9	**49**
MAY/JUN 12	19,919	2	100%	61	**163**	2.9	**56**
JUL/AUG 12	21,721	2	100%	61	**178**	2.9	**61**
SEP/OCT 12	26,838	2	100%	61	**220**	2.9	**76**
NOV/DEC 12	21,198	2	100%	61	**174**	2.9	**60**
2012 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**175**		**60**

EAGLERIDGE WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 12	612,976	66	100%	60	**155**	2.9	**53**
MAR/APR 12	645,913	66	100%	61	**160**	2.9	**55**
MAY/JUN 12	841,918	66	100%	61	**209**	2.9	**72**
JUL/AUG 12	1,444,780	66	100%	61	**359**	2.9	**124**
SEP/OCT 12	1,453,787	66	100%	61	**361**	2.9	**125**
NOV/DEC 12	558,406	66	100%	61	**139**	2.9	**48**
2012 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**231**		**79**

EXHIBIT 5

AVERAGE DAILY DEMAND - 2013

SUDDEN VALLEY WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
DEC/JAN13	21,258,647	2,665	100%	62	**129**	2.5	**51**
FEB/MAR 13	19,031,194	2,666	100%	56	**127**	2.5	**51**
APR/MAY 13	19,531,289	2,666	100%	62	**118**	2.5	**47**
JUN/JUL 13	22,750,780	2,667	100%	62	**138**	2.5	**55**
AUG/SEP 13	22,194,802	2,668	100%	63	**132**	2.5	**53**
OCT/NOV 13	18,850,382	2,669	100%	63	**112**	2.5	**45**
2013 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**126**		**50**

GENEVA WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 13	9,907,982	1,122	100%	63	**140**	2.9	**48**
MAR/APR 13	9,423,156	1,122	100%	61	**138**	2.9	**47**
MAY/JUN 13	9,922,883	1,122	100%	58	**152**	2.9	**53**
JUL/AUG 13	14,388,996	1,121	100%	61	**210**	2.9	**73**
SEP/OCT 13	9,810,152	1,122	100%	61	**143**	2.9	**49**
NOV/DEC 13	8,991,666	1,122	100%	63	**127**	2.9	**44**
2013 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**152**		**52**

AGATE HEIGHTS WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 13	499,721	45	100%	63	**176**	2.9	**61**
MAR/APR 13	507,037	45	100%	61	**185**	2.9	**64**
MAY/JUN 13	576,426	45	100%	58	**221**	2.9	**76**
JUL/AUG 13	794,110	45	100%	61	**289**	2.9	**100**
SEP/OCT 13	562,700	45	100%	61	**205**	2.9	**71**
NOV/DEC 13	479,172	45	100%	63	**169**	2.9	**58**
2013 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**208**		**72**

EXHIBIT 5

AVERAGE DAILY DEMAND - 2013

JOHNSON WELLS WATER SYSTEM

Month	Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 13	17,316	2	100%	63	**137**	2.9	**47**
MAR/APR 13	17,772	2	100%	61	**146**	2.9	**50**
MAY/JUN 13	22,761	2	100%	58	**196**	2.9	**68**
JUL/AUG 13	23,823	2	100%	61	**195**	2.9	**67**
SEP/OCT 13	21,684	2	100%	61	**178**	2.9	**61**
NOV/DEC 13	20,929	2	100%	63	**166**	2.9	**57**
2013 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**170**		**59**

EAGLERIDGE WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 13	580,840	66	100%	63	**140**	2.9	**48**
MAR/APR 13	588,313	66	100%	61	**146**	2.9	**50**
MAY/JUN 13	805,981	67	100%	58	**207**	2.9	**72**
JUL/AUG 13	1,746,253	67	100%	61	**427**	2.9	**147**
SEP/OCT 13	968,316	67	100%	61	**237**	2.9	**82**
NOV/DEC 13	594,125	67	100%	63	**141**	2.9	**49**
2013 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**216**		**75**

EXHIBIT 5

AVERAGE DAILY DEMAND - 2014

SUDDEN VALLEY WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
DEC/JAN14	17,830,542	2,660	100%	62	**108**	2.5	**43**
FEB/MAR 14	17,865,010	2,660	100%	56	**120**	2.5	**48**
APR/MAY 14	17,262,910	2,661	100%	62	**105**	2.5	**42**
JUN/JUL 14	22,993,799	2,662	100%	62	**139**	2.5	**56**
AUG/SEP 14	22,646,380	2,664	100%	63	**135**	2.5	**54**
OCT/NOV 14	17,722,841	2,665	100%	63	**106**	2.5	**42**
2014 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**119**		**47**

GENEVA WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 14	9,822,667	1,127	100%	63	**138**	2.9	**48**
MAR/APR 14	8,539,477	1,131	100%	61	**124**	2.9	**43**
MAY/JUN 14	10,333,623	1,134	100%	58	**157**	2.9	**54**
JUL/AUG 14	13,564,503	1,131	100%	61	**197**	2.9	**68**
SEP/OCT 14	10,164,264	1,137	100%	61	**147**	2.9	**51**
NOV/DEC 14	8,838,256	1,137	100%	63	**123**	2.9	**43**
2014 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**148**		**51**

AGATE HEIGHTS WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 14	560,013	45	100%	63	**198**	2.9	**68**
MAR/APR 14	476,598	45	100%	61	**174**	2.9	**60**
MAY/JUN 14	631,983	45	100%	58	**242**	2.9	**83**
JUL/AUG 14	702,269	45	100%	61	**256**	2.9	**88**
SEP/OCT 14	580,352	45	100%	61	**211**	2.9	**73**
NOV/DEC 14	492,172	45	100%	63	**174**	2.9	**60**
2014 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**209**		**72**

EXHIBIT 5

AVERAGE DAILY DEMAND - 2014

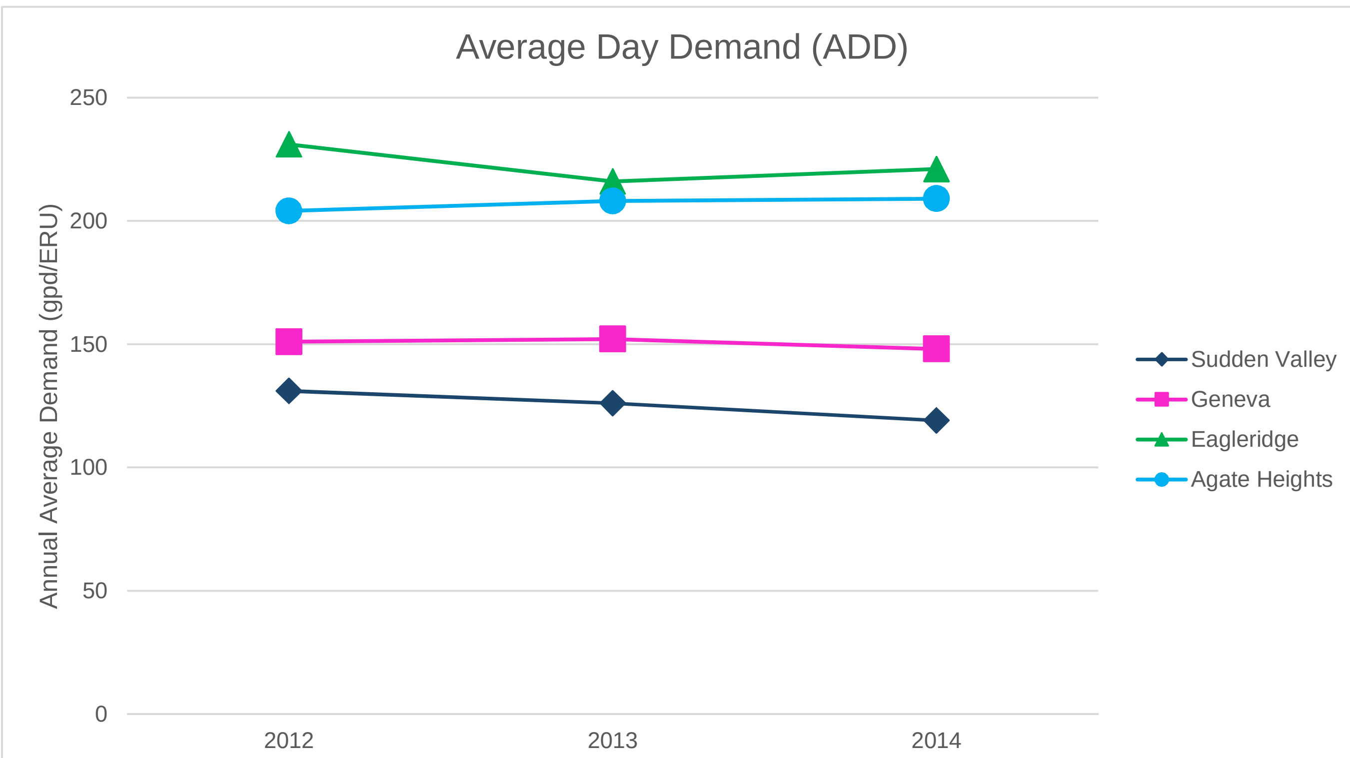
JOHNSON WELLS WATER SYSTEM

Month	Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 14	19,156	2	100%	63	**152**	2.9	**52**
MAR/APR 14	17,772	2	100%	61	**146**	2.9	**50**
MAY/JUN 14	18,872	2	100%	58	**163**	2.9	**56**
JUL/AUG 14	23,823	2	100%	61	**195**	2.9	**67**
SEP/OCT 14	20,465	2	100%	61	**168**	2.9	**58**
NOV/DEC 14	17,009	2	100%	63	**135**	2.9	**47**
2014 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**160**		**55**

EAGLERIDGE WATER SYSTEM

Month	Modified Gross Production (Gal.)	Number of ERUs	% Full Time Occupancy	Billing Cycle (days)	Per ERU Average Daily Consumption	Average Occupancy Per Conn. (persons)	Per Capita Average Daily Consumption
JAN/FEB 14	654,142	67	100%	63	**155**	2.9	**53**
MAR/APR 14	550,918	67	100%	61	**135**	2.9	**46**
MAY/JUN 14	875,632	67	100%	58	**225**	2.9	**78**
JUL/AUG 14	1,603,390	67	100%	61	**392**	2.9	**135**
SEP/OCT 14	1,114,620	67	100%	61	**273**	2.9	**94**
NOV/DEC 14	606,266	67	100%	63	**144**	2.9	**50**
2014 AVERAGE DAILY CONSUMPTION (gpd/ERU)					**221**		**76**

EXHIBIT 5



Average Day Demand (ADD)
Annual Average Demand (gpd/ERU)
250
200
150
100
50
0
2012
2013
2014
Sudden Valley
Geneva
Eagleridge
Agate Heights

APPENDIX B: EXAMPLES

Lake Whatcom Water & Sewer District
360-734-9224

WATER: *Are you using it wisely?*

Why is water metered in Lake Whatcom Water and Sewer District?

Lake Whatcom Water and Sewer District meters all accounts connected to its water distribution system to encourage conservation. Without water conservation, utilities have to develop a large volume of new water. Water-conserving districts do not need to pay as much to develop new water supplies or to expand or upgrade infrastructure. Most importantly, Lake Whatcom Water and Sewer District is within the watershed of our precious drinking water source. It is important to remember that as residents and employees of Lake Whatcom Water and Sewer District, we must make every effort to encourage conservation to protect our beautiful lake for many years to come.

What is Water Conservation?

- **Water conservation** is improved water management practices that reduce or enhance the beneficial use of water.
- A **water conservation measure** is an action, change, or improved process implemented to reduce water loss, waste, or use.
- **Water efficiency** is a tool of water conservation that results in more efficient water use which reduces water demand.

Lake Whatcom Water and Sewer District requests that customers irrigate on a *voluntary* watering schedule: **even numbered addresses to only water outside on Tuesdays, Thursdays, and Saturdays, and odd numbered addresses to water on Wednesdays, Fridays, and Sundays, with no outdoor watering on Mondays.**

Call Lake Whatcom Water & Sewer District
if you have
any questions.
(360) 734-9224
Monday—Thursday
8:00am—5:00pm

The Dos and Don'ts of Water Conservation

Bathroom

- **Do** take short showers and save 5-7 gallons a minute!
- **Do** fill the tub halfway and save 10-15 gallons.
- **Do** install water-saving toilets, showerheads and faucet aerators. Place a plastic bottle filled with water in your toilet tank if you can't switch to a low-flow toilet.
- **Don't** run the water while shaving, washing your hands or brushing your teeth. Faucets use 2-3 gallons a minute.

- **Don't** use the toilet as a wastebasket, and don't flush it unnecessarily.

Everywhere

- **Do** repair leaky faucets and turn taps off tightly. A slow drip wastes 15-20 gallons each day.

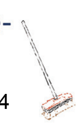
- **Don't** open fire hydrants.

Kitchen & Laundry

- **Do** run the dishwasher and washing machine only when full. Save even more by using the short cycle.
- **Do** install faucet aerators.
- **Don't** let the water run while washing dishes. Kitchen faucets use 2-3 gallons a minute. Filling a basin only takes 10 gallons to wash and rinse.

Outdoors

- **Do** use a self-closing nozzle on your hose.
- **Don't** water your sidewalk or driveway—instead, sweep them clean.



Step 6 - Finding an Interior Leak

The leak detection dial is not sensitive enough to spin with very small leaks such as a dripping faucet or fitting. If the star is spinning, look for a steady stream of water. The toilet by far is the most common culprit. The toilet ball shut-off may not be operating properly, or the flapper valve might not be sealing closed. If it is not a toilet, check the hot water tank. Check that no water is dripping or flowing from the hot water tank pressure relief valve and discharge pipe. The relief valve on the tank is typically piped to discharge outside the home or into a drain next to the hot water tank. If there is water from the relief, it may have popped off due to high pressure or valve failure. If neither the toilet nor hot water tank is the problem, check the crawl space for any signs of damp soil, pooling or streams of water. Also, check under all the sinks for a leaky fitting.

revised 02-06-2012

811

Know what's below.
Call before you dig.

Step 7 - Finding an Exterior Leak

Call 811 before you dig! This is a free service to locate underground utilities. The service will coordinate and notify applicable underground utilities to come out and locate their utility lines so they are marked before digging. More information can be found at their web site www.call811.com.

Many exterior leaks are due to faulty fittings and couplings at service line end connections – either at the house or at the meter. Signs of a leak near the house might not be evident due to footing drains around the foundation that collect and direct water away from the structure. Thoroughly investigate visually and by digging near the meter and where the service line enters the house - these are the two highest probability places to check first and eliminate. Look around sprinkler system heads for wet or green spots. If a leak is not found in these locations, it may be difficult to locate. Also, look for sink holes, cracked pavement, green areas, etc.

LAKE WHATCOM WATER
& SEWER DISTRICT

1220 LAKEWAY DRIVE
BELLINGHAM, WA 98229

Phone: 360-734-9224
Fax: 360-738-8250
Email: general.inbox@lwwsd.org

LAKE WHATCOM WATER
& SEWER DISTRICT

TIPS TO FIND A WATER LEAK

General Information

All water services in Lake Whatcom Water and Sewer District are metered. The District reads meters every two months. As a courtesy while preparing bi-monthly bills, the District notifies customers who have higher than normal consumption. Notification may be in the form of a letter or door tag.

Higher than normal usage could be a result of known or unknown events such as: higher water consumption by guests and occupants, extended irrigation during dry weather, leaving a garden hose on, toilet flush valve stuck open, or possibly a service line leak.

If a leak is suspected, the information and steps described below might help find or narrow down the location of a possible leak. In many cases it is relatively simple to repair a leak once it is found. Handy people can fix leaks even if they are unfamiliar with piping and fittings. Local hardware stores will be able to assist in finding the right parts for the repair. Otherwise, the District recommends that customers obtain quotes from several reputable plumbers before hiring a plumber to find and repair a leak. Ask friends and neighbors for plumber references they have used and trust.

Lake Whatcom Water and Sewer District is here to support its customers. The District can assist with locating the meter, shutting water off at the meter, questions about billing, and general questions about how to find leaks. However the District cannot recommend specific plumbers or assist with finding or repairing leaks on the customer's side of the meter. Service lines and plumbing system on the customer's side of the meter are privately owned and maintained and are the responsibility of the property owner.

If you have questions, please contact the District at (360) 734-9224.

7 STEPS TO FINDING A LEAK

Step 1 - Locate Your Meter

Meters are generally located at one of the property corners along the public road frontage. They are installed underground inside a meter box which can be a black plastic box or concrete box with a metal cover labeled "Water Meter." If the meter cannot be located, please call the District office for assistance. In many cases the District can lookup location descriptions and relay that information over the phone for hints on where it might be. Sometimes water meters are in unusual places. For difficult locations, the District's meter reader will visit the site to assist in finding the meter.

Step 2 - Open the Meter Box

Generally, there is a smaller lid within the larger lid covering the meter box. A screwdriver may be required to pry open the small lid. After the small lid is open, it provides a hand hole to reach in and pull off the entire cover if needed to view the meter. Please put the lid back when you are done to avoid a safety hazard. Many times there are two meters in the box. To identify a meter, compare the number on top of the black cap to the meter number listed on the account bill.

Step 3 - Understanding the Dial

District meters measure water use in cubic feet. One cubic foot equals 7.48 gallons. In the adjacent photo, the meter reads 29809. All of the numbers are read for billing purposes. The register does not reset to zero after each bi-monthly read. One complete "sweep" of the sweep hand means one cubic foot of water has passed through the meter.

Step 4 – Find the Leak Detection Dial

Meters are equipped with a leak detection dial (see photo). The leak detection dial is the 6-pointed silver star in the center of the meter. The star will spin slowly even with very low flow, such as a toilet valve running. The star spins faster for higher flow rates. To test if there is leak, turn off all water fixtures in the house then visually check if the star is spinning. If the star is spinning, there is a leak either inside or outside the house.

Step 5 – Determine if the Leak is Inside or Outside the House

Find the shut-off valve for the home. Sometimes these are not easy to find. The District maintains water service line records for homes built after 2001 which might help locate the shut-off valve. Close the shut-off valve by rotating the handle clockwise and then check your faucets to confirm water is completely off. On older construction shut-off valves may not seal tightly due to corrosion or sediment in the valve body.

When the shut-off valve is closed and water is completely off, check the leak detection dial (silver star) on the meter. If it is not spinning, the leak is inside the home. If it is still spinning, then the leak is somewhere between the shut-off valve and the meter box.

LAKE WHATCOM WATER
& SEWER DISTRICT

1220 Lakeway Drive
Bellingham, WA 98229
Phone: 360-734-9224
Fax: 360-738-8250
Email: general.inbox@lwwsd.org

Other Problems

While some toilet repairs are easy, others may be more complicated. Know your limitations – call a reputable plumber if you have any concerns about how to make a repair. Lake Whatcom Water and Sewer District is *not* responsible for any damage to your home or toilet because of faulty repairs.

Revised 02-06-2012

Know what's below. Call before you dig.

Call 811 before you dig! This is a free service to locate underground utilities. The service will coordinate and notify applicable underground utilities to come out and locate their utility lines so they are marked before digging. More information can be found at their web site www.call811.com.

LAKE WHATCOM WATER
& SEWER DISTRICT

1220 LAKEWAY DRIVE
BELLINGHAM, WA 98229

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LAKE WHATCOM WATER
& SEWER DISTRICT

LEAKY TOILET?

Yes, you can fix it!

Toilets consume approximately 26% of all water in the average home. They are also one of the likeliest places to find a leak that may waste thousands of gallons per month. In the District, leaks not only stress the drinking water system, but they also send clean water into the wastewater treatment plant. You can reduce your impact on the environment, and save money and water, by repairing some leaks yourself.

Step 1: Find the Leak

It can be easy to determine if your toilet is leaking. Maybe you hear the sound of water running, or a faint trickling or hissing. Many times, though, *water will flow through the tank silently,* and this is often why toilet leaks are overlooked. To test your toilet, lift the lid off the toilet tank and drop a Leak Detection Dye Tablet, available at local hardware stores, into the tank. If you do not have a Leak Detection Dye Tablet, several drops of food coloring dropped into the tank are just as good. Do not flush. Wait at least 10 minutes and check the bowl of the toilet. If there is dye in the bowl, the toilet has a leak.

Step 2: Gather Tools

To repair the leak, tools to have handy are

- An adjustable crescent wrench
- A hand towel
- Replacement flapper valve (flapper)

Step 3: Check the Chain

If you have to jiggle the handle to keep the toilet from running, it may be a misaligned flapper valve(2), a loose handle(9), or an incorrect length of chain(4).

To fix: Clean and adjust the chain(4). Make sure the chain isn't too long or short. Tighten the nut holding the toilet handle to the tank. If that doesn't work, the handle may have to be replaced.

Step 4: Check the Flapper

The flapper valve may not be sitting properly on the valve seat(3), or it may need to be replaced. Over time, the rubber material of the flapper deteriorates. If you gently rub the flapper and get streaks on your fingers, it should be replaced now.

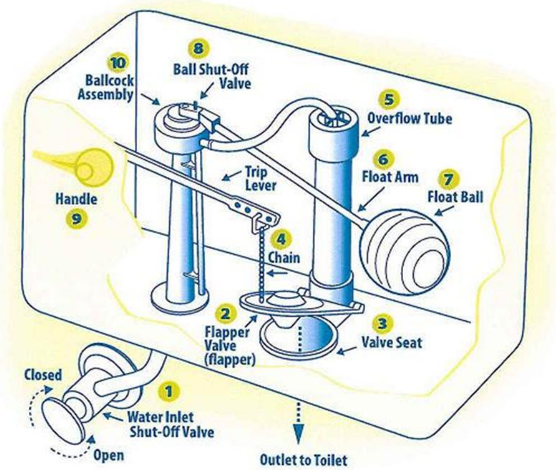
To fix: Drain the toilet tank. Close the water inlet shut-off valve to turn it off(1). Flush the toilet to drain the tank. Check the valve seat(3) for corrosion and clean it if necessary. Check the flapper valve(2) to ensure it is lining up properly with the valve seat. If needed, replacement flappers can easily be purchased at hardware stores and some large grocery stores. Follow the instructions on the flapper valve packaging. After installing the new flapper valve, open the water inlet shut-off valve(1) and flush to test.

Step 5: Check the Overflow Tube

If the water level in the tank is too high, it may continuously spill into the overflow tube(5), creating a large leak. The correct water level is about one-half to one inch below the top of the overflow tube.

To fix: Bend the float arm(6) gently downward. Flush after bending the arm to test whether the water stops at the proper level. Be sure to check that the float arm is screwed in securely so that it will not rotate.

*If the water level is too low, there may not be an efficient flush. If that is the case, carefully bend the float arm upward. You may need to replace the float ball(7) if it has filled with water, or replace the ball shut-off valve(8).



Images courtesy of City of Portland

LAKE WHATCOM WATER
& SEWER DISTRICT

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Appendix C – North Shore Water Consolidation Feasibility Study

Wilson
SURVEY/ENGINEERING

TO:	Patrick Sorensen, General Manager, Lake Whatcom Water & Sewer District
	Bill Hunter, PE, District Engineer / Assistant Manager, Lake Whatcom Water & Sewer District
FROM:	Melanie Mankamyer, PE
SUBJECT:	North Shore Water System Consolidation Feasibility Study
	Amendment Incorporating Comprehensive Water System Plan Updates
JOB NO.:	2016-093
DATE:	December 7, 2017

Purpose
The purpose of this technical memorandum is to present the revised cost estimates for the North Shore Water System Consolidation Study that incorporate updates to several base assumptions that came out of the recent Comprehensive Water System Plan.

Background
In June 2017 the District completed a study of several alternatives for extending water along the North Shore Road, consolidating existing water systems, and making potable water available to adjacent residential properties. The analyses were based on the design standards in the District's 2010 Comprehensive Water System Plan

With the recent work to update the Comprehensive Water System Plan nearing completion, several of the design standards were revised. This Amendment incorporates those changes into the cost analyses and the results are presented below.

Analysis
The change in the design standards that had the greatest impact on the water system consolidation cost estimate was lowering the required fire flow from 750 gpm to 500 gpm. The North Shore service area is zoned rural and is not in a UGA where it would be important to match the fire flow requirements of the adjacent water purveyors (in case the area was annexed). By reducing the fire flow requirements, the locations where water main size was previously twelve inches could be reduced to eight inches in diameter.

The second change was to reduce the projected water demands for the service area. There have been substantial reductions in water use since the last Comprehensive Water System Plan, and the potential future water system customers are anticipated to have water use patterns closer to the Agate Heights area than the Eagleridge area. This allowed the water treatment plant size to be reduced.

Overall the reduction in the projected costs was approximately 10%. As before, the cost share per connection was determined using three participation levels - 50%, 75% and 90%. The updated cost share range shown in Table 1 below is based on the Alternative Project Costs divided by the projected number of participants for each Alternative. The lowest value represents Alternative 2 which has the highest potential number of new connections.

Table 1. Updated Estimated Cost Share Per Connection

	Cost Share per Connection	
	Lump Sum Fee (range)	**Annualized Fee (based on 20-year Bond repayment at 2.73%)**
50% Participation	$42,800 - $50,300	$2,800 - $3,300
75% Participation	$29,900 - $35,100	$1,960 - $2,300
90% Participation	$25,500 - $29,900	$1,670 - $1,960

** Lump sum fee includes an estimate for the service connection including the meter assembly*
If the District pursues and secures a DWSRF Loan with up to 50% principal forgiveness for a consolidation project, then the project costs would be greatly reduced and the connection share would also be much less.

Planning
Also as part of the Comprehensive Water System Plan planning effort, the District reviewed options for phasing the implementation of the North Shore water system consolidation, and making it possible for small developer extensions to accomplish portions of the water main work. This effort defined three potential phases for implementation, with the first two phases having a significantly reduced scope.

Currently the Agate Heights water system has very few uncommitted water service connections. In order to increase the number of connections available, and improve the water treatment plant reliability and resiliency, the Agate Heights Phase 1 improvements would replace the existing plant with a package plant that has twice the capacity and multiple filter units. With this increase in plant capacity, storage capacity becomes the limiting factor, but over 50 additional connections would become available.

The potential Agate Heights Phase 2 improvements extend the distribution main to the two closest Group A water systems - the Agate Bay Trailer Park (25 ERUs) and the Russell Group (The Forks Restaurant). This phase would add a new reservoir, a second water plant module, and about 3,000 feet of 8-inch water mains. This project would qualify for a Drinking Water Consolidation Loan which provides up to 50% principal forgiveness (depending on the availability of funds). The principal forgiveness would substantially reduce the project costs to the District, and the amount needed to be recovered from new connections.

The final Phase 3 improvements would add a second new reservoir, additional plant capacity and consolidate the District's Eagleridge water system. It may also extend the distribution system to the east end of North Shore Road.

LAKE WHATCOM WATER AND SEWER DISTRICT
Whatcom County, Washington

NORTHSHORE CONSOLIDATION FEASIBILITY STUDY

WHATCOM COUNTY, WASHINGTON

Department of Health Contract N21980

WILSON ENGINEERING, LLC
Consulting Engineers
805 Dupont Street, Suite 7
Bellingham, Washington 98225

Project # 2016-093
August 2017

LAKE WHATCOM WATER AND SEWER DISTRICT
NORTHSHORE CONSOLIDATION FEASIBILITY STUDY
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Exhibits not included as part of this Water System Plan. Available at lwwsd.org

LAKE WHATCOM WATER AND SEWER DISTRICT
NORTHSHORE CONSOLIDATION FEASIBILITY STUDY

Whatcom County, Washington

1.0 INTRODUCTION

The Washington State Department of Health (DOH) has entered into an interagency agreement with Lake Whatcom Water and Sewer District of Whatcom County (LWWSD) to prepare and submit a feasibility study evaluating consolidating three existing Group A water systems on the north shore of Lake Whatcom: Eagleridge (#08118), Agate Heights (#52957), and Agate Bay Trailer Park (#00496). In addition, two Group B water systems and numerous individual homes will be considered for consolidation. All are within the District's service area boundary as shown in Figure 1.

Development of this area has resulted in several private water systems, individual wells and individual surface water withdrawals that generally have limited or no fire flow capacity and are relatively expensive to operate due to their small size. The goal of this study is to examine the feasibility of combining the systems into one system that would result in improved water quality and quantity, and increased safety and reliability.

The study area is classified as Rural and with R5A zoning (one unit per five acres). This area is shown in Figure 2. Note that 90% of the lakefront development has already occurred, and at density levels much higher than one unit per five acres.

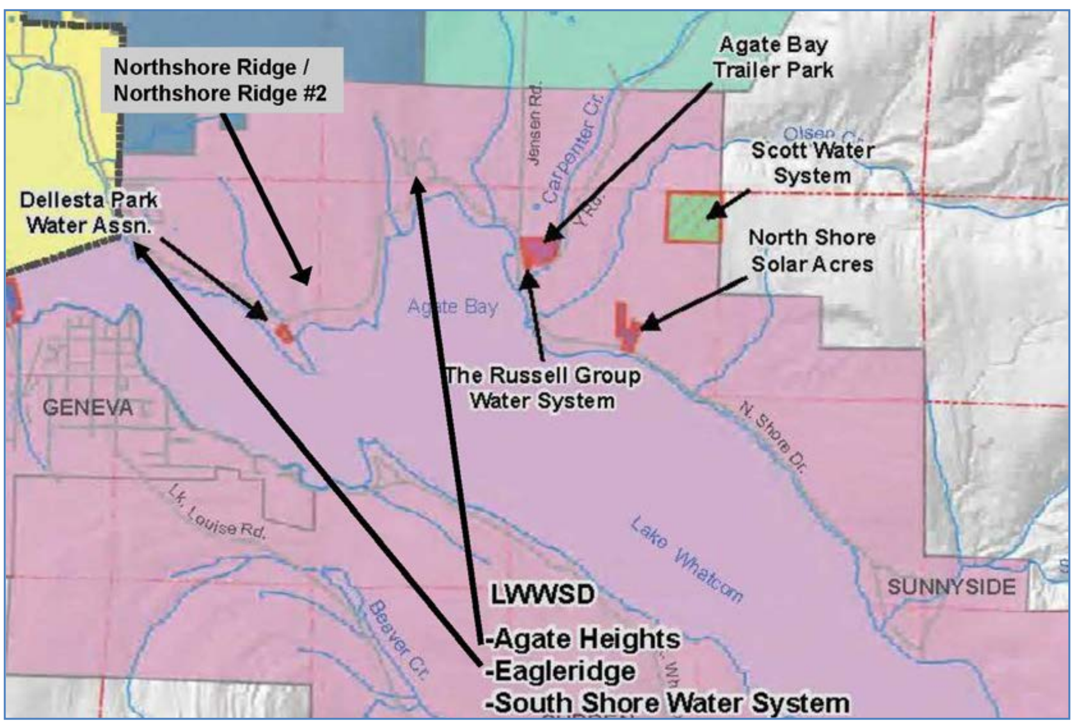

Figure 1. North Shore Area from Whatcom County Coordinated Water System Plan Map

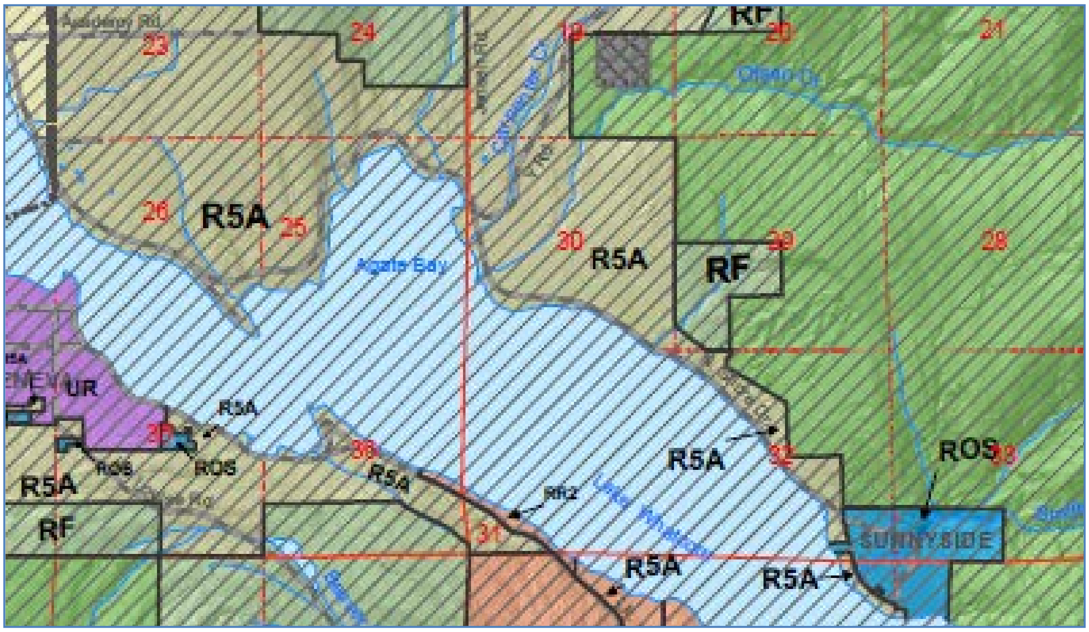

Figure 2. Whatcom County Zoning for North Shore Area

2.0 NORTHSHORE STUDY AREA EXISTING CONDITIONS

The Northshore area of Lake Whatcom Water and Sewer District is located 5 miles east of the center of Bellingham and abuts the City limits on its western edge. The study area is zoned rural - R5A (rural 1 unit per 5 acres). Water facilities inventory forms (WFI's) for several of the systems are included in the Exhibit 1. The Group A systems are (1) Eagleridge (LWWSD), (2) Agate Heights (LWWSD), (3) Agate Bay Trailer Park, and (4) Russel Group (The Fork restaurant). In addition there are several Group B water systems which include (5) North Shore Solar Acres, (6) North Shore Ridge, (7) North Shore Ridge #2, and (8) Dellesta Park. There are also 330 existing private residences within the study area that are on private wells or direct lake draws. The estimated number of existing potential water services with the study area total approximately 525. The subject individual water systems are shown on Figure 1 and the capacity of each is listed below.

- <u>Eagleridge Water System</u> – water source is City of Bellingham; 70 connections; capacity = 85
- <u>Agate Heights Water System</u> – water source is a District-owned well; 39 connections (44 ERUs); capacity = 48 connections (54 ERUs)
- <u>Agate Bay Trailer Park Water System</u> – Group A, well source, 25 connections
- <u>Russell Group</u> (restaurant) – Group A, well source, one connection
- <u>Dellesta Park</u> – Group B, well source, 5 connections (capacity=7)
- <u>North Shore Solar Acres</u> – Group B, well source, 6 connections
- <u>Northshore Ridge</u> – Group B, well source, 4 connections
- <u>Northshore Ridge #2</u> – Group B, well source, 3 connections

2.1 Source of Supply

For the consolidated water system, the District plans to use its Agate Heights well as the Source of Supply, and maintain the connection to the City of Bellingham at Eagleridge as an emergency intertie.

<u>Well</u> - The District's well at Agate Heights is a 10-inch artesian well with a pumped capacity of 494 gpm (322 gpm from artesian pressure). A 100-ft radius protective zone is provided with a

Restrictive Covenant for the well.

Water Rights – The District has several water rights (Permits and Certificates) associated with this well that total 438 gpm:

1. G22681P - 60 gpm instantaneous; 32.4 acre-ft/yr annual
2. G22763P - 360 gpm instantaneous; 465.9 acre-ft/yr annual
3. G23449 - 18 gpm instantaneous; 8.6 acre-ft/yr annual

Water Quality – The water from the existing well needs to be treated to remove manganese. The Agate Heights Water Treatment Plant is currently a 30 gpm Filtronics package treatment system which is nearing capacity. The District plans to increase the capacity of the water treatment plant to accommodate localized demand even if the consolidation project is not constructed.

2.2 Storage

The Agate Heights water system has two reservoirs at two different elevations. The lower 80,000 gallon reservoir is filled at a rate of 30-gpm by the system transmission pumps, which is activated when the treatment plant is operated. The upper 105,000 gallon reservoir is filled at a rate of 21 gpm. The source is the lower reservoir. The existing reservoirs currently provide equalizing, standby, and fire storage for the Agate Heights water system.

2.3 Booster Pumps / Transmission Pumps

The Eagleridge water system currently uses booster pumps to maintain water pressure. With the consolidated water system, these booster pumps would no longer be needed. The Agate Heights water treatment plant pumps are sized to match the treatment plant capacity. The transmission pumps for the filling the upper tank are converted booster pumps, repurposed when the upper tank was installed.

2.4 Distribution System

The water distribution systems both consist entirely of 8-inch ductile iron pipe. Eagleridge currently provide 750 gpm for fire protection and Agate Heights currently provide 500-750 gpm for fire protection.

3.0 SYSTEM DEMANDS

For this feasibility study, we have developed three scenarios based on different projections for system expansion:

- Alternative 1 – Match District sewer service area
- Alternative 2 – Extend water to east end of Northshore Road
- Alternative 3 – Extend only to Group A systems at Y Road

The service areas and proposed schematic facility locations for each of these Alternatives are included in Exhibit 2.

We reviewed the Average Day Demand (ADD) and Maximum Day Demand (MDD) values for both the Eagleridge and Agate Heights water systems listed in the 2010 Water Comprehensive Plan and the 2016 Water Use Efficiency Plan Update since the customers on these systems would be similar to the new customers incorporated into the consolidated water system. The average of the four ADD values in these two reports is 243 gpd/ERU. Given that the existing data set is a small number of customers, and that the DOH Manual recommends using 350 gpd/ERU as a minimum, this analysis used 350 gpd/ERU for ADD.

The average of the four MDD values in these two reports is 680 gpm/ERU. When good metered data is not available, the DOH Manual recommends using two times the ADD for MDD. This analysis used 700 gpd/ERU for MDD.

The resulting PHD (peak hourly demand) is computed using DOH'S PHD Worksheet (See Appendix 8) for each Alternative. In addition to PHD, this water system will provide residential fire flows of 750 gpm.

4.0 SYSTEM ANALYSIS

Analysis is performed in accordance with DOH "Water System Design Manual" as described below. The amount of water supply and storage are interdependent. For instance, equalizing storage is used to supply the difference between pumping rate and demand rate. When demand rates are greater than pumping rates, water in storage is used to supply the difference. When demand rates are less than pumping rates, storage is replenished. The greater the capacity of the water supply the less equalizing storage needed. The minimum capacity of the source(s) must be equal to or greater than the maximum daily demand.

4.1 Source of Supply

The 10-inch well at Agate Heights has been performance tested at 494-gpm, however the current pump capacity is limited to 30-gpm. The District holds water rights on this well for 438 gpm. The MDD (maximum daily demand) for the system is projected to be 700 gpd/ERU. To meet MDD for any of the Alternatives, the treatment plant and pumping capacity will need to be increased.

The size of water treatment plant that each Alternative would need is calculated as follows and listed in the table below:

Build out rate = (700 gpd/parcel X Build-out ERUs) / (1,440 mins/day) = Plant Size (gpm)

Scenario:	Build-out ERUs	Minimum Plant Size (*)
Alternative #1	405	200 gpm
Alternative #2	530	260 gpm
Alternative #3	355	175 gpm

4.2 Storage

Storage required consists of the sum of operating storage, equalizing storage and the greater of standby storage or fire flow storage. Currently Agate Heights has an 80,000 gallon reservoir and a 105,000 gallon reservoir. For this analysis, we excluded the 105,000 gallon reservoir, which serves the upper pressure zone and provides fire suppression storage for the Lake Whatcom Residential and Treatment Center. Eagleridge relies on storage capacity provided by the City of Bellingham.

The total storage volume is the sum of several components. Operating storage is the volume between the "off" and "on" control levels in the reservoir. Equalizing storage is equal to the product of 150 and the difference in peak hourly demand (PHD) and supply rate. Standby storage is equal to twice the ADD of 350 gpd/ERU x N ERUs. Minimum fire suppression storage for the residential portion of this system is 45,000-gallons; however this is nested with standby storage; resulting in the larger of the two values being applicable. Dead storage is the volume in the bottom of the tank below the "silt guard" outlet plus the volume at the top of the tank above the "off" probe. The "total storage required" is the sum of each of these values and can be compared with "storage available" as reflected in the table below. The table also indicates the minimum additional storage volume required. Please note that these values are based on a DOH Design Manual ADD of 350 gpd/ERU and highly sensitive to that value because the largest component of storage (Standby Storage) is equal to two times ADD times the number of ERUs. For example, if the calculated average for ADD of 243 gpd/ERU (see Section 3) were used, the total required storage for Alternative #1 would be reduced by about 82,000 gallons to 230,000 gallons. Using the lower value for ADD will require DOH approval.

Scenario:	**Total Required Storage (gallons)**	**Storage Available (gallons)**	**Additional Storage Needed (gallons)**
Alternative #1	312,000	80,000	232,000
Alternative #2	403,000	80,000	323,000
Alternative #3	274,000	80,000	194,000

4.3 Transmission Pumps

The transmission pump system needs to deliver the treated water to the storage reservoir(s). The flow rates will be sized to match the water treatment plant capacity, and the required pumping head will be calculated based on the elevation head and the friction head.

4.3 Distribution System

The consolidated system will provide 750 gpm fire flow and ensure that a minimum pressure of 20 psi is maintained at each service meter during a fire flow event. Supplying fire flows is the driving factor in the sizing of the distribution system. The hydraulic analyses indicated that the majority of the distribution pipe will need to be 12-inch diameter in order to meet the fire flow scenarios. The remainder will be a minimum of 8-inch diameter.

The District standard practice is to install fire hydrants every 600 feet along the distribution mains.

5.0 PROJECT COST ESTIMATE AND FUNDING OPTIONS

5.1 Project Cost Estimate

We have evaluated three scenarios and developed planning level cost estimates for each. The first is Alternative1 which matches the existing District sewer service area (ending approximately at the east side of Agate Bay). Alternative 2 extends water service to the east end of Northshore Road. Alternative 3 limits the water system extension to only as far as needed to connect the existing Group A water systems and end at the Y Road. These preliminary, planning level cost estimates are included in Exhibit 3.

The preliminary project cost estimate for Alternative 1 is $6.3M to $6.9M. This includes engineering, permitting, and surveying in addition to construction costs and 10-20% contingency. It does not include the cost of metered service connections since the level of participation is unknown, and those costs are typically born directly by the property owners. The build-out number of Equivalent Residential Units (ERUs) assumed for Alternative 1 is 405 (120 from existing service areas).

The Alternative 2 scenario builds on Alternative 1, and adds about 11,750 feet of water main, nineteen fire hydrants, a larger storage reservoir, and a larger water treatment plant and transmission pumps. The build-out number of Equivalent Residential Units (ERUs) assumed for Alternative 2 is 530 (120 from existing service areas).

The preliminary project cost estimate for Alternative 2 is $9.1 to $10M. Again, this includes engineering, permitting, and surveying in addition to construction costs and 10-20% contingency. It does not include the cost of metered service connections since the level of participation is unknown, and those costs are typically born directly by the property owners.

Alternative 3 is a reduction from Alternative 1 - it has about 3,650 feet less of water main and 6 fewer fire hydrants. It also reduces the number of potential future customers by about 50 - the build-out number of Equivalent Residential Units (ERUs) assumed for Alternative 3 is 355 (120 from existing service areas).. The preliminary project cost estimate for Alternative 3 is about $5.7 to $6.2M.

5.2 Financing Options

There are several potential sources of funds for financing a drinking water project of this size. The Drinking Water State Revolving Fund (DWSRF) Loan program specifically targets projects that consolidate existing Group A water systems and will forgive up to 50% of the loan principal for these projects, subject to funding availability. These loans typically have a payback period of 24 years, so collection can also occur over time, and substantially reduce the up-front costs to participants. The Public Works Trust Fund would also fund a project like this, though funds are not reliably available. The District could issue a Revenue Bond, which would typically have a 20 year payback. The final possible funding source considered was USDA-Rural Development, which has a term of up to 40 years, but will only fund projects that have no other financing options. A summary of rates and terms for these options is listed below.

Funding Source	Interest Rate	Loan Term
Drinking Water State Revolving Fund (DWSRF) Consolidation Loan • Potential for 50% principal forgiveness (if funds are available)	1.5%	24 years
Public Works Trust Fund Loan	1-2%	20 years
Revenue Bond (as of 4/20/17; AA Bond Rating)	2.73%	20 years
USDA-Rural Development (as of 7/1/17) • Funding source of last resort	3.25%	up to 40 years

Of these options, the DWSRF Loan with the 50% principal forgiveness is the most attractive financing option because it substantially reduces the amount of capital expenditures that need to be recovered. However, there is the uncertainty that funds would be available for the principal forgiveness portion of the loan. Loan applications are typically accepted in September, and are funded based on how well the project scores on Department of Health evaluation criteria.

The Revenue Bond is a funding source that is more under the control of the District than any of the loan options. The District has an AA Bond Rating and has obtained financing for capital project using Revenue Bonds in the past. Because the District has bonding capacity, it is less likely to qualify for funding from USDA-Rural Development.

5.3 Cost Sharing Options

We have identified three potential methods the District could use to collect payments over time - a Utility Local Improvement District (ULID), a “Special Benefit Area” fee assessed upon connection, or a fixed debt-service/capital charge on the water bill. The underlying assumption for all of these options is that the costs will be borne by the new connections or assessed properties, and not by existing District customers.

The main advantage of a ULID is that it would assess all of the properties that benefit from the improvement, whether they connect or not. It also allows the assessment to be paid over time - typically 20 years with interest. It would address the inherent inequity of those who connect subsidizing fire protection for neighbors who elect not to connect. The disadvantage of a ULID is the high costs associated with creating the ULID and the hurdle that the assessment must be no more than the amount the property’s value is increased by the assessment. The area to be served is already 90% built-out, and these homes already have some source for water. We assume, therefore, that the assessment needed would exceed the amount allowed under the ULID statute.

The “Special Benefit Area” fee would be similar to a ULID, without using the formal ULID process. The project costs would be divided amongst an estimated number of likely connections. It would be possible to pay over time with a security interest recorded against the property.

It is challenging to predict the number of properties that would connect to the public water system if it is installed. Typically, a municipal purveyor cannot compel connection to a public water system, and there is a contingent of property owners who are not interested in connecting to public water. There are, however, approximately 250 residences on surface water withdrawals - some with permits, some with claims and some with applications pending. Of the 118 with permits, the Department of Ecology (DOE) estimates that about 64 include a provision “to connect to a public water supply when connection to such system is practical and discontinue use from the lake.” DOE has indicated that the 42 pending applications would be similarly provisioned, as would any new applications for surface water withdrawals. The District has also been requiring new sewer-only customers to sign a Covenant that requires them to connect to water when it is available. The number of these covenants in place is unknown, and many probably overlap with the DOE provisional water rights. Figure 3 shows the status of surface water rights based on DOE’s database. Note that the map excludes District customers but not others on wells or small water systems. These are red on the map, since they do not having a ***<u>surface</u>*** water right.

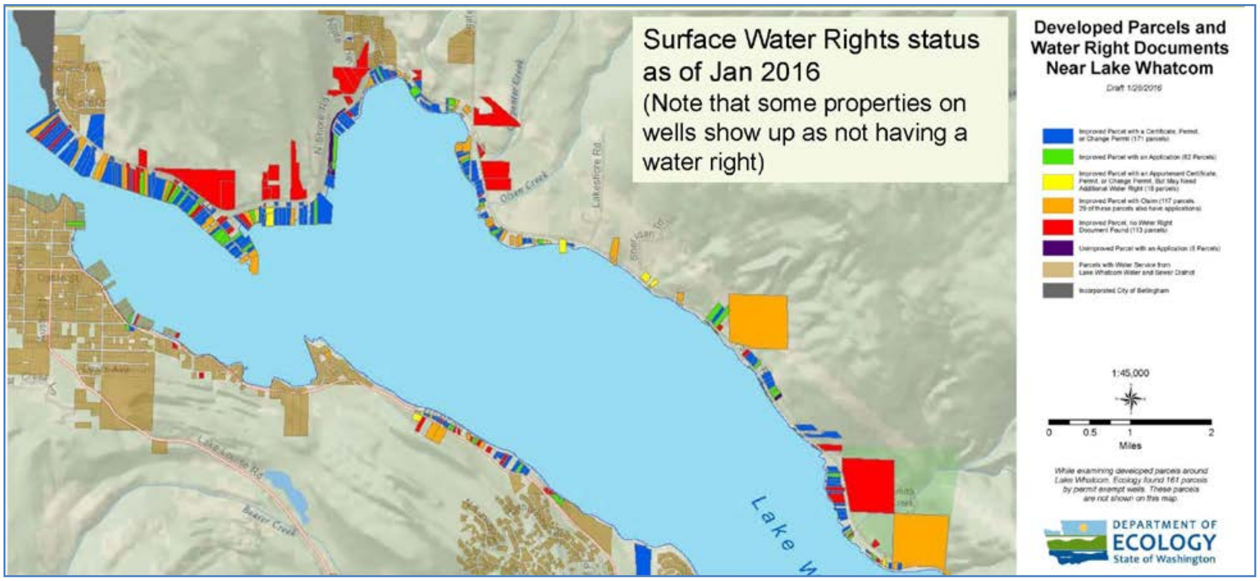

Figure 3. Department of Ecology Surface Water Right Status Map

The third option for cost recovery is adding a capital recovery charge to the water bills. This fee would not apply to existing District water customers on the North Shore. This is a simple approach, and allows the cost share to be adjusted as new connections are added. It may be interesting to investigate adding a capital recovery charge for the portion of the water system needed to provide fire protection to the sewer bills of the existing district customers. This would capture some of those who benefit from the fire protection provided by the improvements, but elected not to connect to public water.

The cost share per connection was determined using three participation levels - 50%, 75% and 90%. The cost share range shown in Table 1 below is based on the Alternative Project Costs divided by the projected number of participants for each Alternative. The lowest value represents Alternative 2 which has the highest potential number of new connections.

Table 1. Estimated Cost Share Per Connection

	Cost Share per Connection	
	Lump Sum Fee (range)	**Annualized Fee (based on 20-year Bond repayment at 2.73%)**
50% Participation	$48,000 - $56,500	$3,146 - $3,704
75% Participation	$33,500 - $39,200	$2,196 - $2,570
90% Participation	$28,500 - $33,300	$1,868- $2,183

* Lump sum fee includes an estimate for the service connection including the meter assembly

If the District pursues and secures a DWSRF Loan with up to 50% principal forgiveness for a consolidation project, then the project costs would be greatly reduced and the connection share would also be much less.

The District recently had its general facilities / connection charge for future connections reviewed. The analysis conducted did not include this potential project as a future capital investment because it was assumed that the project would be paid for by those who benefit. It also did not include the potential new customers associated with this system expansion.

Because of the size of this system expansion when compared to the existing District water utility assets, it may be beneficial to consider establishing a separate general facilities / connection charge for the North Shore. The majority of the water infrastructure is in the South Shore water system, and the majority of customers are served by the South Shore system. The general facilities / connection charge is the “buy-in” for the new customers to the existing system and the consolidation project is essentially installing a new water system for the North Shore service area. It would follow that the cost share per connection above would be the basis for a new general facilities / connection charge specifically for the North Shore, with the appropriate incorporation of the existing assets at Eagleridge and Agate Heights to the “buy-in” calculation.

5.4 Example Rates and Charges

Example Bi-monthly water charges: These numbers are very preliminary and are based on existing District water rates and average water use by Agate Heights water system customers.

- Base Rate = $62.31/two months
- Water Usage over 600 cubic feet (CF) = $8.85/100 CF
- Bi-monthly Base + average usage = $171.43 ($85.72/month)

As an example, a property with a one-inch water service and an average of 750 gallons per day water use would have a total monthly bill in the range of $213.10 to $253.10.

6.0 PUBLIC MEETING AND OUTREACH FEEDBACK

A public meeting was held on June 20, 2017, at 6:30pm at the North Whatcom Fire Hall. The meeting was well attended with 54 individuals and couples signing in. Several District Commissioners were in attendance, along with the General Manager and Assistant General Manager. The consolidation Alternatives and preliminary cost estimates were presented and the floor was open for questions and discussion. There were many comments and questions before the meeting was adjourned at 7:36 pm. There were two main themes of the discussion - comments of support for the project and comments against the project as promoting growth and development in the Lake Whatcom watershed.

A questionnaire was also available and 47 were filled out and returned that evening. Several more were returned the next day. A copy of the questionnaire and the raw results are included in Exhibit 4. The questionnaire gathered some basic information (property use, water source) in addition to interest in connecting to public water. It also polled motivations to connect and financial priorities.

The initial questionnaire responses were evenly split between those who wanted to connect to public water and those who didn’t (21 yes / 21 no). Six respondents wrote in “maybe” or “depends”. There were also recurring items that came up under “motivation” such as fire protection/safety that were added to the second generation questionnaire.

6.1 Summary of Questionnaire Responses

On July 10, 2017, the District sent a follow-up letter with the updated questionnaire to all property owners within the potential service area. The letter indicated that responses should be returned by July 31, 2017.

As of August 24, 2017, the District received 253 questionnaire responses, both from the public meeting and the subsequent mailing to the properties in the area. The mailing included existing District water customers in Eagleridge and Agate Heights, and did not exclude those who had submitted responses at the public meeting since not all of the responses received included addresses. There are known duplicates in the data set that can be identified by names or addresses, and there are probably also unknown duplicates in the responses that did not include a name or address.

The raw questionnaire data is included in Exhibit 4. In analyzing the data, we used addresses to identify 21 responses came from existing District customers. These responses are not included in the summary results listed below.

The breakdown of the questionnaire responses are listed below:

1. What is the current use of your property?
   - Single Family 200
   - Vacant 19
   - Other 12
   - No entry 1

2. What is the water source for your property?
   - Lake Draw 109
   - Well/Lake Draw 2 (checked two boxes)
   - Well 52
   - Shared Well 40
   - Water System 9
   - Rainwater 3
   - Other 6
   - None/No entry 11

3. Are you interested in connecting to a public water system? (broken down by water source)

Water Source:	Yes	No	Maybe/Depends
Lake Draw	29	53	27
Well/Lake Draw	2		
Well	14	23	15
Shared Well	15	12	13
Water System	3	1	5
Rainwater	1	1	1
Other	2	3	1
None	7		1
No entry	1	2	
TOTAL	**74**	**95**	**63**

4. If you are interested, what is your motivation to connect to a public water system?

	Yes	Maybe/Depends
• Reliability	62	36
• Water Quality	59	23
• Water Quantity	20	15
• Fire protection	23	12
• Other	6	8

5. If you are interested, what will drive your decision-making process? (Rank 1-4 with 1 being most important)

	Yes				**Maybe/Depends**			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Overall cost to connect	38	18	4	0	36	18	0	0
Ability to pay connection fee over time	11	17	17	3	4	18	15	3
Estimated water bills	5	23	22	3	7	25	15	1
Other *	11	4	0	8	4	1	2	7

*"Other" includes: water pressure, less maintenance, timing, wants public sewer included, access to water, fire protection, monitored supply, ability to keep current water source for irrigation, will water use be limited, wants mineral-free water, resale of property, clogged intakes.

The "Comments" section of the questionnaire was well used. All of the comments are included with the raw questionnaire data in Exhibit 4. A summary of the most common comments is provided below.

The two main concerns of those who responded that they were not interested in connecting to public water were the costs associated with it and that they see public water as promoting growth in the Lake Whatcom watershed. These properties already have a water source that they are happy with. It is interesting to note that one "No" response was interested in fire protection, and another was interested in connecting to public sewer.

The primary concern of those who responded with "maybe/depends" is cost. Several also expressed concern about promoting growth and four expressed interest in a sewer connection.

The comments received by those who were interested in connecting to public water included general statements of support for the project, interest in fire protection, and interest in access to a potable water source with good quality water. There were two "yes" responders interested in connecting to public sewer. Most of the vacant properties indicated that they would connect considering the current circumstances where the Hirst decision has effectively placed a moratorium on using individual wells for new development.

It is interesting to note that three responders indicated that they are using rain water harvesting as their water source, which confirms that development has not been prevented from occurring even with the "moratorium" on individual wells. One is very interested in connecting to public water, one has just spent $18,000 for the rainwater system and is not interested in public water.

6.2 Other Concerns / Comments

Several brought up the question of whether they would be able to continue to use their existing water source for irrigation, or as a back-up supply. This is a question best answered by the Department of Ecology. We have not pursued this subject with them.

There were several questions at the public meeting about whether the District would force residences to connect. In general, the District does not have the authority to compel connection to public water. The District does have the authority to compel connection to public sewer, and has a policy that connecting to water is required with a sewer connection, where water is available. It was brought up that the District has been requiring sewer-only connections to sign a Covenant that would require connection to public water when it is available.

7.0 SUMMARY AND CONCLUSIONS

All of the water system consolidation Alternatives are technically feasible - the District has sufficient water rights on a well with sufficient production capacity, and the ability to expand the water treatment plant at the existing site. Potential challenges include obtaining a site for the new water reservoir, and underground conditions (possible rock). The financial feasibility of this project depends on the participation of enough parties to make the financial commitment acceptable. Overall costs and the ability to pay over time will be key to achieving reasonable participation levels of those in the “maybe/depends” category.

The public process for this project has raised other factors to consider which are discussed below.

7.1 Public Health

Water quality was the second highest potential motivation for connecting to public water. The District recently completed a program to test the lake waters along the east end of Northshore Road for phosphorus and fecal coliform. This area does not have public sewer, and there are about 100 homes on septic systems, many of which are older and quite close to the Lake. The test results indicate that human fecal coliform bacteria are leaching into the Lake.

These results were not widely distributed prior to the District distributing the water consolidation questionnaire. It raises the question as to whether some of the lake draw respondents would change their response from “no” to “yes” with this additional information.

7.2 Fire Protection

Several of the questionnaire responders indicated that they were also interested in the fire protection that a public water system would bring. Given that there is a significant percentage of the properties in the service area that are not interested in connecting to public water, the District should consider its options on cost recovery for providing hydrants and fire storage for those who benefit from this infrastructure but are not “paying customers”.

7.3 Protection of Lake Whatcom

Many of the questionnaire responders who were against the consolidation project expressed concern that extending public water would promote growth in the watershed and harm the lake in the process. The District is not the Land Use Authority - Whatcom County is. It should be noted that other sources of water are available - surface water for those next to the Lake, and rainwater harvesting for those not able to drill a well. At this time, the Hirst decision has halted the use of permit-exempt wells in Whatcom County, but that is not preventing development in the watershed - it is promoting the proliferation of rainwater harvesting systems. It should be noted that the proposed service area is already 90% built-out, and the availability of public water will have no impact on whether properties are able to subdivide.

There were a few responses that requested a sewer extension and indicated that they would be more interested in connecting to sewer, and that they felt extending sewer would do more to protect the lake than extending water. The District agrees there is a benefit to extending sewer and eliminating septic systems, but is constrained by the Growth Management Act (GMA) on how it proceeds since the un-sewered area is outside of an Urban Growth Area (UGA) or a Limited Area of More Intense Rural Development (LAMIRD).

7.4 Next Steps

The information the District has gathered under this study has been very informative and the District will continue to process and discuss these results. One possible future activity would be to "map" the results of those interested vs not interested, and the properties with covenants that require them to connect. Another potential follow on effort would be a sensitivity analysis on the project cost estimate to see what assumptions have a significant impact on costs (e.g. level of fire protection or standby storage). Reducing the overall costs will be critical in maximizing the number of properties that connect to public water.

Appendix D – Water Quantity / Water Quality Data

Disinfection Byproducts Monitoring Plan

System Name	Lake Whatcom Water & Sewer District	**Type and**	
PWSID#	95910	**Population**	SW and/or GWI 500 - 9,999
Date	1/13/2004 (updated 4/22/04)	**of System**	
Completed by	Charles Anderson (with update by JCL)		

Monitoring requirements are additive; for example a system using ozone and chlorine, or chlorine with conventional filtration must meet the monitoring requirements for both.

Treatment Provided

Chlorine (gas, hypochlorite, etc) or Chloramines

Identify the number of "Treatment Plants" serving your system

A "Treatment Plant" or "TP" may be:

- A single surface water source
- A single well source
- A combination of multiple, individual sources (if all of the water is blended prior to distribution)

1

Enter Description of Treatment Plant Below

TP1	The Sudden Valley Water Treatment Plant (SVWTP) is a direct filtration plant with four multi media filters.
	The coagulant used in alum with no filter aids. The coagulated water is pre-chlorinated prior to flocculation and
	then enters the filtration system. The filtered water is then post chlorinated and the pH is increased with the
	addition of liquid soda ash solution.

Disinfectant Monitoring

Required:

Chlorine residuals must be measured at the same time and place as routine or repeat coliform samples
MRDL for chlorine and chloramines = 4.0 mg/l as Cl2

Compliance

Compliance is based on the running annual average (RAA) of 12 consecutive months
DOH will determine compliance for chlorine MRDL
Daily residual measurements will / will not be included in the compliance calculations (circle one)

Byproduct Monitoring

Required:

TTHM & HAA5 - 1 sample per quarter at maximum residence time MRT)
TTHM MCL = 0.080 mg/l, HAA5 MCL = 0.060 mg/l

Compliance

Compliance is based on the Running Annual Average (RAA) of quarterly results or averages
Any RAA of quarterly averages that exceeds the MCL is a violation
DOH will determine compliance for TTHM & HAA5 based on data submitted by the lab

Specify sampling location(s) for:

TTHM & HAA5	Enter Sampling Locations	Enter sampling schedule
TP1 (MRT)	Parkstone	Feb, May, Aug, Nov

No information needed here

Attach a distribution map with sample locations

Reduced Monitoring

To qualify for reduced monitoring the following criteria must be met (and State must approve)
TTHM RAA < 0.040 mg/l AND HAA5 RAA < 0.030 mg/l AND
RAA of monthly TOC </= 4.0 mg/l prior to any treatment (surface water sources only)
Monitoring may then be reduced to 1 sample per treatment plant per year
during month of warmest water temperature

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Disinfection Byproducts Monitoring Plan Form

System Name	Egleridge
PWSID#	081181
Date	5/20/2012
Completed by	Kevin Cook

Type and Population of System SW and/or GWI <500

Monitoring requirements are additive; for example a system using ozone and chlorine, or chlorine with conventional filtration must meet the monitoring requirements for both.

Treatment Provided

Chlorine (gas, hypochlorite, etc) or Chloramines

Identify the number of "Treatment Plants" serving your system

A "Treatment Plant" or "TP" may be:

- A single surface water source
- A single well source
- A combination of multiple, individual sources (if all of the water is blended prior to distribution)

1

Enter Description of Treatment Plant Below

TP1	City of Bellingham water treatment plant

Disinfectant Monitoring

Required:

Chlorine residuals must be measured at the same time and place as routine or repeat coliform samples
MRDL for chlorine and chloramines = 4.0 mg/l as Cl2

Compliance

Compliance is based on the running annual average (RAA) of 12 consecutive months
DOH will determine compliance for chlorine MRDL
Daily residual measurements will / will not be included in the compliance calculations (circle one)

Byproduct Monitoring

Required:

TTHM & HAA5 - 1 sample per year during month of warmest water temperature
at maximum residence time (MRT).
TTHM MCL = 0.080 mg/l, HAA5 MCL = 0.060 mg/l

Compliance

Must go to quarterly monitoring if annual sample exceeds MCL for either TTHM or HAA5
Compliance is then based on the Running Annual Average (RAA) of quarterly results or averages
DOH will determine compliance for TTHM & HAA5 based on data submitted by the lab

Specify sampling location(s) for:

TTHM & HAA5	Enter Sampling Locations	Enter sampling schedule
TP1 (MRT)	Eagleridge sample station MRT	warmest water 7/1/2013
		warmest water 7/1/2014
		warmest water 7/1/2015
		warmest water 7/1/2016
		warmest water 7/1/2017

No information needed here

Attach a distribution map with sample locations

Reduced Monitoring

There is no reduced monitoring for TTHM & HAA5 for SW systems < 500

Send copy of completed form to:

☐ **Eastern Regional Drinking Water Office, 16201 E Indiana Ave, Suite 1500, Spokane Valley, WA 99216**
Phone: (509) 329-2100 Fax (509) 329-2104

☐ **Northwest Regional Drinking Water Office, 20435 72nd Ave S, Suite 200, Kent, WA 98032**
Phone: (253) 395-6750 Fax: (253) 395-6760

☐ **Southwest Regional Drinking Water Office, PO Box 47823, Olympia, WA 98504-7823**
Phone: (360) 236-3030 Fax to (360) 664-8058

If you need this publication in an alternate format, call (800) 525-0127. For
TTY/TDD call (800) 833-6388.

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Disinfection Byproducts Monitoring Plan Form

System Name	Agate Hieghts	**Type and Population of System**	SW and/or GWI <500
PWSID#	52957B		
Date	5/20/2012		
Completed by	Kevin Cook		

Monitoring requirements are additive; for example a system using ozone and chlorine, or chlorine with conventional filtration must meet the monitoring requirements for both.

Treatment Provided

Chlorine (gas, hypochlorite, etc) or Chloramines

Identify the number of "Treatment Plants" serving your system

A "Treatment Plant" or "TP" may be:

- A single surface water source
- A single well source
- A combination of multiple, individual sources (if all of the water is blended prior to distribution)

1

Enter Description of Treatment Plant Below

TP1	Agate Hieghts water treatment plant, 3320 Sunny Cove Lane, iron and maganese treatment, filtration
	6 inch well fed

Disinfectant Monitoring

Required:

Chlorine residuals must be measured at the same time and place as routine or repeat coliform samples
MRDL for chlorine and chloramines = 4.0 mg/l as Cl2

Compliance

Compliance is based on the running annual average (RAA) of 12 consecutive months
DOH will determine compliance for chlorine MRDL
Daily residual measurements will / will not be included in the compliance calculations (circle one)

Byproduct Monitoring

Required:

TTHM & HAA5 - 1 sample per year during month of warmest water temperature at maximum residence time (MRT).
TTHM MCL = 0.080 mg/l, HAA5 MCL = 0.060 mg/l

Compliance

Must go to quarterly monitoring if annual sample exceeds MCL for either TTHM or HAA5
Compliance is then based on the Running Annual Average (RAA) of quarterly results or averages
DOH will determine compliance for TTHM & HAA5 based on data submitted by the lab

Specify sampling location(s) for:

TTHM & HAA5	Enter Sampling Locations	Enter sampling schedule
TP1 (MRT)	Sunny cove sample station MRT	warmest water 7/1/2013
		warmest water 7/1/2014
		warmest water 7/1/2015
		warmest water 7/1/2016
		warmest water 7/1/2017

No information needed here

Attach a distribution map with sample locations

Reduced Monitoring

There is no reduced monitoring for TTHM & HAA5 for SW systems < 500

Send copy of completed form to:

☐ **Eastern Regional Drinking Water Office, 16201 E Indiana Ave, Suite 1500, Spokane Valley, WA 99216**
Phone: (509) 329-2100 Fax (509) 329-2104

☐ **Northwest Regional Drinking Water Office, 20435 72nd Ave S, Suite 200, Kent, WA 98032**
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Lake Whatcom Water and Sewer District

Annual Drinking Water Quality Report
South Shore Service Area (WA State ID# 959101)
2016 Consumer Confidence Report

What is this report?

In accordance with the Federal Government's Re-authorization of the Safe Drinking Water Act of 1996, all public and private water utilities are required to prepare and provide annual drinking water quality reports to their customers. As well as being required by Federal Law, we want to keep you informed about the excellent water and sewer services delivered to you over the past year. Our goal is to provide safe, dependable, and high quality drinking water.

Where does the drinking water come from?

The drinking water supplied to your home originates from Lake Whatcom, a surface water source. Lake Whatcom Water and Sewer District draws its water from Basin #3 of Lake Whatcom near Sudden Valley. The water enters our water filtration plant where it undergoes filtration and disinfection. The water produced is very high quality, and Lake Whatcom Water and Sewer District is pleased to report the drinking water is safe and meets or exceeds all federal and state requirements.

What's in the drinking water?

Lake Whatcom Water and Sewer District routinely monitors the drinking water in accordance with Federal and State laws. Included are the results for seven constituents that are regulated by the U.S. Environmental Protection Agency (USEPA) and were detected during the period of January 1st to December 31st, 2016. To obtain a complete listing of all constituents, please contact the District. All drinking water, including bottled drinking water, may be reasonably expected to contain at least small amounts of some constituents and/or contaminants. It's important to remember that the presence of these constituents does not necessarily pose a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at (800) 426-4791. Abbreviations and terms used in this report include:

***Parts per billion** (ppb)*

***Parts per million** (ppm)*

***Nephelometric Turbidity Unit** (NTU)* – Nephelometric turbidity unit is a measure of the clarity of water. Turbidity in excess of 5 NTU is just noticeable to the average person.

***Action Level** (AL)* – The concentration of a contaminant, if exceeded, triggers treatment or other requirements that a water system must follow.

Maximum Contaminant Level – The "Maximum Allowed" (MCL) is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs (see below) as feasible using the best available treatment technology. MCL's are set at very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water everyday at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

Maximum Disinfection Residual Level – (MRDL) the highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Contaminant Level Goal – The "Goal" (MCLG) is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

N/D- Non Detectable

Information for persons with compromised immune systems

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. United States Environmental Protection Agency and Centers for Disease Control (USEPA/CDC) guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the toll free Safe Drinking Water Hotline at (800) 426-4791.

Testing completed by Lake Whatcom Water and Sewer District and State certified laboratories.

Detected substance	Violation Yes/No	2016 (or most recent) Level	MCL, AL or MRLD	MCLG	Likely Source of substance
Barium	No	.006 ppm	2 ppm	2 ppm	Erosion from natural deposits, discharge from metal refiners, discharge of drilling waste
Chlorine	No	Of the free chlorine residual samples that were collected with our required bacterial samples in the distribution system the average chlorine residual was .57 ppm with a range of .10 ppm 1.00 ppm	4 ppm (MRLD) maximum in distribution system	2 ppm minimum to first customer in distribution system	Added at Water Treatment Plant for disinfection
Nitrate	No	.48 ppm	10 ppm	10ppm	Erosion from natural deposits, runoff from fertilizer, sewage, leaching from septic tanks
Copper	No	The 90th percentile value of 24 homes sampled showed copper at a level of 278 ppb with a range of 17 ppb to 572 ppb	1300 ppb	1300 ppb	Corrosion of household plumbing, erosion of natural deposits, leaching from wood preservatives
Lead	No	The 90th percentile value of 24 homes sampled showed lead at a level of 5ppb with a range of N/D to 8 ppb	15 ppb	0 ppm	Corrosion of household plumbing, erosion of natural deposits
TTHM Total Trihalomethanes	No	35.9 ppb	80 ppb	N/A	By-product of drinking water chlorination
HAAs Halo-acetic Acid	No	16.8 ppb	60 ppb	N/A	By-product of drinking water chlorination
Turbidity	No	0.04 NTU*	1.0 NTU	N/A	Soil runoff

Facts about detected substances

Barium – Some people who drink water containing barium in excess of the MCL for many years could experience an increase in their blood pressure. Barium is a lustrous, machinable metal which exists in nature only in ores containing mixtures of elements. Barium is used in electronic components, metal alloys, bleaches, dyes, ceramics, glass, and fireworks, as well as well drilling operations where it is released directly in to the ground.

Chlorine – Chlorine is used as a water disinfectant. Disinfection is the most important step in the water treatment process to destroy pathogenic bacteria and other harmful agents. Chlorination is a very common and effective method for the disinfection of your drinking water. Your water provider is required to maintain a free-chlorine residual throughout their water distribution system.

Nitrate – Infants below the age of six months who drink water containing nitrates in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome.

Copper – Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's disease should consult their personal doctor.

Lead – Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development, including slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure. Elevated levels of lead can cause serious health problems, especially for pregnant women and young children. In Sudden Valley and Geneva, lead is not found in the treated water, but lead in drinking water can come from pipes and faucets in our homes. Lake Whatcom Water & Sewer District is responsible for providing high quality drinking water but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for at least 30 seconds before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline at (800) 426-4791, or online at *http://www.epa.gov/safewater/lead*

TTHMs (Total Trihalomethanes) & HAAs (Halo-Acetic Acids) – Some people who drink water containing trihalomethanes or Halo-Acetic Acids in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.

Turbidity – Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.

*0.07 NTU was the maximum instantaneous operational level recorded, 0.07 NTU was the maximum hourly average recorded, 0.07 NTU was the maximum daily average recorded. The annual daily average was 0.04 NTU.

Questions or Concerns about your water?

For questions regarding this report or concerning your water utility, please contact Lake Whatcom Water and Sewer District Water Treatment Plant Operator Kevin Cook at (360) 734-9224. To learn more, please attend any of our regularly scheduled Board of Commissioner meetings.

- ♦ Second Wednesday of each month at 6:30 pm
- ♦ Last Wednesday of each month at 8:00 am

Meetings are held at the District office at 1220 Lakeway Drive at the beginning and end of each Regular meeting, there is a public comment period where you may express any questions or concerns to the Board.

Cross Connections may be hazardous to your health

What is a Cross Connection? A cross connection is any actual or potential physical connection between a potable (i.e., drinkable) water line and any pipe, vessel, or machine containing a non-potable fluid, solid, or gas where the non-potable substance can enter the potable water system by backflow. Garden hoses left connected and turned on when not in use can easily contaminate your home plumbing system. For questions or concerns about potential Cross Connections, please contact Lake Whatcom Water and Sewer District employee Rich Munson at (360) 734-9224.

Do I have any obligations regarding cross connections? Yes, if your residence has an in-ground irrigation system, heat pump, boiler or any other type of identified cross connection that requires a backflow prevention device, you are required to have the device inspected annually by a State Certified Backflow Assembly Tester.

REMEMBER: a cross connection not only threatens your health and safety, but that of your neighbors and the community as whole, so **PLEASE** do your part to prevent them.

Conservation

Inefficient and or leaking faucets, toilets, and excessive outdoor watering account for a significant amount of water that is treated at water treatment plants. Lake Whatcom Water and Sewer District would like to encourage voluntary water conservation, and there are many simple ways to help in this effort. By installing water saving shower heads, kitchen and bathroom faucets and low flow toilets, an average residence will save 25% or more water in a day then a residence without. **We request voluntary even numbered addresses to only water outside on Tuesdays, Thursdays and Saturdays, and odd numbered addresses to water on Wednesdays, Fridays and Sundays, with no outdoor watering on Mondays**. Lake Whatcom Water and Sewer District is a metered system, so saving water means saving money. Water may seem like an unlimited resource in the Pacific Northwest, but there is a limit, and it can only be plentiful for all future generations if we all do our part in conserving this precious resource.

Our commitment to our customers

Lake Whatcom Water and Sewer District staff is on duty around the clock to provide the safest and best quality water service to every home. We ask that all of our customers help us protect our precious water sources which are the heart of our community, our way of life, and our children's future.

Lake Whatcom Water and Sewer District
Annual Drinking Water Quality Report
Eagleridge Service Area (WA State ID# 081181)
2016 Consumer Confidence Report

What is this report?

In accordance with the Federal Government's Re-authorization of the Safe Drinking Water Act of 1996, all public and private water utilities are required to prepare and provide annual drinking water quality reports to their customers. As well as being required by Federal Law, we want to keep you informed about the excellent water and sewer services delivered to you over the past year. Our goal is to provide safe, dependable, and high quality drinking water.

Where does the drinking water come from?

Lake Whatcom Water and Sewer District purchases the water supplied to your home from the City of Bellingham and distributes the water in its own water distribution system to your tap. The City of Bellingham draws its water from Basin #2 of Lake Whatcom and pumps the water to its Water Filtration Plant where it undergoes filtration and disinfection. The water produced is a very high quality drinking water supply, and Lake Whatcom Water and Sewer District is pleased to report that the drinking water is safe and meets or exceeds all federal and state requirements.

What's in the drinking water?

Lake Whatcom Water and Sewer District and the City of Bellingham routinely monitor the drinking water in accordance with federal and state laws. Included are the results for five constituents that are regulated by the U.S. Environmental Protection Agency (USEPA) and were detected during the period of January 1st to December 31st, 2016 to obtain a complete listing of all constituents, please contact the District. All drinking water, including bottled drinking water, may be reasonably expected to contain at least small amounts of some constituents and/or contaminants. It's important to remember that the presence of these constituents does not necessarily pose a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at (800) 426-4791. In the following table you will find many terms and abbreviations you may not be familiar with. Abbreviations and terms used in this report include:

Parts per billion *(ppb)*
Parts per million *(ppm)*
Nephelometric Turbidity Unit *(NTU)* – Nephelometric turbidity unit is a measure of the clarity of water. Turbidity in excess of 5 NTU is just noticeable to the average person.
Action Level – The concentration of a contaminant, if exceeded, triggers treatment or other requirements that a water systems must follow.
Maximum Contaminant Level *(MCL)* – The "Maximum Allowed" is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs (see below) as feasible using the best available treatment technology. MCL's are set at very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.
Maximum Disinfection Residual Level *(MRDL)* – The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
Maximum Contaminant Level Goal *(MCLG)* – The "Goal" is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
N/D- Non Detectable

Information for persons with compromised immune systems

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as those with cancer undergoing chemotherapy, those who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. The United States Environmental Protection Agency and Centers for Disease Control (USEPA/CDC) guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the toll free Safe Drinking Water Hotline at (800) 426-4791.

Testing completed by Lake Whatcom Water and Sewer District, the City of Bellingham and State certified laboratories.

Detected Substance	Violation Yes/No	2016 (or most recent) Level	MCL, MRDL or AL	MCLG	Likely Source of Substance
Copper	No	The 90th percentile value of 8 homes sampled showed copper at a level of 71 ppb with a range of 11 ppb to 71 ppb	1300 ppb	1300ppb	Corrosion of household plumbing, erosion of natural deposits, leaching from wood preservatives
Lead	No	The 90th percentile value of 8 homes sampled showed lead at N/D ppb Range ND to N/D ppb Zero homes sampled above the AL	15 ppb	0	Corrosion of household plumbing, erosion of natural deposits
TTHM Total Trihalomethanes	No	44.6 ppb	80 ppb	0	By-product of drinking water chlorination
HAAs Halo-acetic-Acid	No	14.7 ppb	60 ppb	0	By-product of drinking water chlorination
Turbidity	No	0.09 NTU was the highest recorded at the city's plant	1.0 NTU	0	Soil run-off
Chlorine	No	Of the free chlorine residuals samples collected with our required bacterial samples in the distribution system the average free chlorine residual average was approximately .34 ppm with a range of .20 ppm to .50 ppm.	4 ppm MRDL	.2 ppm minimum at first customer in distribution system.	Added for disinfection at the City of Bellingham's water treatment plant

Facts about detected substances

Copper – Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's disease should consult their personal doctor.

Lead – Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight deficits in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure. Elevated levels of lead in drinking water can cause serious health problems, especially for pregnant women and young children. In Bellingham, lead is not found in the treated water, but lead in drinking water can come from pipes and faucets in our customers' homes. Lake Whatcom Water and Sewer is responsible for providing high quality drinking water but cannot control the variety of materials used in customer's plumbing. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for at least 30 seconds before using the water for drinking or cooking. You can capture this water to use on plants. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline at (800) 426-4791, or online at *http://www.epa.gov/safewater/lead*

TTHMs & Halo-Acetic Acids – Some people who drink water containing trihalomethanes or Halo-Acetic Acids in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous systems and may have an increased risk of getting cancer.

Turbidity – Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headache.

Chlorine – Chlorine is used as a water disinfectant. Disinfection is the most important step in the water treatment process to destroy pathogenic bacteria and other harmful agents. Chlorination is a very common and effective method for the disinfection of your drinking water. Your water provider is required to maintain a free-chlorine residual throughout their water distribution system.

Questions or Concerns about your water?

For questions regarding this report or concerning your water, please contact Lake Whatcom Water and Sewer District Water Treatment Plant Operator Kevin Cook at (360) 734-9224. To learn more, please attend any of our regular, bi-monthly Board of Commissioner meetings.

- Second Wednesday of each month at 6:30 pm
- Last Wednesday of each month at 8:00 am

Meetings are held at the District office at 1220 Lakeway Drive. At the beginning and end of each Regular meeting, there is a public comment period where you may address any questions or concerns to the Board.

Cross Connections may be hazardous to your health

What is a Cross Connection? A cross connection is any actual or potential physical connection between a potable (i.e., drinkable) water line and any pipe, vessel, or machine containing a non-potable fluid, solid, or gas where the non-potable substance can enter the potable water system by backflow. Garden hoses left connected and turned on when not in use can easily contaminate your home plumbing system. For questions or concerns about potential Cross Connections, please contact Lake Whatcom Water and Sewer District employee Rich Munson at (360) 734-9224.

Do I have any obligations regarding cross connections? Yes, if your residence has an in-ground irrigation system, heat pump, boiler or any other type of identified cross connection that requires a backflow prevention device, you are required to have the device inspected annually by a State Certified Backflow Assembly Tester.

REMEMBER: a cross connection not only threatens your health and safety, but that of your neighbors and the community as whole, so **PLEASE** do your part to prevent them.

Conservation

Inefficient and/or leaking faucets, toilets, and excessive outdoor watering account for a significant amount of water that is treated at water treatment plants. Lake Whatcom Water and Sewer District would like to encourage voluntary water conservation. By installing water saving shower heads, kitchen and bathroom faucets and low flow toilets, an average residence could save 25% or more water a day then a residence without. **We request voluntary even numbered addresses to only water outside on Tuesdays, Thursdays and Saturdays, and odd numbered addresses to water on Wednesdays, Fridays and Sundays, with no outdoor watering on Mondays**. Lake Whatcom Water and Sewer District is a metered system, so saving water means saving money. Water may seem like an unlimited resource in the Pacific Northwest, but there is a limit, and it can only be plentiful for all future generations if we all do our part in conserving this precious resource.

Our commitment to our customers

Lake Whatcom Water and Sewer District staff is on duty around the clock to provide the safest and best quality water service to every home. We ask that all of our customers help us protect our precious water sources which are the heart of our community, our way of life, and our children's future.

Lake Whatcom Water and Sewer District

Annual Drinking Water Quality Report

Agate Heights Service Area (Washington state I.D. #52957B)

2016 Consumer Confidence Report

What is this report?

In accordance with the Federal Government's Re-authorization of the Safe Drinking Water Act of 1996, all public and private water utilities are required to prepare and provide annual drinking water quality reports to their customers. As well as being required by Federal Law, we want to keep you informed about the excellent water and sewer services delivered to you over the past year. Our goal is to provide safe, dependable, and high quality drinking water.

Where does the drinking water come from?

The Agate Heights water system is served by the Giesbrecht 10-inch artesian well, which is located within the Squalicum aquifer system. This well produces a high quality drinking water supply that contains naturally occurring iron and manganese and other minerals. The water is drawn from the well and undergoes a chlorination and filtration process to reduce the level of iron and manganese, and to provide chlorine residual to protect the water distribution system. Lake Whatcom Water and Sewer District is pleased to report that your drinking water is safe and meets or exceeds all federal and state requirements.

What's in the drinking water?

Lake Whatcom Water and Sewer District routinely monitors the drinking water in accordance with Federal and State laws. Included are the results for six constituents that are regulated by the U.S. Environmental Protection Agency (USEPA) and were detected during the period of January 1st to December 31st, 2016. To obtain a complete listing of all constituents, please contact the District. All drinking water, including bottled drinking water, may be reasonably expected to contain at least small amounts of some constituents and/or contaminants. It's important to remember that the presence of these constituents does not necessarily pose a health risk. More information about contaminants and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at (800) 426-4791. Abbreviations and terms used in this report include:

***Parts per billion** (ppb)*
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***Nephelometric Turbidity Unit** (NTU)* – Nephelometric turbidity unit is a measure of the clarity of water. Turbidity in excess of 5 NTU is just noticeable to the average person.
Action Level – The concentration of a contaminant, if exceeded, triggers treatment or other requirements that a water system must follow.
Maximum Contaminant Level – The "Maximum Allowed" (MCL) is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs (see below) as feasible using the best available treatment technology. MCL's are set at very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water every day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.
Maximum Disinfection Residual Level – (MRDL) The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
Maximum Contaminant Level Goal – The "Goal" (MCLG) is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.
N/D- Non Detectable

Information for persons with compromised immune systems Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. United States Environmental Protection Agency and Centers for Disease Control (USEPA/CDC) guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbiological contaminants are available from the toll free Safe Drinking Water Hotline at (800) 426-4791.

Testing is completed by Lake Whatcom Water and Sewer District and State certified laboratories.

Detected Substance	Violation Yes/No	2016(or most recent) Level	MCL, Al or MDRL	MCLG	Likely Source of Substance
Arsenic	No	.004 ppm	.010 ppm	0 ppm	Erosion of natural deposits, runoff from orchards, runoff from glass, and electronics production wastes
Barium	No	.039 ppm	2 ppm	2 ppm	Erosion from natural deposits, discharge from metal refiners, discharge of drilling waste
Copper	No	The 90th percentile value of 7 homes sampled showed copper at a level of 144 ppb with a range of 13 ppb to 144 ppb	1,300 ppb	1,300 ppb	Corrosion of household plumbing, erosion of natural deposits, leaching from wood preservatives
Fluoride	N0	.10 ppm	4.0 ppm	4.0 ppm	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
Lead	No	The 90th percentile value of 7 homes sampled showed lead N/D levels	15 ppb	0 ppb	Corrosion of household plumbing, erosion of natural deposits
HAAs Halo- acetic acids	No	6.5 ppb	60 ppb	0 ppb	By-product of drinking water chlorination
TTHM Total Trihalomethanes	No	12.9 ppb	80 ppb	0 ppb	By-product of drinking water chlorination
Chlorine	No	Of the free chlorine residual samples that were collected with our required bacterial samples in the distribution system the average chlorine residual was approximately .47 ppm with a range of .18 ppm to .60 ppm.	4 ppm MRDL	.2 ppm minimum at first customer in distribution system	Added at water treatment plant for disinfection.

Facts about detected substances

Arsenic – While your drinking water meets EPA's standard for arsenic, it does contain low levels of arsenic. EPA's standard balances the current understanding of arsenic's possible health effects against the costs of removing arsenic from drinking water. EPA continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

Barium – Some people who drink water containing barium in excess of the MCL for many years could experience an increase in their blood pressure. Barium is a lustrous, machinable metal which exists in nature only in ores containing mixtures of elements. Barium is used in electronic components, metal alloys, bleaches, dyes, ceramics, glass, and fireworks, as well as well drilling operations where it is released directly in to the ground

Copper – Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver or kidney damage. People with Wilson's Disease should consult their personal doctor.

Fluoride -- Bone disease (pain and tenderness of the bones); Children may get mottled teeth.

Lead – Elevated levels of lead in drinking water can cause serious health problems, especially for pregnant women and young children. In our Agate Heights system, lead is not found in the treated water, but lead in drinking water can come from pipes and faucets in our homes. Lake Whatcom Water and Sewer District is responsible for providing high quality drinking water but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for at least 30 seconds before using the water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline at (800) 426-4791, or online at *http://www.epa.gov/safewater/lead*

TTHMs (Total Trihalomethanes) & HAAs (Halo-Acetic Acids) – Some people who drink water containing Trihalomethanes or Halo-Acetic Acids in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.

Chlorine – Chlorine is used as a water disinfectant. Disinfection is the most important step in the water treatment process to destroy pathogenic bacteria and other harmful agents. Chlorination is a very common and effective method for the disinfection of your drinking water. Your water provider is required to maintain a free-chlorine residual throughout their water distribution system.

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Appendix E – Hydraulic Analyses

Appendix E - Hydraulic Models and Analysis Results

The program used to perform the hydraulic analysis was InfoWater Version 12.3, the Innovyze water distribution modeling program that is fully integrated with ArcGIS for its graphical interface.

A. Sudden Valley: and

B. Geneva:

<u>Model Set-Up</u>

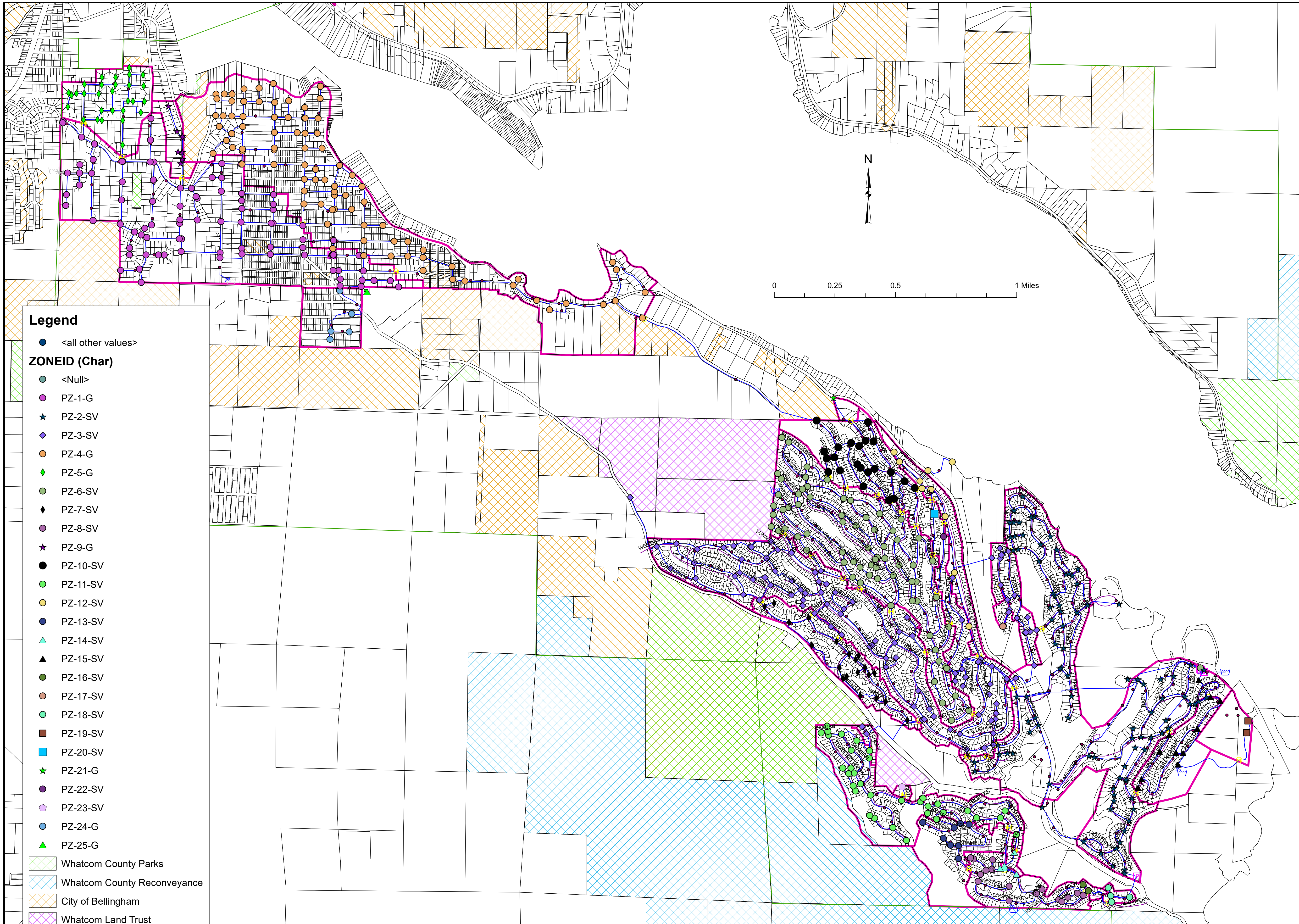
The hydraulic model for Sudden Valley and Geneva was updated since the previous water system plan update. Updates included infrastructure for all Developer Extension Agreements that have been constructed, updates to Maximum Day Demand (MDD) and Peak Hour Demand (PHD), and updates to PRV settings so that the model represents current settings and conditions. Pump curves were updated so that flow rates accurately represented measured flow rates. Fire flow demands were updated to include junctions with new hydrants. The new Division 22 reservoir that has recently been constructed was added to the model. Elevations were updated to be based on NAVD88 (which is now the vertical datum used by the City of Bellingham).

MDD was updated to be 250 gpd/ERU for Sudden Valley ERUs and 370 gpd/ERU for Geneva ERUs (Appendix B). Distribution of MDD was based on the previous model but was updated as appropriate. PHD was updated using Equation 5-1 from the DOH Water System Design Manual calculating a total peak hour demand for each hydraulically distinct pressure zone. The total zone PHD was then distributed to the junctions within that pressure zone with the same distribution as the MDD demand.

There are 25 hydraulically distinct pressure zones within the south shore water system. Many of these are within similar bands of elevation, but due to the topography and distribution do not have connecting pipes. See Figure E-1 for a map of the 25 pressure zones.

All pipes 6" and larger ***<u>or</u>*** part of a loop were included in the Sudden Valley system analysis. All pipes in the Geneva system were included in the analysis. The minimum system pressures used were 30 psi for peak hourly demand conditions with equalizing storage depleted and 20 psi for fireflow plus Maximum Daily Demand (MDD) conditions with equalizing and fire suppression storage depleted. These are the State required minimum system pressures.

The modeling performed was for the full anticipated build-out population of Geneva and Sudden Valley based on existing infrastructure (infill of vacant lots). Build-out for Geneva is estimated at 1239 ERUs and build-out for Sudden Valley is estimated at about 3267 ERUs. Scenarios for less than full build-out were not assessed because the system currently has capacity for full build-out.



LAKE WHATCOM WATER AND SEWER DISTRICT

WHATCOM COUNTY WASHINGTON

FIGURE E-1

SOUTH SHORE PRESSURE ZONES

DATE JULY 2017

SCALE As Shown

JOB NUMBER 2016-096

SHEET 1 OF 1

Coordinate System:
State Plane Washington North
North American Datum 1983

Data Source:
City of Bellingham Public Works Dept.,
Whatcom County Planning & Assessor

WILSON ENGINEERING, LLC
805 DUPONT STREET
BELLINGHAM, WA 98225
(360)733-6100FAX(360)647-9061

www.wilsonengineering.com

Wilson
SURVEY/ENGINEERING

In order to evaluate the system under conditions that deplete all equalizing and/or fire suppression storage volume (per DOH Water System Design Manual, Section 8.2.3.5, a and b), all reservoir storage was evaluated to determine operating, equalizing, and fire suppression storage volumes. Results are summarized in Table A-1 of Appendix A. Peak Hour Demand per reservoir was calculated using DOH Equation 5-1 using the number of ERUs for each reservoir. Fire Suppression Storage is 750 gpm x 60 minutes for each reservoir except Division 30 because Division 30 only serves residential connections in Sudden Valley (need 500 gpm x 60 minutes). Other reservoirs could serve Commercial/Condos in Sudden Valley or Geneva connections, which have a fire flow requirement of 750 gpm. Storage for the two Division 22 reservoirs is shared proportionally between the two. Fire Suppression Storage is nested within Standby Storage.

In looking at Division 7 and Division 30, Division 7 has excess storage and Division 30 has a storage shortfall unless it were operated to be continuously full (no operating storage). Previous reports (2009 Reservoir Capacity Analysis, 2015 Division 22 Reservoir Predesign Report) have addressed this issue and it has been concluded that Division 30 can share the standby storage provided by Division 7 because Division 30 is fed by a booster station from Division 7 and the booster station is fully redundant and can be powered by an on-site generator. This level of reliability is adequate to transfer standby storage from Division 7 to Division 30 in the majority of standby situations, including a prolonged power outage.

Operating Storage levels shown in Table A-1 match current operating records except for Division 22. Currently, Division 22 is serving fewer ERUs and Division 30 is serving more ERUs than shown in the table because the new Division 22 reservoir is not yet in service. Once it is complete, operation will be adjusted to approximately match the ERU distribution shown in Table A-1 and the bottom of the operational level of the Division 22 reservoirs will be raised to the levels shown in Table A-1.

ERU allocations per reservoir are based on the operational PRV settings such that Division 30 does not feed connections on the northeast side of Lake Louise Road. A map of where the reservoirs are feeding under this ERU allocation scenario is shown in Figure A-1 of Appendix A.

For Peak Hour Demand (PHD), the model was evaluated with tank levels such that all equalizing storage was depleted, as shown in Table A-1. For fire suppression flows during Maximum Day Demand (MDD), the model was evaluated with tank levels such that all equalizing storage and fire suppression storage was depleted, as shown in Table A-1.

<u>Model Calibration</u>

An effort was made to calibrate the model as described below. Limitations in resources (availability of field crews to perform flushing) did not allow for data collection in enough areas of the system to perform a full system calibration. Data that was collected and calibration conclusions from that data are described below. We recommend that LWWSD continue to collect pressure and flow data during routine flushing so that data is available from throughout the system to assess model calibration more comprehensively in the future. Calibration was performed using the guidance provided by the AWWA Manual M32: Computer Modeling of Water Distribution Systems. Pressures were monitored by two hydrant pressure loggers manufactured by Global Water, installed at appropriate locations in the distribution system. This typically included installing one logger at a hydrant adjacent to the hydrant being flushed to monitor the local pressure drop and the second logger at the hydrant that the model indicated was the limiting junction (location where pressure dropped to 20 psi during fire flow and therefore limited the fire flow rate). The loggers were factory calibrated from 0-200 psi and were field adjusted with a one point calibration to 0 psi under the guidance of a Global Water technician. The reported accuracy of the loggers is +/- 1% of full scale. Loggers were programmed to collect one pressure reading every 30 seconds. Flow rates were measured using a water meter and a stopwatch.

Calibration data was collected during the summer months and during the day. Residential demand during this time was assumed to be approximately equal to MDD for comparison to the MDD model demands. Absolute pressures were assessed to determine if there were any major discrepancies in system connectivity or PRV settings. Relative pressure drop during flushing was compared to model pressure drop at the field-measured flow rate and flushing location.

Flow and pressure data was collected over 4 days of flushing in pressure zones PZ-3-SV, PZ-6-SV, and PZ-7-SV. This limited calibration effort revealed that the model in those areas did not contain major errors in connectivity or PRV settings. It also demonstrated that, in general, the field-measured pressure drops during flushing were higher than predicted by the model. In order to reconcile these differences, adjustments to the model were made. The Hazen-Williams friction coefficient was adjusted from a previously assumed value of 100 to a value of 70 for the Sudden Valley portion of the system. This is justified because some or perhaps much of the distribution pipe is cast iron, and coefficients this low may be appropriate for cast iron pipe that is more than 40 years old. Minor losses due to bends and valves were added to the model (minor loss coefficient of 1 for every pipe segment). These changes brought the model in to agreement with the measured data within approximately 1 psi for the areas for which data was collected. Because the Sudden Valley water system was all constructed in the early 1970s in the time span of a couple years, and because the adjustments needed were very similar for all the areas in which data was collected, we assumed that this calibration could reasonably be applied throughout the Sudden Valley water system. As more data is collected in the future, this can be reassessed.

No data was collected in the Geneva area of the south shore water system. In general, most of the water mains in the Geneva area are newer than those in Sudden Valley and are cement mortar lined ductile iron. For this reason, we left the Hazen-Williams friction coefficient unchanged from the previous water system plan at a value of 100. Estimated minor losses from pipe bends were added to the Geneva area of the model.

Model and Analysis Results

A first item to note when assessing the model results is the impact of the limited number of services and fire hydrants near the storage reservoirs. The original system was designed to previous State standards (20 psi) and certain lots close to the reservoirs only have 20 psi of static pressure. These lots have been identified and qualify for reimbursement by the District for the purchase of a residential booster in accordance with District Resolution 410 (and Resolutions 721, 778, Administrative Code 4.2.1). This complicates the analysis somewhat because these areas will not necessarily maintain 20 psi under MDD + fire flow conditions or 30 psi under PHD.

Peak Hour Demand

Peak Hour Demand pressure results can be seen in Table E-1. This table is ordered by pressure at each junction from low to high.

Table E-1 indicates that there are 18 junctions with less than 30 psi. Each of these is addressed individually below. All of the junctions are either near a reservoir or are in Sudden Valley on the ridge that runs from the Division 22 reservoirs to the southeast. For those not near a reservoir, the street name is given.

The junctions with less than 30 psi under PHD that are not near a reservoir were not identified in the previous analysis. These may be a result of the calibration effort. Calibration data was not collected for the specific location along the ridge SE of Division 22, and it is possible that the modifications may not be applicable for this area. Further data could be collected to further calibrate the model in this area.

ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)	Description
J1288	0	799	815.69	7.23	Near Div 22
J203	0	800	825.07	10.86	Near Div 22
J1540	0	668	697.17	12.64	Near Div 7
J1822FH	0	778	815.69	16.33	Near Div 22
J1428	2.3	748.96	793.79	19.43	Basin View Cir
J276	5.86	747.08	793.28	20.02	Sudden Valley Dr
J592	3.56	745.84	793.45	20.63	Basin View Cir
J768	1.03	771.38	820.48	21.27	Near Div 22
J1847	0	780	829.43	21.42	Near Div 22
J602	0.51	770.35	820.47	21.72	Near Div 22
J590	2.02	742.98	793.42	21.85	Sudden Valley Dr
J482	3.16	643.63	696.6	22.95	Near Div 7
J1072	10.97	1,003.00	1,056.83	23.32	Near Div 30
J54	2.8	763.82	820.71	24.65	Near Div 22
J502	4.82	736.59	794.14	24.94	Sudden Valley Dr
J1914	1.79	749.04	811.35	27	Highwood Cir
J1494	2.3	730.96	793.31	27.01	Sandalwood Cir
J1896	0	621	687.43	28.79	Near Geneva Res

Table E-1 shows that there are still quite a few services that receive water in excess of 100 psi. Further investigation in to PRV adjustments or addition of PRVs (and subsequently pressure zones) may be investigated.

MDD + Fire Flow

There are a couple of low-pressure junctions that limit fire flows to insufficient quantities in order to maintain 20 psi throughout the system. Again, this is primarily due to the junctions/services near the reservoirs. Specifically, junctions at the northwest end of Water Tower Ct and Kinglet Ct near the Division 22 reservoirs and one junction near the Division 30 reservoir were responsible for the limitation. When these junctions were artificially lowered in elevation (to account for the fact that services in these areas are eligible for reimbursement of individual booster pumps), most of the available fire flow results showed that greater than 500 gpm was available. The amount of artificial elevation decrease for these areas was a maximum of 28 ft (12 psi).

There are three exceptions to the above description. There is one fire hydrant at the northwest end of Kinglet Ct that cannot achieve 500 gpm while maintaining 20 psi

(J1822FH). This is because the static pressure at this hydrant is approximately 20 psi. Even with a residual pressure at the hydrant of 10 psi, less than 500 gpm is available.

A second area with less than 500 gpm fire flow available is at Fire Hydrant 10-057 (J1428) on Basin View Circle. This hydrant has too low of a static pressure to provide 500 gpm while maintaining 20 psi, and it limits a number of hydrants around it to slightly less than 500 gpm (but all more than 400 gpm). The third hydrant that is an issue is Fire Hydrant 6-038 on Highwood Circle (J1914). This hydrant provides 382 gpm while maintaining 20 psi. These two areas were not a problem when the model was last analyzed and is probably a result of the calibration of the model. Data for the calibration effort was not collected for this specific area, so it is possible that the C factor of 70 and minor losses may not be appropriate for this area. Further data could be collected to assess this in the future.

There are also some areas where available fire flow is greater than 500 gpm but less than the fire flow standard of 750 gpm for specific areas. Some of these are in the Sudden Valley commercial or multi-family areas and are again likely the result of the calibration effort. Calibration data for these areas was not collected and could be investigated in further detail.

Full fire flow model results as described above can be seen in Table E-2.

In the "Critical Node Pressure" column of Table E-2, it can be seen that there are quite a few scenarios in which portions of the system could be depressurized if a hydrant was opened all the way and the pressure at the hydrant was allowed to drop to 20 psi. The results indicate that this generally is only a risk if more than 1000 gpm is drawn out of specific hydrants. In order to attempt to prevent this, LWWSD may consider labeling hydrants with capacities.

The National Fire Protection Association (NFPA) Code 291 sets forth guidelines for marking hydrants that could be implemented by LWWSD in coordination with the local fire districts. It recommends that hydrant tops and nozzle caps be painted according to the following based on rated capacity:

Rated capacity of 1500 gpm or greater: Light blue

Rated capacity of 1000 – 1499 gpm: Green

Rated capacity of 500-999 gpm: Orange

Rated capacity of less than 500 gpm: Red

NFPA 291 also recommends that hydrants having a static pressure of less than 40 psi should be rated at one-half of the static pressure (instead of at 20 psi) and that any pressure rating less than 20 psi should be stenciled on to the top of the hydrant in black.

C. North Shore - Eagleridge:

Model Set-Up

The Eagleridge water system model includes all pipes and pumps. The model demands were updated to reflect a MDD of 800 gpd/ERU and a system PHD of 130.5 gpm (based on MDD, build-out of 85 ERUs). Demands were distributed throughout the system. Pump curves were updated based on available information. Elevations were updated to all be based on NAVD88. For existing information, this was done by converting elevation information from Old City of Bellingham Datum to NAVD88 (Old City of Bellingham Datum is 1.71 ft lower than NAVD88). Junction elevations were updated to NAVD88 using LIDAR from the 2013 City of Bellingham project that produced detailed (3 ft by 3 ft resolution) DTM (Digital Terrain Model) data. This data was downloaded from the Washington State Department of Natural Resources LIDAR portal (http://lidarportal.dnr.wa.gov/).

The source from the City of Bellingham was updated to reflect current operating conditions. The connection from the City is at a hydraulic grade of approximately 519 ft. Based on information from the City of Bellingham CityIQ database, the connection is fed by approximately 2500 feet of unlooped 8-inch diameter water main. This information was input in to the model.

Model Verification

SCADA data of pump station discharge pressure and pump on/off status was analyzed to confirm that operation was consistent with model set-up. Suction and discharge pressures as well as the PRV setting were measured manually to confirm parameters. Field crew resources were not available to perform flushing and pressure measurement, so model calibration was not performed. The previously assumed Hazen Williams friction coefficient of 100 continues to be used. We recommend re-assessing this when flow and pressure data can be measured.

Model and Analysis Results

The model was analyzed based on the existing configuration with domestic and fire flow pumps. Results indicate that the existing system can provide sufficient pressure and flow to meet Peak Hour Demand for the projected build-out while maintaining a minimum system pressure of well above 30 psi (Table E-3). Results also indicate that the existing system can provide 750 gpm at all fire hydrants while maintaining a minimum system pressure of 20 psi (Table E-4).

Because of the change in source pressure from the previous analysis, the possibility of bypassing or eliminating the pump station was investigated. The hydraulic grade line of the Eagleridge system with the PRV setting of 105 psi is approximately 572 ft whereas the City source hydraulic grade line is approximately 519 ft. The model indicates that with the three residential flow pumps bypassed and served by the pressure of the City source with 20 ft of pipe as small as 2.5 inches in diameter (which is currently installed), 30 psi can be provided to all connections under peak hour demand. It is understood that the District receives low pressure complaints when this existing bypass is in operation, but the model indicates that the minimum pressure is provided to all customers. These results are shown in Table E-3A.

MDD plus fire flow was also investigated under pump bypass scenarios. With bypassing the pumps with 8-inch diameter pipe, it was found that most available fire flows were approximately 500-600 gpm. However, the pressure from the City source requires further investigation because in order to do a full assessment, the City source pressure needs to be modeled under conditions where equalizing and fire suppression storage in the reservoir are depleted and MDD in the City distribution system is accounted for. These items require coordination with the City to quantify and require a more detailed analysis.

D. North Shore - Agate Heights:

The Johnson Well Group B system with two connections was not modeled. The Agate Heights system was modeled and is described below.

Model Set-Up

The Agate Heights water system model includes all pipes, pumps, tanks and pressure reducing valve stations. MDD was updated to 500 gpd/ERU, and PHD was calculated for each pressure zone. Demands were appropriately distributed. PRV settings were updated to reflect current operational settings. Elevations were updated to all be based on NAVD88. For existing information, this was done by converting elevation information from Old City of Bellingham Datum to NAVD88 (Old City of Bellingham Datum is 1.71 ft lower than NAVD88). Junction and PRV elevations were updated to NAVD88 using LIDAR from the 2013 City of Bellingham project that produced detailed (3 ft by 3 ft resolution) DTM (Digital Terrain Model) data. This data was downloaded from the Washington State Department of Natural Resources LIDAR portal (http://lidarportal.dnr.wa.gov/).

Model Verification

System operating parameters were confirmed from the system's SCADA data. Tank levels were set such that equalizing storage was depleted for the PHD analysis and both equalizing and fire suppression storage volumes were depleted for the MDD + fire suppression flow rate analysis. These were set based on Table 3.3-6.

Field crew resources were not available to perform flushing and pressure measurement, so model calibration was not performed. The previously assumed Hazen Williams friction coefficient of 100 continues to be used. We recommend re-assessing this when flow and pressure data can be measured.

Model and Analysis Results

The results indicate that the system is capable of maintaining the minimum 30 psi pressure during peak hour demands (See Table E-5). Table E-5 indicates three junctions with less than 30 psi, but these are junctions on the transmission pipes and are not points in the distribution system. The results also indicate that the system can provide in excess of 750 gpm fire flows at the Lake Whatcom Residential and Treatment Center (LWRTC) and throughout the residential subdivisions while maintaining the minimum 20 psi system pressure (See Table E-6).

With the addition of a second, higher tank to serve the LWRTC, the Opal Terrace pressure zone was converted from being pressurized by a booster pump station to gravity service. While the analysis indicates the pumps should have sufficient capacity to keep up with refilling the tank under maximum day demand (MDD) conditions, staff have indicated that larger pumps would aid in overall system operations. This upgrade will be coordinated with the proposed project to increase the capacity of the Agate Heights Water Treatment Plant.

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
1	☐	J1288	0.00	799.00	815.69	7.23
2	☐	J203	0.00	800.00	825.07	10.86
3	☐	J1540	0.00	668.00	697.17	12.64
4	☐	J1822FH	0.00	778.00	815.69	16.33
5	☐	J1428	2.30	748.96	793.79	19.43
6	☐	J276	5.86	747.08	793.28	20.02
7	☐	J592	3.56	745.84	793.45	20.63
8	☐	J768	1.03	771.38	820.48	21.27
9	☐	J1847	0.00	780.00	829.43	21.42
10	☐	J602	0.51	770.35	820.47	21.72
11	☐	J590	2.02	742.98	793.42	21.85
12	☐	J482	3.16	643.63	696.60	22.95
13	☐	J1072	10.97	1,003.00	1,056.83	23.32
14	☐	J54	2.80	763.82	820.71	24.65
15	☐	J502	4.82	736.59	794.14	24.94
16	☐	J1914	1.79	749.04	811.35	27.00
17	☐	J1494	2.30	730.96	793.31	27.01
18	☐	J1896	0.00	621.00	687.43	28.79
19	☐	J1394	5.10	726.45	797.22	30.67
20	☐	J356	15.70	624.96	696.27	30.90
21	☐	J566	12.22	613.00	687.37	32.23
22	☐	J912	5.10	740.34	816.23	32.88
23	☐	J1620	0.00	824.81	903.24	33.99
24	☐	J1900	11.72	470.00	556.80	37.61
25	☐	J1845	0.00	600.00	687.15	37.76
26	☐	J1924	3.81	712.03	799.23	37.78
27	☐	J1054	11.66	605.35	693.27	38.10
28	☐	J1438	2.55	722.99	811.41	38.31
29	☐	J1464	9.87	597.00	687.03	39.01
30	☐	J104	0.00	811.31	903.24	39.84
31	☐	J704	6.61	723.58	815.69	39.91
32	☐	J56	2.55	726.07	818.61	40.10
33	☐	J882	3.34	625.79	720.07	40.85
34	☐	J1482	0.00	625.06	720.08	41.17
35	☐	J1384	2.55	707.63	804.74	42.08
36	☐	J1386	3.05	707.43	804.56	42.09
37	☐	J1920	15.79	804.37	903.10	42.78
38	☐	J1272	0.00	797.55	898.21	43.62
39	☐	J102	19.06	801.05	903.24	44.28
40	☐	J798	1.03	711.04	813.87	44.56
41	☐	J1843	2.81	584.00	687.12	44.68
42	☐	J1086	0.00	477.58	580.95	44.79
43	☐	J1004	0.00	611.15	715.37	45.16
44	☐	J580	3.75	482.57	586.87	45.19
45	☐	J604	1.03	710.12	814.66	45.30
46	☐	J448	0.00	480.78	585.33	45.30
47	☐	J1334	7.12	706.64	811.31	45.35
48	☐	J201	1.07	580.00	685.16	45.57
49	☐	J1882	1.41	580.00	685.48	45.71
50	☐	J1442	4.32	684.18	789.75	45.74

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
51	☐	J274	9.42	685.47	791.35	45.88
52	☐	J1618	8.01	472.94	580.96	46.80
53	☐	J1410	5.35	700.54	808.90	46.95
54	☐	J1672	0.00	677.35	787.67	47.81
55	☐	J1472	16.61	446.29	556.82	47.89
56	☐	J776	4.24	470.34	581.08	47.99
57	☐	J796	3.31	701.48	812.77	48.22
58	☐	J784	6.36	688.79	801.38	48.78
59	☐	J38	12.01	472.32	585.27	48.94
60	☐	J1434	5.58	699.30	812.59	49.09
61	☐	J1322	4.15	605.47	719.38	49.36
62	☐	J185	0.00	572.00	686.24	49.50
63	☐	J652	2.42	470.00	584.45	49.59
64	☐	J1480	2.86	604.86	719.55	49.69
65	☐	J1346	0.00	615.26	729.96	49.70
66	☐	J210	0.00	441.46	556.26	49.74
67	☐	J894	4.07	697.71	812.54	49.76
68	☐	J1796	4.32	675.66	790.53	49.77
69	☐	J1052	0.94	571.00	686.25	49.94
70	☐	J736	0.00	472.00	587.90	50.22
71	☐	J80	14.10	775.82	892.11	50.39
72	☐	J422	10.71	439.69	556.26	50.51
73	☐	J1448	0.00	471.54	588.30	50.59
74	☐	J152	0.00	695.32	812.55	50.79
75	☐	J1136	6.61	695.00	812.55	50.93
76	☐	J212	0.00	438.46	556.26	51.04
77	☐	J1718	0.00	689.91	807.82	51.09
78	☐	J1534	6.00	462.78	580.94	51.20
79	☐	J1042	3.50	467.70	586.39	51.43
80	☐	J442	0.00	461.91	580.94	51.57
81	☐	J1092	17.45	778.92	898.21	51.69
82	☐	J1348	0.00	461.34	580.94	51.82
83	☐	J1640	2.26	461.21	580.94	51.88
84	☐	J498	4.15	575.81	695.98	52.07
85	☐	J1112	2.75	465.06	585.23	52.07
86	☐	J840	6.85	931.84	1,052.30	52.20
87	☐	J1108	3.56	685.37	807.15	52.76
88	☐	J630	6.87	671.49	793.68	52.94
89	☐	J1274	0.00	775.75	898.21	53.06
90	☐	J1232	3.76	563.00	685.48	53.07
91	☐	J1668	3.05	682.66	805.42	53.19
92	☐	J922	5.20	428.00	550.79	53.21
93	☐	J1262	2.09	596.45	719.46	53.30
94	☐	J342	8.99	457.90	581.13	53.40
95	☐	J1720	0.00	684.57	807.82	53.40
96	☐	J1990	9.72	774.55	898.42	53.67
97	☐	J1536	4.00	456.92	580.91	53.72
98	☐	J416	0.00	635.70	760.04	53.88
99	☐	J1656	6.24	590.61	714.98	53.89
100	☐	J686	2.89	460.00	584.46	53.93

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
101	☐	J408	0.00	431.56	556.26	54.03
102	☐	J1702	6.53	463.00	588.02	54.17
103	☐	J728	2.80	690.30	815.55	54.27
104	☐	J1460	2.86	602.91	728.46	54.40
105	☐	J782	21.27	465.35	592.17	54.95
106	☐	J486	7.54	560.00	687.01	55.03
107	☐	J742	2.26	456.35	583.59	55.13
108	☐	J1788	2.81	558.00	685.48	55.24
109	☐	J584	6.36	679.47	808.03	55.71
110	☐	J1134	6.36	683.80	812.69	55.85
111	☐	J1484	5.06	659.91	789.17	56.01
112	☐	J1928	3.76	556.00	685.42	56.08
113	☐	J1050	3.81	590.32	720.11	56.24
114	☐	J858	0.00	458.43	588.30	56.27
115	☐	J828	0.00	457.63	587.60	56.31
116	☐	J1244	3.30	555.00	685.40	56.50
117	☐	J884	1.68	589.92	720.34	56.51
118	☐	J376	6.11	555.00	686.22	56.86
119	☐	J52	3.30	554.00	685.27	56.88
120	☐	J582	0.00	455.51	586.87	56.92
121	☐	J988	1.94	453.00	584.45	56.96
122	☐	J1826	7.05	760.52	891.98	56.96
123	☐	J1030	3.25	453.11	585.49	57.36
124	☐	J86	11.72	423.50	556.37	57.57
125	☐	J1694	0.76	674.68	808.08	57.80
126	☐	J1502	0.00	674.39	807.82	57.81
127	☐	J542	1.76	451.96	585.75	57.97
128	☐	J1828	6.10	453.70	587.91	58.16
129	☐	J1224	7.80	421.87	556.27	58.24
130	☐	J522	3.56	656.48	790.90	58.24
131	☐	J1504	0.00	673.13	807.82	58.36
132	☐	J1590	0.00	594.90	729.96	58.52
133	☐	J199	0.55	550.00	685.16	58.57
134	☐	J444	0.00	445.77	580.94	58.57
135	☐	J1790	18.76	624.76	760.05	58.62
136	☐	J836	2.35	550.00	685.40	58.67
137	☐	J1522	9.41	551.00	686.97	58.92
138	☐	J1910	0.00	650.01	787.56	59.60
139	☐	J1380	0.00	443.38	580.95	59.61
140	☐	J1984	0.00	589.80	727.55	59.69
141	☐	J1558	0.00	450.00	587.90	59.75
142	☐	J1930	0.00	592.70	730.79	59.83
143	☐	J1956	4.43	412.00	550.74	60.12
144	☐	J312	0.00	451.00	589.90	60.19
145	☐	J1402	2.89	445.00	584.45	60.42
146	☐	J990	1.45	445.00	584.45	60.42
147	☐	J1376	0.00	590.28	730.18	60.62
148	☐	J205	0.00	546.00	686.23	60.76
149	☐	J1942	5.73	594.20	734.45	60.77
150	☐	J1952	3.81	675.46	815.83	60.82

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
151	☐	J272	2.98	410.00	550.76	60.99
152	☐	J1998	0.00	439.73	580.94	61.18
153	☐	J794	3.30	544.00	685.48	61.31
154	☐	J1710	2.98	409.00	550.75	61.42
155	☐	J1284	3.05	647.79	789.73	61.50
156	☐	J870	3.81	576.00	718.02	61.54
157	☐	J730	3.05	672.47	814.61	61.59
158	☐	J1670	0.00	644.82	787.67	61.90
159	☐	J306	12.19	444.54	587.76	62.05
160	☐	J982	2.81	543.00	686.25	62.07
161	☐	J1330	6.11	543.00	686.26	62.07
162	☐	J1256	0.00	577.40	720.74	62.11
163	☐	J1884	0.00	444.25	587.68	62.15
164	☐	J1696	0.00	441.00	584.45	62.16
165	☐	J1982	4.05	583.99	727.55	62.21
166	☐	J280	3.56	666.90	810.77	62.34
167	☐	J106	5.66	443.66	587.69	62.41
168	☐	J1644	1.79	672.47	816.53	62.42
169	☐	J1252	5.86	672.23	816.59	62.55
170	☐	J188	2.98	406.00	550.75	62.72
171	☐	J1204	1.76	438.67	583.53	62.77
172	☐	J1554	1.79	670.22	816.29	63.30
173	☐	J1234	3.56	659.39	805.70	63.39
174	☐	J620	4.51	434.50	580.94	63.45
175	☐	J1222	0.00	640.83	787.56	63.58
176	☐	J1908	0.00	639.90	787.56	63.98
177	☐	J1248	0.00	579.65	727.41	64.02
178	☐	J1954	0.76	403.00	550.75	64.02
179	☐	J1726	2.55	666.45	814.25	64.04
180	☐	J330	0.00	433.10	580.92	64.05
181	☐	J738	5.31	440.00	587.90	64.09
182	☐	J1200	0.00	433.17	581.12	64.11
183	☐	J788	5.10	640.10	788.55	64.32
184	☐	J1906	4.74	432.57	581.10	64.36
185	☐	J1818	14.81	611.32	760.03	64.44
186	☐	J172	4.43	402.00	550.73	64.44
187	☐	J164	0.00	581.37	730.18	64.48
188	☐	J1246	0.00	578.40	727.41	64.56
189	☐	J532	5.58	640.43	789.52	64.60
190	☐	J524	0.00	431.45	580.92	64.76
191	☐	J1404	0.00	438.09	587.68	64.82
192	☐	J586	2.98	401.00	550.80	64.91
193	☐	J1996	2.51	431.04	580.97	64.97
194	☐	J460	0.00	437.42	587.71	65.12
195	☐	J1750	2.81	535.00	685.48	65.20
196	☐	J72	8.20	434.00	584.49	65.21
197	☐	J1728	0.00	436.99	587.63	65.27
198	☐	J752	5.73	577.07	727.75	65.29
199	☐	J1310	0.00	636.55	787.56	65.43
200	☐	J1946	0.00	539.08	690.22	65.49

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
201	☐	J1026	7.77	637.62	788.77	65.50
202	☐	J526	4.80	436.36	587.64	65.55
203	☐	J195	4.09	780.00	931.53	65.66
204	☐	J328	0.00	429.16	580.92	65.76
205	☐	J1748	1.41	533.00	685.48	66.07
206	☐	J1712	2.22	398.00	550.76	66.19
207	☐	J1852	5.96	575.69	728.47	66.20
208	☐	J1364	0.00	900.05	1,053.24	66.38
209	☐	J418	0.00	606.58	760.04	66.49
210	☐	J826	0.00	433.85	587.60	66.62
211	☐	J252	5.49	565.56	719.51	66.71
212	☐	J1338	0.00	402.00	556.13	66.79
213	☐	J1912	1.54	654.00	808.25	66.83
214	☐	J256	7.39	566.12	720.71	66.98
215	☐	J1854	2.15	573.84	728.47	67.00
216	☐	J1184	1.49	396.00	550.76	67.06
217	☐	J1598	8.94	532.00	686.98	67.15
218	☐	J1548	0.00	563.51	718.94	67.35
219	☐	J404	3.30	530.00	685.44	67.35
220	☐	J690	0.00	431.33	587.67	67.74
221	☐	J1422	5.17	529.00	685.49	67.81
222	☐	J626	2.98	394.00	550.80	67.94
223	☐	J1138	4.43	394.00	550.91	67.99
224	☐	J278	1.01	428.02	585.04	68.04
225	☐	J1630	5.94	896.48	1,053.57	68.06
226	☐	J570	4.24	423.54	580.94	68.20
227	☐	J1508	0.00	570.13	727.72	68.29
228	☐	J1708	1.68	562.32	720.37	68.48
229	☐	J406	2.35	527.00	685.41	68.64
230	☐	J510	3.39	426.00	584.45	68.65
231	☐	J1936	21.09	423.33	581.82	68.68
232	☐	J1060	4.43	392.00	550.72	68.78
233	☐	J1214	3.86	427.00	585.73	68.78
234	☐	J1810	0.76	392.00	550.77	68.79
235	☐	J1736	0.00	428.45	587.63	68.97
236	☐	J1266	0.00	421.38	580.95	69.14
237	☐	J1550	0.00	559.36	718.94	69.14
238	☐	J692	0.00	428.00	587.67	69.18
239	☐	J774	3.71	391.00	550.74	69.22
240	☐	J108	6.53	427.94	587.69	69.22
241	☐	J1202	0.00	421.32	581.12	69.24
242	☐	J1236	5.58	646.59	806.85	69.44
243	☐	J1146	5.31	425.00	585.27	69.44
244	☐	J1841	0.00	525.00	685.44	69.52
245	☐	J1318	0.00	554.63	715.12	69.54
246	☐	J1168	2.22	390.00	550.76	69.66
247	☐	J1950	5.26	419.81	581.32	69.98
248	☐	J264	20.68	525.00	686.93	70.17
249	☐	J1784	0.00	524.00	686.27	70.31
250	☐	J1230	15.66	424.80	587.56	70.53

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
251		J1808	14.22	380.00	542.84	70.56
252		J1002	2.63	559.05	722.07	70.64
253		J204	5.73	566.81	729.96	70.70
254		J512	3.39	421.00	584.45	70.82
255		J1862	3.71	387.00	550.87	71.01
256		J1802	0.00	563.74	727.64	71.02
257		J908	0.00	624.00	788.27	71.18
258		J924	5.10	625.13	789.74	71.33
259		J1556	2.55	647.12	812.00	71.44
260		J1058	2.22	385.00	550.74	71.81
261		J528	3.93	421.27	587.57	72.06
262		J804	8.26	421.17	587.56	72.10
263		J1520	0.00	414.65	581.12	72.13
264		J58	2.15	553.64	720.11	72.13
265		J426	4.78	552.86	719.67	72.28
266		J1144	1.94	418.00	585.27	72.48
267		J402	4.94	528.85	696.14	72.49
268		J186	2.98	383.00	550.74	72.68
269		J1874	0.00	518.00	686.27	72.91
270		J1844	6.09	621.02	789.33	72.93
271		J304	3.34	559.07	727.64	73.04
272		J1994	4.07	621.23	790.58	73.38
273		J168	2.42	415.00	584.49	73.44
274		J70	3.86	415.00	584.49	73.44
275		J1020	1.54	644.04	814.06	73.67
276		J1972	0.00	882.89	1,053.24	73.81
277		J1916	2.22	380.00	550.87	74.04
278		J710	6.28	417.00	587.91	74.05
279		J1624	0.00	515.00	686.27	74.21
280		J832	0.00	880.25	1,051.54	74.22
281		J766	2.02	644.26	815.55	74.22
282		J191	10.26	760.00	931.53	74.32
283		J1450	10.10	384.00	555.64	74.37
284		J1336	1.47	384.00	556.13	74.59
285		J1196	11.59	413.00	585.15	74.59
286		J558	5.86	618.39	790.89	74.75
287		J1812	14.65	880.58	1,053.28	74.83
288		J1804	4.83	418.00	590.79	74.87
289		J1476	16.25	411.59	585.01	75.15
290		J410	0.00	382.74	556.26	75.18
291		J1849	0.00	513.00	686.55	75.20
292		J1282	7.41	377.00	550.77	75.29
293		J1832	0.00	512.00	685.79	75.30
294		J538	2.51	410.58	584.41	75.32
295		J1576	0.00	553.23	727.41	75.47
296		J1632	0.00	879.10	1,053.57	75.60
297		J1724	1.79	614.41	789.00	75.65
298		J1574	4.78	552.79	727.41	75.66
299		J1320	0.00	540.30	715.12	75.75
300		J374	0.00	511.00	685.91	75.79

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
301	☐	J952	8.78	613.69	788.67	75.82
302	☐	J1966	6.57	511.00	686.25	75.93
303	☐	J1622	0.00	511.00	686.27	75.94
304	☐	J1834	3.30	510.00	685.44	76.02
305	☐	J1368	5.58	633.63	809.22	76.08
306	☐	J606	2.75	407.39	584.06	76.55
307	☐	J414	8.01	404.11	580.91	76.61
308	☐	J756	8.25	874.60	1,051.67	76.72
309	☐	J1212	8.57	543.63	720.74	76.74
310	☐	J1382	0.00	406.76	584.11	76.84
311	☐	J946	2.51	403.32	580.96	76.97
312	☐	J1658	13.48	537.15	714.98	77.05
313	☐	J830	0.00	635.85	814.06	77.22
314	☐	J980	1.41	508.00	686.25	77.23
315	☐	J876	0.00	609.22	787.59	77.29
316	☐	J724	3.76	507.00	685.84	77.49
317	☐	J1308	14.51	608.47	787.56	77.60
318	☐	J30	2.51	404.87	584.15	77.68
319	☐	J1616	0.00	401.50	580.91	77.74
320	☐	J1664	0.00	541.15	720.76	77.83
321	☐	J32	0.00	403.94	584.15	78.08
322	☐	J286	4.00	400.99	581.37	78.16
323	☐	J36	3.50	403.79	585.03	78.53
324	☐	J1120	0.00	544.08	725.44	78.58
325	☐	J48	0.00	543.43	725.44	78.86
326	☐	J1198	0.00	402.09	584.15	78.88
327	☐	J1298	8.01	398.78	580.90	78.91
328	☐	J1118	7.39	543.06	725.44	79.02
329	☐	J1278	1.94	402.00	584.44	79.05
330	☐	J1654	12.56	402.00	584.45	79.05
331	☐	J838	0.00	869.70	1,052.32	79.13
332	☐	J1636	5.52	532.23	714.97	79.18
333	☐	J1839	0.00	368.00	550.84	79.23
334	☐	J1860	6.09	605.53	789.18	79.58
335	☐	J138	5.92	367.00	550.82	79.65
336	☐	J160	5.76	400.32	584.24	79.69
337	☐	J640	6.11	503.00	686.94	79.70
338	☐	J244	4.70	503.00	686.98	79.72
339	☐	J1690	13.25	867.49	1,051.54	79.75
340	☐	J1088	1.94	400.00	585.08	80.20
341	☐	J158	5.76	399.17	584.27	80.21
342	☐	J384	3.78	371.00	556.12	80.21
343	☐	J446	4.70	500.00	685.34	80.31
344	☐	J62	3.10	536.54	722.07	80.39
345	☐	J1584	13.17	601.60	787.67	80.63
346	☐	J902	10.44	370.00	556.11	80.64
347	☐	J972	0.94	500.00	686.26	80.71
348	☐	J1530	0.97	398.00	584.45	80.79
349	☐	J193	6.17	745.00	931.52	80.82
350	☐	J400	21.05	509.57	696.15	80.85

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
351	☐	J154	9.06	540.75	727.64	80.98
352	☐	J660	0.94	498.00	685.16	81.10
353	☐	J1324	0.00	531.62	718.94	81.16
354	☐	J726	0.00	393.18	580.90	81.34
355	☐	J956	1.89	499.00	686.96	81.44
356	☐	J372	0.00	394.58	582.61	81.47
357	☐	J1824	23.73	424.05	612.08	81.48
358	☐	J197	0.55	497.00	685.16	81.53
359	☐	J1514	0.00	393.32	581.67	81.61
360	☐	J464	2.71	507.19	696.15	81.88
361	☐	J1286	2.80	600.75	789.73	81.88
362	☐	J1926	1.89	496.00	685.41	82.07
363	☐	J1542	0.00	395.00	584.44	82.09
364	☐	J842	4.24	497.00	686.96	82.31
365	☐	J1342	6.76	598.14	788.27	82.38
366	☐	J454	0.00	597.44	787.67	82.43
367	☐	J60	2.86	529.99	720.24	82.44
368	☐	J338	0.00	600.05	790.39	82.47
369	☐	J834	0.00	861.14	1,051.54	82.50
370	☐	J550	2.75	394.73	585.27	82.56
371	☐	J1526	0.00	390.48	581.78	82.89
372	☐	J236	3.39	400.00	591.38	82.92
373	☐	J1258	0.00	392.06	583.46	82.93
374	☐	J1944	2.42	393.00	584.45	82.95
375	☐	J180	3.39	393.00	584.48	82.97
376	☐	J556	9.42	597.80	789.74	83.17
377	☐	J1068	1.94	393.00	585.08	83.23
378	☐	J1366	0.00	861.08	1,053.24	83.26
379	☐	J688	0.00	494.00	686.22	83.29
380	☐	J1918	0.00	393.00	585.27	83.31
381	☐	J1122	2.98	358.00	550.74	83.51
382	☐	J1124	1.49	358.00	550.74	83.52
383	☐	J1646	4.36	392.00	585.14	83.69
384	☐	J958	1.18	532.73	726.08	83.78
385	☐	J1978	0.00	389.94	583.34	83.80
386	☐	J1078	0.00	389.33	583.12	83.97
387	☐	J1062	1.51	389.30	583.46	84.13
388	☐	J1280	5.92	355.00	550.75	84.82
389	☐	J140	5.92	355.00	550.81	84.85
390	☐	J1172	14.57	490.00	686.29	85.05
391	☐	J746	1.76	384.63	581.04	85.11
392	☐	J1662	0.00	524.27	720.76	85.14
393	☐	J268	0.75	384.10	580.98	85.31
394	☐	J1176	5.08	359.00	556.11	85.41
395	☐	J974	6.11	489.00	686.28	85.48
396	☐	J762	3.72	590.27	787.64	85.52
397	☐	J662	9.06	530.54	728.48	85.77
398	☐	J488	0.00	852.85	1,051.48	86.06
399	☐	J466	0.00	497.47	696.14	86.09
400	☐	J818	4.36	387.00	586.14	86.29

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
401	☐	J1010	0.00	587.56	787.50	86.63
402	☐	J284	0.00	380.81	581.04	86.76
403	☐	J1156	8.99	518.61	718.84	86.76
404	☐	J1506	0.00	527.42	727.72	86.79
405	☐	J996	16.90	697.48	897.83	86.81
406	☐	J1836	8.09	488.49	689.30	87.01
407	☐	J1606	3.10	526.45	727.29	87.02
408	☐	J1560	0.00	486.00	686.94	87.07
409	☐	J904	7.56	355.00	556.11	87.14
410	☐	J1254	0.00	355.00	556.11	87.14
411	☐	J234	5.80	390.00	591.48	87.30
412	☐	J874	5.40	585.66	787.52	87.47
413	☐	J680	0.00	383.00	585.01	87.53
414	☐	J1756	6.91	524.77	727.32	87.77
415	☐	J1104	3.25	380.78	583.34	87.77
416	☐	J1486	0.00	380.26	582.99	87.84
417	☐	J1240	7.54	483.00	686.22	88.06
418	☐	J250	4.05	514.75	719.22	88.60
419	☐	J610	1.44	517.19	722.07	88.77
420	☐	J890	7.77	581.94	787.50	89.07
421	☐	J1192	7.05	480.00	685.80	89.17
422	☐	J642	6.93	511.06	717.48	89.44
423	☐	J1754	3.25	374.23	580.91	89.55
424	☐	J1182	1.49	344.00	550.75	89.58
425	☐	J1932	0.00	480.00	686.90	89.65
426	☐	J1454	0.00	374.05	581.03	89.69
427	☐	J928	0.00	580.21	787.50	89.82
428	☐	J598	2.39	511.32	719.11	90.03
429	☐	J648	2.42	377.00	585.14	90.19
430	☐	J430	7.75	383.00	591.48	90.34
431	☐	J814	4.31	511.76	720.26	90.34
432	☐	J16	3.30	477.00	686.23	90.66
433	☐	J1780	0.00	516.72	726.25	90.79
434	☐	J1510	4.05	577.84	787.49	90.84
435	☐	J1878	0.00	517.81	727.78	90.98
436	☐	J744	0.00	375.00	585.14	91.05
437	☐	J846	5.17	475.00	685.34	91.14
438	☐	J1070	0.97	374.00	584.63	91.27
439	☐	J1800	2.98	340.00	550.74	91.32
440	☐	J844	4.70	476.00	686.96	91.41
441	☐	J1414	0.00	372.33	583.37	91.45
442	☐	J1782	0.00	374.00	585.08	91.46
443	☐	J1512	0.00	370.41	581.67	91.54
444	☐	J930	0.00	576.02	787.50	91.63
445	☐	J116	8.94	473.00	685.16	91.93
446	☐	J822	0.97	509.32	722.07	92.18
447	☐	J722	9.41	473.00	685.80	92.21
448	☐	J636	3.57	507.51	720.78	92.41
449	☐	J1758	0.00	513.76	727.32	92.54
450	☐	J806	3.10	505.52	719.14	92.56

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
451	☐	J1592	5.01	367.42	581.03	92.56
452	☐	J1564	11.59	379.00	593.33	92.87
453	☐	J1876	4.78	513.33	727.78	92.92
454	☐	J812	3.39	369.00	584.47	93.36
455	☐	J1314	0.00	470.00	685.80	93.51
456	☐	J1032	2.89	375.00	591.37	93.75
457	☐	J1602	7.77	571.14	787.69	93.83
458	☐	J1716	0.00	511.40	728.19	93.94
459	☐	J262	2.81	470.00	686.90	93.98
460	☐	J1328	1.41	470.00	686.90	93.98
461	☐	J324	5.23	501.25	719.10	94.39
462	☐	J1524	0.00	363.02	581.78	94.79
463	☐	J1934	0.00	467.00	686.22	94.99
464	☐	J1588	3.12	497.93	717.34	95.07
465	☐	J682	1.76	363.86	583.40	95.13
466	☐	J1960	0.00	380.00	599.64	95.17
467	☐	J1048	6.91	499.36	719.14	95.23
468	☐	J1830	0.00	466.00	685.79	95.24
469	☐	J868	8.99	496.18	716.61	95.51
470	☐	J490	0.00	831.04	1,051.48	95.52
471	☐	J1578	0.00	364.00	584.45	95.52
472	☐	J1532	2.42	371.00	591.48	95.53
473	☐	J872	28.14	498.00	718.54	95.56
474	☐	J1870	3.39	363.00	584.80	96.10
475	☐	J1760	4.36	366.00	587.90	96.15
476	☐	J1270	5.23	681.02	903.10	96.23
477	☐	J1938	7.74	360.10	582.56	96.39
478	☐	J1518	14.22	320.00	542.82	96.55
479	☐	J646	2.42	362.00	585.05	96.65
480	☐	J350	2.42	362.00	585.13	96.68
481	☐	J712	10.71	494.20	717.63	96.81
482	☐	J412	0.00	357.46	580.90	96.82
483	☐	J224	0.00	674.35	897.85	96.84
484	☐	J238	0.00	501.77	726.23	97.26
485	☐	J178	2.42	360.00	584.48	97.27
486	☐	J638	1.68	495.97	720.96	97.49
487	☐	J954	5.96	501.08	726.25	97.57
488	☐	J22	5.17	461.00	686.23	97.59
489	☐	J1488	0.00	357.64	582.99	97.64
490	☐	J84	10.49	493.63	719.02	97.66
491	☐	J1698	4.36	360.00	585.39	97.66
492	☐	J96	2.42	359.00	584.45	97.69
493	☐	J944	7.74	355.09	580.95	97.86
494	☐	J1544	6.25	357.18	583.12	97.90
495	☐	J392	5.96	499.71	725.85	97.99
496	☐	J114	0.94	459.00	685.16	98.00
497	☐	J800	0.00	493.72	720.40	98.22
498	☐	J424	2.39	492.39	719.12	98.24
499	☐	J1430	6.75	367.00	593.95	98.34
500	☐	J142	2.75	353.67	580.93	98.47

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
501	☐	J368	3.86	357.00	584.48	98.57
502	☐	J436	7.25	375.00	602.54	98.59
503	☐	J1064	1.51	355.83	583.46	98.63
504	☐	J258	0.00	492.63	720.40	98.69
505	☐	J144	0.00	352.88	580.93	98.81
506	☐	J222	10.28	669.78	897.85	98.83
507	☐	J470	5.17	457.00	685.34	98.94
508	☐	J1580	0.00	356.00	584.45	98.99
509	☐	J1400	19.26	354.17	582.99	99.14
510	☐	J34	0.00	354.04	582.99	99.20
511	☐	J600	3.57	489.78	719.11	99.36
512	☐	J1470	0.00	558.75	788.10	99.38
513	☐	J182	0.00	489.44	719.50	99.69
514	☐	J1452	5.49	350.86	581.03	99.73
515	☐	J998	0.00	667.65	897.83	99.73
516	☐	J854	4.24	352.90	583.34	99.85
517	☐	J156	5.73	496.89	727.62	99.98
518	☐	J1704	3.34	488.39	719.34	100.07
519	☐	J260	0.00	489.11	720.40	100.22
520	☐	J1732	0.00	496.85	728.23	100.26
521	☐	J1922	5.65	455.00	686.74	100.41
522	☐	J1174	2.63	487.24	719.11	100.47
523	☐	J128	2.42	352.00	584.45	100.72
524	☐	J548	7.54	454.00	686.94	100.93
525	☐	J496	6.25	347.95	580.93	100.95
526	☐	J82	5.02	485.84	719.09	101.07
527	☐	J322	31.77	501.01	734.44	101.14
528	☐	J240	3.57	492.79	726.25	101.16
529	☐	J916	0.00	451.00	685.36	101.55
530	☐	J148	6.11	451.00	685.40	101.57
531	☐	J232	2.42	350.00	584.45	101.59
532	☐	J670	7.15	492.81	727.41	101.65
533	☐	J1238	4.70	451.00	686.22	101.92
534	☐	J1082	1.94	349.00	584.45	102.02
535	☐	J1970	3.50	346.93	583.06	102.31
536	☐	J74	2.75	344.35	580.93	102.51
537	☐	J544	4.52	482.09	719.09	102.69
538	☐	J50	2.81	448.00	685.17	102.76
539	☐	J1340	8.11	550.98	788.18	102.78
540	☐	J926	2.89	347.00	584.65	102.97
541	☐	J462	7.75	355.00	592.74	103.01
542	☐	J1678	5.94	814.59	1,053.02	103.31
543	☐	J428	4.24	341.74	580.94	103.64
544	☐	J978	5.02	488.73	728.13	103.73
545	☐	J1276	3.39	345.00	584.44	103.75
546	☐	J1894	0.00	344.54	585.30	104.32
547	☐	J1080	0.97	343.00	584.11	104.47
548	☐	J1730	0.00	315.06	556.26	104.51
549	☐	J189	8.25	690.00	931.55	104.66
550	☐	J122	2.89	344.00	586.14	104.92

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
551	☐	J302	4.52	476.31	719.10	105.20
552	☐	J1848	8.64	476.73	719.82	105.33
553	☐	J346	3.30	442.00	685.76	105.62
554	☐	J634	0.00	342.00	585.76	105.62
555	☐	J1892	0.00	341.26	585.30	105.74
556	☐	J1822	0.00	481.64	725.77	105.78
557	☐	J1474	5.02	481.63	725.76	105.78
558	☐	J1456	2.89	340.00	584.64	106.00
559	☐	J1814	0.00	481.06	725.76	106.02
560	☐	J246	0.00	480.78	725.75	106.15
561	☐	J676	7.86	482.48	727.63	106.22
562	☐	J920	0.00	439.00	685.33	106.74
563	☐	J146	6.11	439.00	685.34	106.74
564	☐	J702	0.00	334.53	580.93	106.76
565	☐	J94	2.89	338.00	584.45	106.78
566	☐	J1634	4.70	440.00	686.91	106.98
567	☐	J318	0.00	473.70	720.96	107.14
568	☐	J1816	2.15	478.42	725.82	107.20
569	☐	J500	0.00	357.00	604.78	107.36
570	☐	J1194	2.35	438.00	685.81	107.37
571	☐	J1742	3.39	336.00	584.52	107.68
572	☐	J1792	0.00	336.00	584.52	107.69
573	☐	J1868	2.89	336.00	584.79	107.80
574	☐	J666	0.00	478.04	727.65	108.15
575	☐	J1046	5.02	476.01	725.75	108.21
576	☐	J976	0.00	477.40	728.13	108.64
577	☐	J100	3.10	470.00	720.96	108.74
578	☐	J1378	0.00	474.93	726.25	108.90
579	☐	J820	4.05	468.98	720.94	109.17
580	☐	J1358	6.91	473.36	725.90	109.42
581	☐	J986	3.10	474.12	727.48	109.78
582	☐	J300	6.68	465.62	719.01	109.79
583	☐	J910	4.36	330.00	584.52	110.28
584	☐	J382	3.30	431.00	685.72	110.37
585	☐	J248	0.00	470.83	725.75	110.46
586	☐	J1496	0.00	472.35	727.44	110.53
587	☐	J1858	7.75	342.00	597.95	110.90
588	☐	J896	6.11	429.00	684.99	110.92
589	☐	J628	3.57	462.25	718.95	111.23
590	☐	J758	3.00	324.09	580.95	111.30
591	☐	J126	2.42	327.00	584.45	111.55
592	☐	J866	4.36	327.00	584.46	111.56
593	☐	J1126	3.32	467.77	725.82	111.81
594	☐	J1566	0.00	326.20	584.58	111.96
595	☐	J1096	2.35	426.00	685.15	112.29
596	☐	J700	0.00	325.49	585.32	112.59
597	☐	J898	0.00	425.00	684.99	112.65
598	☐	J914	3.30	425.00	685.36	112.81
599	☐	J1398	3.75	323.80	584.17	112.82
600	☐	J1568	1.01	323.64	584.17	112.89

Table E-1: PHD Pressure Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
601	☐	J68	3.39	324.00	585.49	113.31
602	☐	J1864	7.25	341.00	602.54	113.33
603	☐	J364	2.86	465.63	727.42	113.43
604	☐	J698	3.50	322.67	585.32	113.81
605	☐	J1468	0.00	525.11	788.10	113.95
606	☐	J966	3.86	320.00	584.52	114.62
607	☐	J1744	2.42	320.00	584.52	114.62
608	☐	J760	0.00	315.98	580.95	114.81
609	☐	J440	5.80	320.00	585.10	114.87
610	☐	J816	16.23	454.81	720.33	115.05
611	☐	J1128	0.00	460.06	725.82	115.15
612	☐	J1890	0.97	318.00	584.41	115.43
613	☐	J1902	0.00	519.69	787.47	116.03
614	☐	J1958	0.00	331.00	599.64	116.40
615	☐	J1686	2.42	311.00	579.71	116.43
616	☐	J964	4.36	315.00	584.52	116.78
617	☐	J1178	6.28	333.00	602.55	116.80
618	☐	J1866	0.00	332.00	602.54	117.23
619	☐	J948	0.00	445.52	717.51	117.86
620	☐	J900	0.00	625.00	897.83	118.22
621	☐	J1000	2.81	412.00	684.99	118.28
622	☐	J1500	3.39	322.00	596.43	118.91
623	☐	J1660	8.20	326.00	601.76	119.49
624	☐	J1498	3.39	320.00	596.43	119.78
625	☐	J514	0.71	447.69	726.62	120.86
626	☐	J292	5.49	447.98	727.72	121.21
627	☐	J694	2.81	403.00	685.13	122.25
628	☐	J1360	0.00	436.55	725.78	125.32
629	☐	J1106	3.30	395.00	685.36	125.81
630	☐	J398	2.86	436.67	727.16	125.87
631	☐	J1842	0.00	435.01	727.16	126.59
632	☐	J1806	0.00	494.42	787.48	126.98
633	☐	J1838	0.00	490.60	788.02	128.88
634	☐	J1600	1.24	427.93	725.82	129.07
635	☐	J1840	0.00	489.78	788.02	129.23
636	☐	J207	13.99	546.00	846.30	130.12
637	☐	J1904	2.04	486.56	787.44	130.37
638	☐	J1166	2.04	485.96	787.86	130.82
639	☐	J1390	0.00	376.37	689.30	135.59
640	☐	J516	1.44	408.55	727.02	137.99
641	☐	J187	0.00	597.00	931.60	144.98
642	☐	JDIV22P	0.00	0.00	790.39	342.47

Table E-2: South Shore Fire Flow Model Results

	ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
1	J1822FH	500.00	325.29	J1288	13.07	801.16	172.82	20.00	26.96
2	J1428	501.09	323.16	J1428	20.00	795.12	323.17	20.00	20.07
3	J1914	500.85	381.64	J1914	20.00	795.20	381.64	20.00	20.01
4	J592	751.69	430.42	J1428	19.03	792.88	405.73	20.00	21.00
5	J276	752.78	441.06	J1428	19.66	794.33	431.50	20.00	20.35
6	J1286	751.33	1,057.55	J1428	0.94	751.14	431.69	20.00	57.84
7	J1284	751.45	524.63	J1428	16.99	788.18	431.81	20.00	27.73
8	J522	751.69	1,156.42	J1428	-7.49	731.67	432.05	20.00	56.81
9	J1994	751.93	1,399.31	J1428	-16.12	711.77	432.30	20.00	71.45
10	J1796	752.05	617.25	J1428	12.74	778.36	432.41	20.00	38.69
11	J1442	752.05	469.42	J1428	18.66	792.02	432.43	20.00	24.81
12	J558	752.78	738.44	J1428	7.26	765.71	433.14	20.00	59.81
13	J274	754.47	884.51	J1428	-0.07	748.80	434.83	20.00	45.07
14	J1724	750.85	640.52	J1428	11.97	776.59	436.12	20.00	50.52
15	J532	752.65	869.16	J1428	0.85	750.93	436.54	20.00	49.18
16	J872	753.38	705.87	J1428	9.00	769.74	437.26	20.00	68.18
17	J322	754.59	652.72	J1428	11.59	775.70	439.87	20.00	76.42
18	J408	750.00	900.91	J1428	-0.28	748.32	440.86	20.00	45.15
19	J1730	750.00	1,065.41	J1428	-4.81	737.85	440.86	20.00	89.56
20	J210	750.00	727.92	J1428	8.21	767.91	440.87	20.00	37.45
21	J410	750.00	1,019.76	J1428	-3.42	741.06	440.87	20.00	64.69
22	J1224	751.93	1,220.72	J1428	-9.78	726.39	442.80	20.00	54.97
23	J86	752.90	10,620.26	J1428	-321.28	7.49	444.11	20.00	54.91
24	J788	752.42	806.94	J1428	6.59	764.18	449.28	20.00	49.27
25	J502	752.29	587.28	J1428	14.98	783.54	450.24	20.00	25.12
26	J164	500.00	1,291.87	J1428	-7.27	732.18	488.07	20.00	60.75
27	J1716	500.00	1,059.57	J1428	1.09	751.49	488.96	20.00	78.47
28	J840	501.81	497.22	J840	20.00	978.00	497.22	20.00	19.99
29	J998	500.00	498.44	J998	20.00	713.81	498.44	20.00	20.00
30	J1590	500.00	936.51	J1428	5.31	761.23	498.58	20.00	47.50
31	J1472	754.11	1,782.47	J1428	-25.92	689.15	498.78	20.00	45.58
32	J704	753.14	1,854.41	J1288	-0.55	769.74	499.72	20.00	40.59
33	J1272	500.00	503.93	J1272	20.00	843.70	503.95	20.00	20.01
34	J1556	751.21	762.29	J1288	17.29	810.89	504.23	20.00	50.09
35	J796	751.57	1,908.46	J1288	-1.30	768.00	504.60	20.00	48.80
36	J894	751.93	1,095.62	J1288	12.97	800.93	504.96	20.00	45.50
37	J1136	753.14	1,081.63	J1288	13.18	801.43	506.16	20.00	46.20
38	J1318	750.00	2,051.24	J1288	-2.44	765.36	508.30	20.00	66.13
39	J1394	752.42	800.93	J1428	9.94	771.90	510.67	20.00	30.16
40	J1636	751.93	2,714.02	J1288	-11.83	743.69	511.43	20.00	76.31
41	J630	753.26	677.57	J1428	14.44	782.29	511.50	20.00	34.00
42	J1656	752.18	2,288.48	J1288	-6.24	756.60	512.57	20.00	51.03
43	J1588	751.09	2,661.43	J1288	-13.26	740.39	513.50	20.00	92.96
44	J1322	751.45	1,560.01	J1428	-9.36	727.35	513.53	20.00	48.39
45	J1236	752.65	2,233.01	J1288	-5.03	759.38	514.36	20.00	69.56
46	J1658	754.71	2,685.12	J1288	-13.99	738.71	514.48	20.00	74.38
47	J1234	751.69	2,020.98	J1288	-1.04	768.61	514.76	20.00	63.50
48	J868	753.14	2,889.68	J1288	-15.27	735.76	514.80	20.00	93.25
49	J1548	750.00	1,172.86	J1288	12.07	798.86	515.00	20.00	57.76
50	J1324	750.00	1,887.23	J1288	1.46	774.37	515.00	20.00	77.31

Table E-2: South Shore Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
51	☐	J642	752.42	2,053.87	J1288	-1.43	767.69	515.44	20.00	85.29
52	☐	J1434	752.65	1,204.90	J1288	11.61	797.78	515.47	20.00	45.75
53	☐	J870	751.33	1,346.19	J1288	9.44	792.79	515.89	20.00	56.62
54	☐	J182	750.00	2,704.41	J1288	-13.50	739.84	516.10	20.00	98.26
55	☐	J1358	503.50	1,076.13	J1428	1.46	752.33	516.39	20.00	88.75
56	☐	J712	753.74	2,014.30	J1288	-0.72	769.34	517.03	20.00	91.98
57	☐	J1156	753.14	2,398.69	J1288	-7.66	753.33	517.44	20.00	84.91
58	☐	J1438	751.21	784.55	J1288	17.24	810.78	517.78	20.00	32.01
59	☐	J816	755.67	2,826.21	J1428	-57.66	615.90	517.96	20.00	112.68
60	☐	J1924	751.81	1,023.10	J1288	14.30	804.01	518.38	20.00	37.44
61	☐	J784	753.02	1,332.95	J1288	9.79	793.60	518.39	20.00	48.58
62	☐	J1334	753.38	952.48	J1288	15.25	806.19	520.63	20.00	39.70
63	☐	J1384	751.21	774.21	J1288	17.44	811.26	522.52	20.00	34.43
64	☐	J1386	751.45	1,059.61	J1288	14.05	803.42	526.01	20.00	39.88
65	☐	J1410	752.54	943.53	J1288	15.55	806.90	527.98	20.00	40.73
66	☐	J1720	750.00	1,003.42	J1288	14.89	805.37	529.88	20.00	46.39
67	☐	J1554	750.85	530.03	J1554	20.00	716.37	530.01	20.00	19.31
68	☐	J900	500.00	594.87	J996	5.56	710.30	534.84	20.00	37.60
69	☐	J1108	751.69	1,254.64	J1288	11.66	797.91	534.91	20.00	49.53
70	☐	J996	503.98	538.82	J996	20.00	743.64	538.82	20.00	20.04
71	☐	J584	753.02	1,045.50	J1288	15.05	805.74	558.61	20.00	47.48
72	☐	J1694	750.36	762.20	J1288	18.14	812.87	558.80	20.00	38.67
73	☐	J1732	500.00	1,466.81	J1428	-9.50	727.04	561.55	20.00	90.38
74	☐	J222	502.42	625.83	J996	8.00	715.93	572.25	20.00	32.14
75	☐	J1368	752.65	1,158.30	J1288	14.35	804.11	585.12	20.00	62.69
76	☐	J1460	751.45	592.32	J1460	20.00	649.06	592.32	20.00	20.00
77	☐	J1482	500.00	595.60	J1482	20.00	671.22	595.60	20.00	20.00
78	☐	J730	751.45	766.59	J604	4.12	719.63	605.30	20.00	35.64
79	☐	J768	750.49	613.70	J768	20.00	817.54	613.69	20.00	20.01
80	☐	J1670	500.00	774.60	J1672	5.91	690.98	614.42	20.00	34.09
81	☐	J280	751.69	1,319.42	J1288	13.67	802.55	615.66	20.00	51.47
82	☐	J1984	500.00	657.97	J1428	18.99	792.79	620.83	20.00	24.07
83	☐	J1982	502.05	815.44	J1428	14.61	782.69	622.88	20.00	36.63
84	☐	J1484	501.81	623.05	J1484	20.00	706.06	623.05	20.00	20.00
85	☐	J1726	751.21	2,783.99	J996	-172.37	299.67	630.69	20.00	57.01
86	☐	J442	750.00	1,004.47	J1428	8.79	769.25	633.11	20.00	37.64
87	☐	J402	751.33	634.20	J402	20.00	575.00	634.19	20.00	19.83
88	☐	J1086	750.00	1,330.71	J1428	-0.02	748.92	636.61	20.00	41.33
89	☐	J1644	750.85	1,011.31	J1288	16.80	809.77	637.91	20.00	45.50
90	☐	J328	750.00	1,098.58	J1428	5.81	762.37	639.54	20.00	48.35
91	☐	J1952	751.81	1,925.07	J1288	6.50	786.00	642.95	20.00	56.39
92	☐	J1616	750.00	1,269.01	J1428	1.44	752.29	646.04	20.00	62.78
93	☐	J56	751.21	2,283.41	J1288	0.31	771.71	646.16	20.00	39.71
94	☐	J412	750.00	1,267.98	J1428	1.46	752.34	647.32	20.00	76.26
95	☐	J726	750.00	1,306.88	J1428	0.58	750.31	647.63	20.00	66.62
96	☐	J414	753.87	1,273.98	J1428	1.42	752.23	649.54	20.00	62.02
97	☐	J1754	751.57	1,304.71	J1428	0.67	750.50	649.77	20.00	72.36
98	☐	J1536	751.93	1,130.29	J1428	5.10	760.74	650.46	20.00	41.05
99	☐	J1298	753.87	1,299.69	J1428	0.82	750.87	651.49	20.00	64.47
100	☐	J1246	500.00	691.83	J1428	19.03	792.89	652.21	20.00	24.81

Table E-2: South Shore Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
101	☐	J1534	752.90	1,429.13	J1428	-1.43	745.66	655.44	20.00	46.57
102	☐	J670	503.62	1,374.97	J1428	-0.36	748.14	655.84	20.00	82.76
103	☐	J1998	750.00	1,667.65	J1428	-5.43	736.44	666.22	20.00	56.42
104	☐	J1266	750.00	1,856.61	J1428	-8.56	729.21	667.95	20.00	64.90
105	☐	J620	752.18	1,708.08	J1428	-6.02	735.07	669.61	20.00	58.66
106	☐	J1480	501.45	674.51	J1480	20.00	651.02	674.51	20.00	20.02
107	☐	J1854	751.09	1,141.23	J1288	16.16	808.30	675.77	20.00	48.38
108	☐	J144	750.00	1,666.27	J1428	-5.05	737.31	678.17	20.00	85.92
109	☐	J142	751.33	1,596.49	J1428	-3.90	739.96	679.69	20.00	83.99
110	☐	J702	750.00	1,347.01	J1428	0.56	750.26	679.91	20.00	81.71
111	☐	J496	753.02	1,693.41	J1428	-5.44	736.42	681.92	20.00	88.12
112	☐	J760	500.00	1,031.11	J1428	9.77	771.52	686.51	20.00	68.83
113	☐	J946	751.21	1,947.06	J1428	-9.68	726.62	687.82	20.00	71.60
114	☐	J758	751.45	2,008.86	J1428	-10.61	724.47	687.94	20.00	101.88
115	☐	J944	753.74	2,031.87	J1428	-10.85	723.92	690.58	20.00	90.52
116	☐	J1996	751.21	1,499.01	J1428	-1.71	745.01	690.97	20.00	54.55
117	☐	J268	750.36	2,007.25	J1428	-10.26	725.28	692.53	20.00	78.90
118	☐	J454	500.00	790.22	J1672	12.84	706.99	693.98	20.00	33.02
119	☐	J1584	504.71	1,057.22	J1672	-12.82	647.76	698.69	20.00	52.81
120	☐	J1942	502.90	1,339.93	J1288	14.60	804.69	701.86	20.00	48.39
121	☐	J766	750.96	989.63	J768	17.65	812.12	702.78	20.00	33.66
122	☐	J728	751.33	875.02	J768	18.55	814.18	703.15	20.00	32.43
123	☐	J912	752.42	711.40	J1288	19.95	817.04	704.19	20.00	20.30
124	☐	J1592	752.42	1,990.24	J1428	-9.33	727.44	705.30	20.00	84.07
125	☐	J1452	752.65	1,710.39	J1428	-4.68	738.16	705.53	20.00	85.18
126	☐	J746	750.85	2,064.68	J1428	-10.53	724.66	706.62	20.00	78.41
127	☐	J1950	752.54	2,092.64	J1428	-9.77	726.41	710.04	20.00	65.07
128	☐	J1946	750.00	907.93	J482	18.77	686.96	712.97	20.00	35.06
129	☐	J464	750.73	1,099.23	J482	17.37	683.71	713.69	20.00	53.13
130	☐	J482	750.85	713.83	J482	20.00	689.79	713.81	20.00	19.97
131	☐	J580	751.81	1,870.13	J482	12.16	671.70	714.78	20.00	44.25
132	☐	J1054	753.14	760.87	J482	19.74	689.19	716.11	20.00	21.59
133	☐	J356	754.23	1,154.76	J482	16.95	682.75	717.19	20.00	25.78
134	☐	J400	755.67	1,160.83	J482	16.91	682.66	718.64	20.00	54.97
135	☐	J1496	500.00	1,406.38	J1428	2.75	755.31	721.72	20.00	85.13
136	☐	J1050	501.93	917.97	J882	4.99	637.31	732.69	20.00	35.18
137	☐	J742	751.09	1,965.94	J482	11.92	671.15	734.37	20.00	53.60
138	☐	J252	502.78	928.30	J882	4.15	635.36	735.22	20.00	39.33
139	☐	J1708	500.85	1,055.68	J1288	17.77	812.02	739.22	20.00	49.05
140	☐	J1042	751.69	2,014.54	J482	11.10	669.26	740.07	20.00	49.13
141	☐	J58	501.09	910.86	J1288	18.90	814.61	740.11	20.00	39.19
142	☐	J250	502.05	1,054.96	J1288	17.79	812.05	740.19	20.00	57.93
143	☐	J598	501.21	926.63	J1288	18.78	814.33	740.26	20.00	46.60
144	☐	J1174	501.33	973.54	J1288	18.41	813.48	740.36	20.00	55.54
145	☐	J806	501.57	1,014.72	J1288	18.10	812.77	740.47	20.00	56.28
146	☐	J628	501.81	1,133.30	J1288	17.16	810.60	740.84	20.00	75.37
147	☐	J1704	501.69	987.09	J1288	18.32	813.27	740.87	20.00	57.06
148	☐	J600	501.81	1,041.53	J1288	17.89	812.29	740.88	20.00	61.56
149	☐	J256	503.74	1,099.02	J1288	17.45	811.27	740.94	20.00	50.99
150	☐	J544	502.29	992.25	J882	-2.02	621.13	741.31	20.00	58.06

Table E-2: South Shore Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
151	☐	J302	502.29	1,135.19	J1288	17.15	810.58	741.32	20.00	72.41
152	☐	J426	502.42	995.51	J882	-3.29	618.20	741.36	20.00	46.30
153	☐	J82	502.54	982.22	J882	-1.26	622.88	741.55	20.00	56.78
154	☐	J324	502.65	1,044.60	J1288	17.87	812.25	741.68	20.00	59.47
155	☐	J1256	500.00	989.69	J1288	18.28	813.19	741.81	20.00	41.49
156	☐	J60	501.45	961.89	J1288	18.51	813.71	741.96	20.00	47.39
157	☐	J300	503.38	1,147.81	J1288	17.05	810.36	742.41	20.00	75.70
158	☐	J1048	503.50	1,090.76	J1288	17.52	811.42	743.05	20.00	63.76
159	☐	J1662	500.00	1,237.69	J1288	16.35	808.73	743.55	20.00	66.35
160	☐	J1448	500.00	1,059.94	J1288	17.86	812.22	746.22	20.00	35.19
161	☐	J858	500.00	1,679.19	J1288	13.42	801.98	746.22	20.00	54.90
162	☐	J662	504.59	2,407.32	J1288	4.37	781.10	747.07	20.00	79.07
163	☐	J606	751.33	1,886.79	J482	12.65	672.83	749.22	20.00	67.07
164	☐	J318	500.00	947.05	J1288	18.61	813.95	749.41	20.00	53.26
165	☐	J638	500.85	1,336.06	J1288	15.53	806.83	750.25	20.00	77.55
166	☐	J822	500.49	1,269.13	J1288	16.09	808.14	753.95	20.00	67.96
167	☐	J1002	751.33	832.14	J1288	19.47	815.92	754.68	20.00	28.35
168	☐	J62	501.57	1,006.17	J1288	18.20	813.00	755.04	20.00	44.89
169	☐	J1120	500.00	1,205.29	J1288	16.76	809.67	758.26	20.00	53.74
170	☐	J32	750.00	1,647.92	J482	14.21	676.43	762.77	20.00	64.28
171	☐	J203	500.00	764.13	J203	20.00	823.16	764.04	20.00	20.02
172	☐	J54	751.33	1,244.39	J203	18.18	818.96	765.45	20.00	23.61
173	☐	J1606	501.57	1,979.86	J1288	9.64	793.24	767.70	20.00	75.11
174	☐	J160	752.78	1,658.09	J482	14.09	676.16	771.65	20.00	65.33
175	☐	J158	752.78	1,689.46	J482	13.89	675.69	772.64	20.00	66.21
176	☐	J448	750.00	1,780.59	J482	13.17	674.02	773.74	20.00	41.35
177	☐	J1758	500.00	1,095.33	J1288	17.83	812.14	776.58	20.00	53.87
178	☐	J286	751.93	2,315.21	J1428	-10.80	724.05	778.31	20.00	71.86
179	☐	J538	751.21	1,914.99	J482	12.43	672.33	779.88	20.00	65.29
180	☐	J1756	503.50	1,718.74	J1288	12.54	799.93	779.89	20.00	71.86
181	☐	J1828	501.69	1,982.89	J1288	10.97	796.33	781.73	20.00	56.90
182	☐	J1112	751.33	1,957.51	J482	11.84	670.95	784.97	20.00	47.90
183	☐	J1204	750.85	1,906.91	J482	12.75	673.06	785.57	20.00	58.20
184	☐	J1052	750.45	792.76	J185	19.57	617.16	786.24	20.00	20.50
185	☐	J986	501.57	1,433.03	J1288	15.33	806.38	793.45	20.00	80.11
186	☐	J278	750.49	2,257.76	J482	10.01	666.73	795.35	20.00	63.45
187	☐	J980	750.67	1,127.11	J185	-5.35	559.66	795.93	20.00	46.58
188	☐	J38	755.80	1,304.71	J482	16.79	682.37	797.19	20.00	37.03
189	☐	J1030	751.57	2,079.17	J482	11.07	669.19	798.61	20.00	53.07
190	☐	J700	750.00	1,880.84	J482	12.67	672.86	806.30	20.00	94.83
191	☐	J698	751.69	2,173.98	J482	10.55	667.99	807.99	20.00	101.27
192	☐	J1892	750.00	2,265.30	J482	9.95	666.59	809.42	20.00	95.66
193	☐	J1894	750.00	1,379.19	J482	16.31	681.28	809.43	20.00	72.89
194	☐	J36	751.69	2,334.35	J482	9.56	665.70	809.62	20.00	72.90
195	☐	J1330	752.91	987.72	J185	7.85	590.13	813.77	20.00	32.38
196	☐	J306	503.38	1,952.68	J1288	11.47	797.46	814.24	20.00	57.99
197	☐	J1062	750.73	2,059.27	J482	11.86	671.01	814.65	20.00	76.23
198	☐	J1064	750.73	1,142.99	J482	18.12	685.45	814.66	20.00	56.62
199	☐	J1990	502.29	985.94	J1272	10.03	820.69	815.56	20.00	30.24
200	☐	J550	751.33	2,392.19	J482	9.11	664.67	816.45	20.00	76.91

Table E-2: South Shore Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
201	☐	J832	500.00	821.68	J832	20.00	926.41	821.68	20.00	20.01
202	☐	J460	500.00	1,997.67	J1288	11.20	796.85	829.82	20.00	58.67
203	☐	J304	501.69	848.90	J1802	17.98	605.23	831.09	20.00	22.01
204	☐	J682	750.85	2,077.03	J482	11.99	671.31	833.15	20.00	84.56
205	☐	J106	501.57	1,310.88	J1288	16.75	809.66	839.62	20.00	42.83
206	☐	J108	501.81	1,515.10	J1288	15.23	806.14	840.71	20.00	52.00
207	☐	J1414	750.00	1,966.09	J482	13.02	673.67	842.17	20.00	79.28
208	☐	J1476	757.85	2,336.42	J482	9.90	666.48	842.95	20.00	69.12
209	☐	J690	500.00	1,178.21	J1288	17.80	812.08	846.38	20.00	41.15
210	☐	J1172	756.94	1,314.29	J185	-15.53	536.15	846.51	20.00	55.66
211	☐	J1104	751.57	1,491.11	J482	16.39	681.45	852.68	20.00	64.24
212	☐	J854	752.05	2,009.50	J482	12.84	673.26	853.16	20.00	86.15
213	☐	J199	750.26	1,079.64	J201	7.00	596.16	856.20	20.00	33.26
214	☐	J526	501.33	915.35	J1288	19.64	816.34	857.32	20.00	25.46
215	☐	J1512	750.00	2,381.60	J1428	-8.31	729.79	861.49	20.00	81.26
216	☐	J1728	500.00	1,690.56	J1288	14.24	803.86	869.39	20.00	51.40
217	☐	J1310	500.00	890.77	J1222	18.15	682.71	871.58	20.00	21.84
218	☐	J154	504.59	1,800.96	J1288	13.52	802.20	872.56	20.00	64.74
219	☐	J1364	500.00	879.03	J1364	20.00	946.21	879.03	20.00	20.01
220	☐	J156	502.90	2,195.71	J1288	9.97	794.01	881.03	20.00	85.07
221	☐	J1524	750.00	2,396.80	J1428	-7.25	732.24	894.15	20.00	83.06
222	☐	J528	501.09	1,504.09	J1288	16.07	808.09	896.39	20.00	51.52
223	☐	J838	500.00	1,280.45	J840	-6.93	915.85	903.71	20.00	46.94
224	☐	J1230	504.34	2,377.69	J1288	8.61	790.86	914.29	20.00	61.68
225	☐	J1566	750.00	2,454.07	J482	10.26	667.32	920.27	20.00	98.45
226	☐	J1308	505.19	1,119.11	J1910	2.00	654.62	930.68	20.00	37.36
227	☐	J1078	750.00	952.25	J482	19.94	689.65	937.92	20.00	21.74
228	☐	J1544	753.02	1,676.98	J482	16.09	680.76	940.94	20.00	71.26
229	☐	J197	750.26	1,576.34	J201	-15.96	543.16	961.33	20.00	55.97
230	☐	J804	502.29	2,628.71	J1288	6.29	785.51	969.96	20.00	67.73
231	☐	J1806	500.00	1,356.97	J1672	-7.97	658.95	971.15	20.00	71.64
232	☐	J928	500.00	1,010.64	J1672	17.53	717.81	971.15	20.00	25.29
233	☐	J1902	500.00	1,256.88	J1672	0.10	677.58	971.15	20.00	58.26
234	☐	J756	502.18	1,252.84	J840	2.09	936.66	971.25	20.00	40.47
235	☐	J1904	500.73	1,354.80	J1672	-7.73	659.51	971.88	20.00	72.96
236	☐	J762	501.33	1,405.47	J1672	-11.97	649.73	972.48	20.00	54.81
237	☐	J874	501.93	1,088.94	J1672	12.50	706.20	973.09	20.00	33.55
238	☐	J1970	751.69	1,660.87	J482	16.45	681.60	973.26	20.00	71.48
239	☐	J1602	502.78	1,561.45	J1672	-26.02	617.30	973.93	20.00	66.02
240	☐	J272	750.90	986.46	J272	20.00	456.16	986.46	20.00	20.17
241	☐	J1568	750.49	1,527.57	J482	17.34	683.65	992.53	20.00	70.41
242	☐	J1398	751.81	2,291.45	J482	12.29	672.01	993.86	20.00	93.17
243	☐	J1178	752.91	2,133.59	J1288	16.43	808.92	999.43	20.00	97.67
244	☐	J436	753.36	1,389.15	J1288	19.04	814.94	999.86	20.00	58.15
245	☐	J1864	753.36	1,771.81	J1288	17.81	812.11	999.88	20.00	84.74
246	☐	J676	503.98	2,305.79	J1288	10.79	795.91	1,016.36	20.00	89.13
247	☐	J1232	751.79	1,201.73	J1882	12.63	609.16	1,041.74	20.00	27.37
248	☐	J116	754.26	1,865.12	J201	-26.36	519.16	1,042.65	20.00	66.37
249	☐	J1660	753.80	2,192.65	J1288	16.46	808.98	1,043.96	20.00	99.07
250	☐	J908	500.00	1,045.32	J908	20.00	670.16	1,045.31	20.00	19.58

Table E-2: South Shore Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
251	☐	J1166	500.73	1,940.98	J1672	-62.93	532.10	1,086.57	20.00	102.94
252	☐	J490	500.00	1,164.52	J840	17.58	972.41	1,116.10	20.00	25.64
253	☐	J1238	752.24	1,173.24	J1934	13.07	497.16	1,117.72	20.00	27.46
254	☐	J416	500.00	1,456.43	J1364	-6.27	885.58	1,128.28	20.00	46.15
255	☐	J80	500.70	1,344.43	J1364	3.38	907.84	1,128.98	20.00	46.92
256	☐	J1678	501.57	1,268.84	J1364	9.55	922.09	1,129.86	20.00	35.60
257	☐	J1818	502.29	1,407.99	J1364	-1.85	895.79	1,130.58	20.00	43.02
258	☐	J50	751.34	2,227.90	J201	-37.20	494.16	1,145.46	20.00	77.21
259	☐	J1958	750.00	2,261.42	J1288	16.95	810.13	1,172.43	20.00	92.32
260	☐	J1960	750.00	1,723.12	J1288	18.66	814.07	1,172.43	20.00	61.34
261	☐	J1840	500.00	1,950.56	J1672	-51.79	557.81	1,177.14	20.00	97.59
262	☐	J1096	751.12	2,386.64	J201	-42.35	482.27	1,185.20	20.00	85.53
263	☐	J1750	751.34	1,471.93	J1882	8.19	598.89	1,187.02	20.00	34.36
264	☐	J794	751.57	1,554.26	J1882	4.40	590.16	1,187.24	20.00	35.61
265	☐	J1468	500.00	1,953.09	J840	-22.50	879.92	1,189.17	20.00	88.12
266	☐	J1342	502.42	1,688.14	J840	-5.87	918.28	1,191.28	20.00	53.38
267	☐	J952	503.14	1,933.86	J840	-20.93	883.55	1,193.22	20.00	63.75
268	☐	J1860	502.18	1,845.19	J840	-14.70	897.92	1,194.44	20.00	59.23
269	☐	J1938	753.74	2,408.93	J1428	2.06	753.72	1,194.48	20.00	74.48
270	☐	J34	750.00	1,879.10	J482	17.18	683.28	1,207.93	20.00	63.41
271	☐	J1486	750.00	1,530.59	J482	18.76	686.93	1,207.94	20.00	43.62
272	☐	J1400	759.30	2,038.95	J482	16.42	681.52	1,217.23	20.00	67.88
273	☐	J694	751.34	2,591.59	J201	-48.43	468.23	1,238.24	20.00	94.56
274	☐	J1138	751.34	2,398.58	J201	-28.62	513.94	1,244.56	20.00	66.81
275	☐	J1928	751.79	1,265.13	J1928	20.00	602.16	1,265.14	20.00	20.01
276	☐	J1282	752.24	1,833.24	J201	-1.41	576.75	1,266.82	20.00	51.96
277	☐	J372	750.00	1,794.70	J1428	13.11	779.21	1,272.24	20.00	48.33
278	☐	J52	751.57	1,469.84	J201	12.76	609.44	1,273.65	20.00	28.23
279	☐	J1862	751.12	2,346.89	J201	-25.38	521.43	1,275.42	20.00	66.13
280	☐	J1182	750.45	1,841.50	J201	-1.60	576.30	1,275.45	20.00	58.51
281	☐	J1124	750.45	1,792.72	J201	0.50	581.15	1,280.29	20.00	52.48
282	☐	J1058	750.67	1,322.10	J1060	16.97	431.16	1,285.55	20.00	22.66
283	☐	J774	751.12	1,702.70	J201	4.19	589.66	1,286.00	20.00	40.95
284	☐	J1712	750.67	1,595.77	J201	8.70	600.08	1,292.37	20.00	34.91
285	☐	J1106	751.57	1,295.55	J1106	20.00	441.16	1,295.54	20.00	21.52
286	☐	J140	751.79	2,205.97	J201	-17.27	540.13	1,296.22	20.00	68.60
287	☐	J138	751.79	2,393.57	J201	-27.13	517.38	1,296.22	20.00	71.35
288	☐	J1858	753.59	2,309.53	J1288	17.43	811.22	1,300.80	20.00	83.90
289	☐	J1270	500.96	1,664.19	J840	4.87	943.09	1,328.86	20.00	39.96
290	☐	J586	750.90	2,137.79	J201	-12.39	551.41	1,329.07	20.00	50.13
291	☐	J1920	502.90	1,765.14	J840	-0.11	931.58	1,330.83	20.00	37.97
292	☐	J102	503.50	1,833.95	J840	-3.69	923.34	1,331.43	20.00	41.99
293	☐	J1876	502.42	1,868.99	J1288	17.35	811.04	1,351.58	20.00	57.81
294	☐	J1760	752.02	1,354.56	J1760	20.00	412.16	1,354.56	20.00	19.98
295	☐	J922	751.57	2,102.07	J201	-8.58	560.20	1,368.87	20.00	38.97
296	☐	J738	752.46	1,710.96	J736	6.13	486.16	1,370.65	20.00	33.84
297	☐	J446	752.24	2,125.08	J201	-8.93	559.38	1,379.85	20.00	52.20
298	☐	J920	750.00	2,679.51	J201	-35.34	498.45	1,393.42	20.00	79.50
299	☐	J430	753.59	3,269.12	J185	-41.75	475.64	1,398.14	20.00	82.45
300	☐	J846	752.46	1,824.49	J201	5.11	591.79	1,402.88	20.00	46.78

Table E-2: South Shore Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
301	☐	J836	751.12	1,451.45	J1244	17.83	596.16	1,404.94	20.00	22.19
302	☐	J146	752.91	2,711.39	J201	-35.74	497.53	1,406.96	20.00	79.62
303	☐	J470	752.46	1,969.60	J201	-0.46	578.93	1,408.35	20.00	55.73
304	☐	J916	750.00	2,649.20	J201	-30.73	509.08	1,422.49	20.00	74.38
305	☐	J914	751.57	1,574.67	J201	15.13	614.92	1,424.06	20.00	35.60
306	☐	J1422	752.46	2,049.20	J1882	-2.10	575.16	1,438.38	20.00	42.13
307	☐	J1922	752.69	2,521.68	J185	-30.71	501.12	1,445.07	20.00	70.72
308	☐	J1500	751.57	2,540.41	J1288	17.35	811.03	1,447.81	20.00	88.90
309	☐	J148	752.91	2,709.27	J201	-30.73	509.08	1,455.53	20.00	74.40
310	☐	J1926	750.90	1,785.10	J201	10.04	603.18	1,477.70	20.00	37.87
311	☐	J1834	751.57	1,965.32	J1882	3.91	589.02	1,487.51	20.00	41.90
312	☐	J234	752.69	3,429.08	J185	-39.37	481.14	1,553.01	20.00	78.62
313	☐	J652	751.12	1,575.69	J652	20.00	516.16	1,575.69	20.00	19.99
314	☐	J1630	501.57	1,732.23	J1072	18.53	1,022.76	1,607.56	20.00	25.91
315	☐	J1072	502.90	1,608.88	J1072	20.00	1,026.16	1,608.88	20.00	20.03
316	☐	J462	753.59	3,049.17	J185	-19.67	526.61	1,694.35	20.00	82.49
317	☐	J1240	753.59	1,789.71	J688	15.23	529.16	1,719.36	20.00	24.77
318	☐	J1336	750.26	2,601.39	J201	-6.41	565.21	1,733.52	20.00	59.05
319	☐	J904	751.34	1,788.96	J201	18.60	622.93	1,734.60	20.00	23.94
320	☐	J382	751.57	3,384.66	J201	-37.37	493.75	1,734.83	20.00	82.76
321	☐	J902	751.85	2,117.19	J201	9.43	601.76	1,735.11	20.00	38.90
322	☐	J1430	753.13	2,643.96	J185	-5.93	558.32	1,742.36	20.00	67.16
323	☐	J346	751.57	3,153.73	J201	-24.88	522.57	1,772.76	20.00	74.93
324	☐	J724	751.79	2,772.59	J1882	-10.32	556.19	1,778.37	20.00	51.20
325	☐	J1194	751.12	3,380.84	J201	-30.50	509.62	1,817.47	20.00	78.38
326	☐	J1278	750.90	1,873.10	J1278	20.00	448.16	1,873.10	20.00	19.94
327	☐	J648	751.12	2,079.54	J1646	13.50	423.16	1,970.65	20.00	26.44
328	☐	J964	752.02	1,981.11	J964	20.00	361.16	1,981.11	20.00	19.96
329	☐	J1402	751.34	2,552.13	J652	9.17	491.16	2,207.96	20.00	30.85
330	☐	J710	752.91	3,069.12	J736	-3.83	463.16	2,210.48	20.00	43.72
331	☐	J16	751.57	3,187.96	J201	-1.20	577.24	2,251.46	20.00	52.90
332	☐	J640	752.91	3,639.53	J1464	-3.94	587.90	2,279.78	20.00	53.68
333	☐	J1634	752.24	3,732.81	J1464	-5.59	584.09	2,288.56	20.00	70.91
334	☐	J974	752.91	3,094.71	J201	2.76	586.37	2,298.36	20.00	47.21
335	☐	J510	751.57	2,762.36	J652	4.80	481.08	2,342.42	20.00	36.20
336	☐	J744	750.00	2,512.69	J1646	12.63	421.16	2,364.54	20.00	27.38
337	☐	J988	750.90	2,503.74	J652	15.27	505.24	2,368.50	20.00	25.12
338	☐	J1918	750.00	2,402.41	J1918	20.00	439.16	2,402.41	20.00	19.90
339	☐	J512	751.57	2,596.96	J652	13.52	501.21	2,409.85	20.00	28.42
340	☐	J910	752.02	2,432.38	J910	20.00	376.16	2,432.38	20.00	19.95
341	☐	J1654	755.82	2,950.43	J652	0.65	471.49	2,445.35	20.00	41.84
342	☐	J548	753.59	4,062.11	J1464	-6.60	581.77	2,457.89	20.00	68.11
343	☐	J1082	750.90	2,501.72	J1082	20.00	395.16	2,499.70	20.00	19.27
344	☐	J1530	750.45	2,824.97	J652	7.99	488.44	2,500.29	20.00	36.25
345	☐	J1696	750.00	2,691.10	J652	14.45	503.34	2,533.03	20.00	26.31
346	☐	J1944	751.12	3,040.83	J652	1.07	472.47	2,539.82	20.00	43.59
347	☐	J926	751.34	2,576.79	J926	20.00	393.16	2,576.79	20.00	19.97
348	☐	J96	751.12	3,042.91	J652	3.82	478.82	2,601.48	20.00	43.86
349	☐	J1849	750.00	3,098.93	J201	11.32	606.13	2,615.07	20.00	34.78
350	☐	J68	751.57	2,700.54	J1698	18.57	402.86	2,673.42	20.00	21.89

Table E-2: South Shore Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
351	☐	J1896	750.00	2,725.65	J1896	20.00	667.16	2,725.62	20.00	20.05
352	☐	J956	750.90	3,695.33	J1896	14.47	654.39	2,726.52	20.00	45.99
353	☐	J1843	751.34	2,799.72	J1896	19.63	666.31	2,726.97	20.00	21.25
354	☐	J844	752.24	2,762.25	J1896	19.83	666.76	2,727.87	20.00	22.06
355	☐	J244	752.24	3,442.06	J1896	16.05	658.05	2,727.87	20.00	40.71
356	☐	J1522	754.48	3,705.61	J1896	14.42	654.29	2,730.10	20.00	36.24
357	☐	J566	755.82	3,046.66	J1896	18.35	663.35	2,731.45	20.00	22.03
358	☐	J1214	751.79	3,819.51	J1464	5.92	610.67	2,759.41	20.00	44.49
359	☐	J818	752.02	3,940.00	J1464	4.91	608.33	2,767.59	20.00	53.98
360	☐	J812	751.57	3,475.08	J652	-2.69	463.80	2,825.94	20.00	48.76
361	☐	J686	751.34	3,130.57	J201	16.48	618.03	2,852.15	20.00	28.58
362	☐	J180	751.57	3,267.55	J652	6.65	485.34	2,869.34	20.00	37.19
363	☐	J1146	752.46	4,113.37	J1896	13.08	651.18	2,892.02	20.00	46.52
364	☐	J70	751.79	3,291.19	J1896	17.92	662.36	2,893.75	20.00	34.13
365	☐	J72	753.80	3,098.83	J1896	18.97	664.77	2,895.54	20.00	27.34
366	☐	J1196	755.37	4,012.16	J1896	13.76	652.76	2,899.47	20.00	45.83
367	☐	J680	750.00	4,241.67	J1896	12.19	649.12	2,907.40	20.00	56.69
368	☐	J440	752.69	3,630.05	J1896	16.15	658.28	2,931.77	20.00	49.84

Table E-3: Existing Eagleridge PHD Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
1	☐	J10	0.00	426.00	571.43	63.01
2	☐	J-NE-19	1.98	409.00	571.43	70.38
3	☐	J-NE-14	7.90	391.00	571.41	78.17
4	☐	J-NE-18	5.94	387.00	571.43	79.91
5	☐	J-NE-11	9.88	382.00	571.41	82.07
6	☐	J-NE-10	1.98	381.14	571.42	82.45
7	☐	J-NE-15	9.88	379.00	571.41	83.37
8	☐	J-NE-17	15.82	376.00	571.45	84.69
9	☐	J-NE-16	9.88	376.00	571.45	84.69
10	☐	J-NE-12	5.94	374.00	571.41	85.54
11	☐	J-NE-21	5.94	372.00	571.42	86.41
12	☐	J-NE-20	1.98	372.00	571.42	86.41
13	☐	J-NE-9	9.88	370.00	571.42	87.27
14	☐	J-NE-1	0.00	324.00	527.29	88.09
15	☐	J-NE-13	11.86	356.00	571.41	93.34
16	☐	J-NE-6	9.88	339.00	571.58	100.78
17	☐	J-NE-7	13.84	337.00	571.53	101.62
18	☐	J-NE-3	0.00	335.00	571.83	102.62
19	☐	J-NE-4	1.98	333.00	571.69	103.42
20	☐	J-NE-8	5.94	331.00	571.52	104.22
21	☐	J-PMP-NE-D	0.00	329.50	606.06	119.83

Table E-3A: Eagleridge PHD Model Results with pump station bypassed by 2.5 inch pipe

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
1	☐	J10	0.00	426.00	512.94	37.67
2	☐	J-NE-19	1.98	409.00	512.94	45.04
3	☐	J-NE-14	7.90	391.00	512.93	52.83
4	☐	J-NE-18	5.94	387.00	512.94	54.57
5	☐	J-NE-11	9.88	382.00	512.93	56.73
6	☐	J-NE-10	1.98	381.14	512.93	57.11
7	☐	J-NE-15	9.88	379.00	512.93	58.03
8	☐	J-NE-17	15.82	376.00	512.96	59.35
9	☐	J-NE-16	9.88	376.00	512.97	59.35
10	☐	J-NE-12	5.94	374.00	512.93	60.20
11	☐	J-NE-21	5.94	372.00	512.94	61.07
12	☐	J-NE-20	1.98	372.00	512.94	61.07
13	☐	J-NE-9	9.88	370.00	512.93	61.93
14	☐	J-NE-13	11.86	356.00	512.93	68.00
15	☐	J-NE-6	9.88	339.00	513.10	75.44
16	☐	J-NE-7	13.84	337.00	513.05	76.28
17	☐	J-NE-3	0.00	335.00	513.34	77.28
18	☐	J-NE-4	1.98	333.00	513.21	78.08
19	☐	J-NE-8	5.94	331.00	513.04	78.88
20	☐	J-NE-1	0.00	324.00	517.29	83.75

Table E-4: Existing Eagleridge MDD + Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
1	☐	J-NE-8	751.80	1,189.06	J-NE-8	20.00	377.16	1,189.06	20.00	19.99
2	☐	J-NE-19	750.00	1,363.31	J10	12.63	455.15	1,304.39	20.00	27.36
3	☐	J-NE-20	750.60	1,401.17	J10	7.85	444.11	1,304.99	20.00	33.53
4	☐	J-NE-21	751.80	1,356.69	J10	13.70	457.61	1,306.19	20.00	27.46
5	☐	J-NE-18	751.80	1,472.76	J10	3.10	433.15	1,336.76	20.00	36.90
6	☐	J-NE-14	752.39	1,437.36	J10	9.44	447.79	1,350.35	20.00	31.06
7	☐	J-NE-15	752.99	1,441.33	J10	9.02	446.82	1,350.95	20.00	32.03
8	☐	J-NE-12	751.80	1,483.17	J10	4.52	436.43	1,356.18	20.00	36.55
9	☐	J-NE-13	753.59	1,491.58	J10	3.68	434.50	1,357.97	20.00	38.54
10	☐	J-NE-16	752.99	1,532.12	J10	-1.06	423.55	1,360.80	20.00	41.18
11	☐	J-NE-17	754.78	1,477.24	J10	6.11	440.09	1,362.59	20.00	34.97
12	☐	J-NE-11	752.99	1,447.75	J10	10.44	450.08	1,367.65	20.00	30.51
13	☐	J-NE-10	750.60	1,416.77	J10	14.40	459.22	1,369.28	20.00	26.45
14	☐	J-NE-9	752.99	1,483.60	J10	6.57	441.17	1,371.67	20.00	34.89
15	☐	J-NE-7	754.18	1,679.64	J10	-11.13	400.31	1,423.86	20.00	53.10
16	☐	J-NE-6	752.99	1,743.74	J10	-17.71	385.13	1,436.62	20.00	57.71
17	☐	J-NE-4	750.60	1,807.10	J10	-20.31	379.12	1,473.23	20.00	60.30

Table E-5: Agate Heights PHD Model Results

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
1	☐	J-AG-19	0.00	550.29	568.36	7.83
2	☐	J-AG-06	0.00	528.29	568.35	17.36
3	☐	J-AG-05	0.00	528.29	569.54	17.87
4	☐	J-AG-26	8.53	467.00	568.29	43.89
5	☐	J-AG-08	6.14	393.00	524.93	57.16
6	☐	J-AG-27	10.68	428.29	568.29	60.66
7	☐	J-AG-15	19.79	698.29	842.00	62.27
8	☐	J-AG-14	0.00	690.00	842.01	65.87
9	☐	J14	6.52	596.00	748.01	65.87
10	☐	J-AG-10	3.05	372.00	524.92	66.26
11	☐	J-AG-09	4.59	364.00	524.92	69.73
12	☐	J-AG-07	2.15	403.00	568.29	71.62
13	☐	J-AG-18	0.00	676.00	842.00	71.93
14	☐	J-AG-04	0.00	395.29	569.60	75.53
15	☐	J-AG-11	7.68	346.29	524.92	77.40
16	☐	J-AG-03	0.00	381.29	569.64	81.61
17	☐	J-AG-12	6.14	334.00	524.92	82.72
18	☐	J-AG-01	0.00	368.29	569.76	87.29
19	☐	J12	14.68	538.00	748.01	91.00
20	☐	J-AG-02	0.00	358.29	569.67	91.59
21	☐	J-AG-16	0.00	599.00	842.00	105.29
22	☐	J-AG-17	0.00	599.00	842.02	105.30
23	☐	J-AG-25	0.00	539.00	842.35	131.44
24	☐	J-AG-20	0.00	536.00	842.35	132.74

Table E-6: Agate Heights Fire Flow Model Results

		ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)	Design Pressure (psi)	Design Fire Node Pressure (psi)
1	☐	J-AG-07	750.35	2,647.92	J-AG-26	-7.73	449.16	1,604.33	20.00	47.73
2	☐	J-AG-08	751.39	2,265.57	J-AG-26	3.80	475.76	1,605.37	20.00	43.67
3	☐	J-AG-09	751.04	2,264.25	J-AG-26	3.82	475.83	1,605.02	20.00	49.56
4	☐	J-AG-10	750.69	1,704.98	J-AG-26	17.84	508.18	1,604.67	20.00	26.29
5	☐	J-AG-11	751.74	2,236.23	J-AG-26	4.63	477.68	1,605.72	20.00	52.29
6	☐	J-AG-12	751.39	1,729.72	J-AG-26	17.31	506.95	1,605.37	20.00	29.78
7	☐	J-AG-14	750.00	2,010.83	J-AG-15	16.41	736.17	1,906.18	20.00	23.59
8	☐	J-AG-15	753.82	1,519.27	J-AG-15	20.00	744.45	1,519.27	20.00	20.00
9	☐	J-AG-16	750.00	2,071.27	J-AG-15	0.37	699.14	1,622.27	20.00	48.13
10	☐	J-AG-17	750.00	1,761.41	J-AG-15	14.64	732.08	1,628.47	20.00	30.44
11	☐	J-AG-18	750.00	1,847.78	J-AG-15	10.34	722.16	1,617.05	20.00	29.66
12	☐	J-AG-26	751.39	1,145.48	J-AG-26	20.00	513.16	1,145.48	20.00	20.00
13	☐	J-AG-27	751.74	1,899.42	J-AG-26	3.23	474.45	1,334.26	20.00	36.77

Appendix F – Financial Data

6-year Operating Income and Expenses
2017-2018 Operating Budget
Master Fees and Charges Schedule

Lake Whatcom Water and Sewer District
Fund Resources and Uses Arising from Cash Transactions
For the Year Ended December 31, 2016

Beginning Cash and Investments		
30810	Reserved	576,111
30880	Unreserved	2,561,577
388 / 588	Prior Period Adjustments, Net	-
Revenues		
310	Taxes	-
320	Licenses and Permits	-
330	Intergovernmental Revenues	1,064,741
340	Charges for Goods and Services	6,045,677
350	Fines and Penalties	84,137
360	Miscellaneous Revenues	78,698
Total Revenues:		7,273,252
Expenditures		
530	Utilities	4,103,639
Total Expenditures:		4,103,639
Excess (Deficiency) Revenues over Expenditures:		3,169,614
Other Increases in Fund Resources		
391-393, 596	Debt Proceeds	7,338,843
397	Transfers-In	-
385	Special or Extraordinary Items	-
386 / 389	Custodial Activities	-
381, 395, 398	Other Resources	-
Total Other Increases in Fund Resources:		7,338,843
Other Decreases in Fund Resources		
594-595	Capital Expenditures	1,770,174
591-593, 599	Debt Service	6,968,016
597	Transfers-Out	-
585	Special or Extraordinary Items	-
586 / 589	Custodial Activities	62,890
Total Other Decreases in Fund Resources:		8,801,080
Increase (Decrease) in Cash and Investments:		**1,707,377**
Ending Cash and Investments		
5081000	Reserved	861,673
5088000	Unreserved	3,983,391
Total Ending Cash and Investments		**4,845,064**

The accompanying notes are an integral part of this statement.

Lake Whatcom Water and Sewer District
Fund Resources and Uses Arising from Cash Transactions
For the Year Ended December 31, 2015

Beginning Cash and Investments		
30810	Reserved	524,448
30880	Unreserved	2,127,214
388 & 588	Prior Period Adjustments, Net	-
Operating Revenues		
310	Taxes	-
320	Licenses and Permits	-
330	Intergovernmental Revenues	1,889,661
340	Charges for Goods and Services	5,701,207
350	Fines and Penalties	59,921
360	Miscellaneous Revenues	85,031
Total Operating Revenues:		7,735,820
Operating Expenditures		
530	Utilities	3,859,569
598	Miscellaneous Expenses	-
Total Operating Expenditures:		3,859,569
Net Operating Increase (Decrease):		3,876,251
Nonoperating Revenues		
370-380, 395 & 398	Other Financing Sources	100,849
391-393	Debt Proceeds	-
397	Transfers-In	-
Total Nonoperating Revenues:		100,849
Nonoperating Expenditures		
580, 596 & 599	Other Financing Uses	-
591-593	Debt Service	758,573
594-595	Capital Expenditures	2,732,501
597	Transfers-Out	-
Total Nonoperating Expenditures:		3,491,074
Net Increase (Decrease) in Cash and Investments:		**486,026**
Ending Cash and Investments		
5081000	Reserved	576,111
5088000	Unreserved	2,561,577
Total Ending Cash and Investments		**3,137,688**

The accompanying notes are an integral part of this statement.

Lake Whatcom Water and Sewer District
Fund Resources and Uses Arising from Cash Transactions
For the Year Ended December 31, 2014

Beginning Cash and Investments		
30810	Reserved	563,840
30880	Unreserved	2,006,925
388 & 588	Prior Period Adjustments, Net	-
Operating Revenues		
310	Taxes	-
320	Licenses and Permits	-
330	Intergovemmental Revenues	175,649
340	Charges for Goods and Services	5,270,575
350	Fines and Penalties	64,178
360	Miscellaneous Revenues	139,098
Total Operating Revenues:		5,649,500
Operating Expenditures		
530	Utilities	3,891,029
Total Operating Expenditures:		3,891,029
Net Operating Increase (Decrease):		1,758,471
Nonoperating Revenues		
370-380, 395 & 398	Other Financing Sources	103,654
391-393	Debt Proceeds	-
397	Transfers-In	-
Total Nonoperating Revenues:		103,654
Nonoperating Expenditures		
580, 596 & 599	Other Financing Uses	-
591-593	Debt Service	512,858
594-595	Capital Expenditures	1,268,369
597	Transfers-Out	-
Total Nonoperating Expenditures:		1,781,227
Net Increase (Decrease) in Cash and Investments:		**80,898**
Ending Cash and Investments		
5081000	Reserved	566,495
5088000	Unreserved	2,085,167
Total Ending Cash and Investments		**2,651,662**

The accompanying notes are an integral part of this statement.

MCAG NO. 2330

Lake Whatcom Water and Sewer District

STATEMENT C-4

FUND RESOURCES AND USES ARISING FROM CASH TRANSACTIONS

For the Year Ended December 31, 2013

BARS Code		401 Enterprise
Beginning Cash and Investments		
30810	Beg Fund Bal-Reserved	4,539,666
30880	Beg Fund Bal-Unreserved	474,708
38800/58800	Prior Period Adjustments, net	0
Operating Revenues		
310	Taxes	0
320	Licenses & Permits	0
330	Intergovernmental Revenues	0
340	Charges for Goods and Services	5,030,581
350	Fines & Penalties	79,026
360	Miscellaneous Revenues	97,718
Total Operating Revenues:		5,207,325
Operating Expenditures		
530	Utilities	3,716,959
598	Intergovernmental Payments	0
Total Operating Expenditures:		3,716,959
Net Operating Increase (Decrease):		1,490,366
Nonoperating Revenues		
370, 380, 395, 398	Other Financing Sources	95,824
391-393	Debt Proceeds	0
397	Transfers-In	0
Total Nonoperating Revenues:		95,824
Nonoperating Expenditures		
580, 596, 599	Other Financing Uses	0
591-593	Debt Service	3,324,893
594-595	Capital Expenditures	704,906
597	Transfers-Out	0
Total Nonoperating Expenditures:		4,029,799
Increase (Decrease) in Cash and Investments		-2,443,609
Ending Cash and Investments		
50810	End Fund Bal-Reserved	563,840
50880	End Fund Balance-Unreserved	2,006,925

The accompanying notes are an integral part of this Statement.

MCAG NO. 2330

Lake Whatcom Water and Sewer District

STATEMENT C-4

FUND RESOURCES AND USES ARISING FROM CASH TRANSACTIONS

For the Year Ended December 31, 2012

BARS Code		401 Enterprise
Beginning Cash and Investments		
30810	Beg Fund Bal-Reserved	4,964,558
30880	Beg Fund Bal-Unreserved	227,342
38800/58800	Prior Period Adjustments, net	0
Operating Revenues		
310	Taxes	0
320	Licenses & Permits	0
330	Intergovernmental Revenues	0
340	Charges for Goods and Services	4,640,410
350	Fines & Penalties	0
360	Miscellaneous Revenues	252,808
Total Operating Revenues:		4,893,218
Operating Expenditures		
530	Utilities And Environment	3,524,225
598	Intergovernmental Payments	0
Total Operating Expenditures:		3,524,225
Net Operating Increase (Decrease):		1,368,993
Nonoperating Revenues		
370, 380, 395, 398	Other Financing Sources	93,199
391-393	Debt Proceeds	0
397	Transfers-In	0
Total Nonoperating Revenues:		93,199
Nonoperating Expenditures		
580, 596, 599	Other Financing Uses	0
591-593	Debt Service	848,917
594-595	Capital Expenditures	791,977
597	Transfers-Out	0
Total Nonoperating Expenditures:		1,640,894
Increase (Decrease) in Cash and Investments		-178,702
Ending Cash and Investments		
50810	End Fund Bal-Reserved	4,539,661
50880	End Fund Balance-Unreserved	473,537

The accompanying notes are an integral part of this Statement.

MCAG NO. 2330

LAKE WHATCOM WATER AND SEWER DISTRICT

STATEMENT OF ACTIVITIES ARISING FROM CASH TRANSACTIONS
For the Year Ended December 31, 2011

OPERATING RECEIPTS		
Combined Water/Sewer Sales		$ 4,378,245
Miscellaneous		108,818
	Total Operating Receipts	4,487,063
OPERATING DISBURSEMENTS		
Combined Water/Sewer - Salaries		1,210,935
Combined Water/Sewer - Benefits		442,896
Combined Water/Sewer - Supplies		198,488
Combined Water/Sewer - Services		1,720,824
Other Operating Expenditures		30,855
	Total Operating Expenses	3,603,998
	Operating Income	883,065
NON-OPERATING RECEIPTS		
Investment Income		88,714
Capital Contributions		62,741
Interest on Assessments		43,617
Special Assessments		66,417
	Total Nonoperating Receipts	261,489
NON-OPERATING DISBURSEMENTS		
Purchase of Capital Assets		2,383,892
Long-term Debt Payments - Principal		526,224
Long-term Debt Payments - Interest		326,636
	Total Nonoperating Disbursements	3,236,752
Net decrease in net cash and investments		(2,092,198)
Beginning balance of cash and investments		7,284,098
Unreserved ending		227,342
Reserved ending		4,964,558
Ending balance of cash and investments		$ 5,191,900

See accountants' compilation report and notes to financial statements.

LAKE WHATCOM WATER AND SEWER FUND SUMMARY 2017

	401 OPERATING	420 SYSTEM REINVESTMENT	425 SEWER/ STORM WATER CONTINGENCY	426 WATER CONTINGENCY	431 2016 BOND FUND	440 DWSRF PROJECTS	450 DEBT SERVICE	460 BOND RESERVE (RESTRICTED)	TOTAL
2017 REVENUES AND TRANSFERS IN	6,298,017	1,668,000	103,750	2,500	-	229,950	890,172	3,850	9,196,239
2017EXPENDITURES AND TRANSFERS OUT	(6,928,728)	(1,668,000)	(210,200)	-	(156,923)	(1,058,100)	(913,162)	(200)	(10,935,313)
CASH/INVESTMENTS 2016 CARRYOVER	1,750,000	-	887,000	440,000	156,923	828,150	22,990	773,200	4,858,263
PROPOSED 2017 YEAR END BALANCE	**$1,119,289**	**$0**	**$780,550**	**$442,500**	**$0**	**$0**	**$0**	**$776,850**	**$3,119,189**
ALLOCATED TO OPERATING RESERVES	**-$800,000**								
AVAILABLE 2017 YEAR END BALANCE	**$319,289**								

LAKE WHATCOM WATER AND SEWER FUND SUMMARY 2018

	401 OPERATING	420 SYSTEM REINVESTMENT	425 SEWER/ STORM WATER CONTINGENCY	426 WATER CONTINGENCY	431 2016 BOND FUND	450 DEBT SERVICE	460 BOND RESERVE (RESTRICTED)	TOTAL
2018 REVENUES AND TRANSFERS IN	6,693,348	1,505,000	60,000	120,000	-	938,885	-	9,317,233
2018 EXPENDITURES AND TRANSFERS OUT	(7,147,277)	(2,005,000)	(60,000)	(120,000)	(590,000)	(938,885)	-	(10,861,162)
CASH/INVESTMENTS 2017 CARRYOVER	1,750,000	500,000	770,000	440,000	590,000	-	772,350	4,822,350
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PROPOSED 2018 YEAR END BALANCE	**$1,296,071**	**$0**	**$770,000**	**$440,000**	**$0**	**$0**	**$772,350**	**$3,278,421**
ALLOCATED TO OPERATING RESERVES	**-$850,000**							
AVAILABLE 2018 YEAR END BALANCE	**$446,071**							

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

Administrative Fees			
Item	**Item Description**	**Fee/Charge**	**Reference**
1	**Equipment Charge, Hourly**		
	Air Compressor - Ingersol/Rand 185 CFM Diesel	$20.00	Resolution 798
	Backhoe - John Deere 580D	$45.00	
	Boom Truck - 6,000 Pound	$30.00	
	Combination Vacuum/Flush Truck	$100.00	
	Sewer Camera Van	$75.00	
	Dump Truck - 2-Yard	$25.00	
	Dump Truck - 5-Yard	$45.00	
	Equipment Trailer - 14,000 Pound	$15.00	
	Flush Truck	$65.00	
	Portable Engine Pump - 600 gpm @130-Feet	$40.00	
	Portable Generator - 75 kw	$45.00	
	Portable Generator - 250 kw	$85.00	
	Tanker Truck - 3,000 Gallon	$75.00	
	Tool Truck	$20.00	
2	**Information Reproduction**		
	Digital Recording - Board Meeting	$35.00	Resolution 680
	Document - Standard Size - Less than 10 Pages	No Charge	Resolution 680
	Document - Standard Size - More than 10 Pages	$0.15 per page	Resolution 717
	Document - Non-Standard Size - Deposit	$50.00	Resolution 680
	Document - Non-Standard Size - Reproduction	Cost	Resolution 680
3	**Labor, Hourly**		
	Accounting Clerk	$34.00	Resolution 798 Direct Labor Costs
	Accounts Payable/Payroll	$38.00	
	Accounts Receivable	$38.00	
	Administrative Assistant	$46.00	
	Construction Engineer	$53.00	
	District Engineer	$71.00	
	Engineering Technician	$42.00	
	Finance Manager	$62.00	
	General Manager	$80.00	
	Maintenance Electrician	$53.00	
	Maintenance Supervisor	$57.00	
	Maintenance worker	$42.00	
	Utility Systems Support Specialist	$42.00	
	Water Treatment Plant Operator	$46.00	
	Wilson Engineering Consultation - Current Hourly Rate + 10%		Resolution 798
4	**Document Recording Fees**		
	Document Recording	$105.00	Resolution 753
	Lien Record/Release	$100.00	Resolution 839
	Transfer, real estate closing	$30.00	Resolution 806

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

Administrative Fees (cont'd)			
Item	**Item Description**	**Fee/Charge**	**Reference**
4	**Document Recording Fees**		
	Segregation of assessment, equivalent residential units and water/sewer permits	$100.00	Resolution 819
	Assessment Transfer	$250.00	Resolution 680
5	Payment Return Item	$25.00	Resolution 820

Billing - Sewer Service					
Item	**Item Description**			**Fee/Charge**	**Reference**
6	**Regular Customer Charge Per Billing Cycle - Sewer**				
	Effective January 1, 2015	Account Charge	$7.03		Resolution 806
		Volume Charge per dwelling unit	$141.00		
		Total Billing Cycle Charge		$148.03	
		Low Income/Senior/Disabled Rate (40% Discount)		$88.82	
	Effective January 1, 2016	Account Charge	$7.21		Resolution 806
		Volume Charge per dwelling unit	$144.53		
		Total Billing Cycle Charge		$151.74	
		Low Income/Senior/Disabled Rate (40% Discount)		$91.04	
	Effective January 1, 2017	Account Charge	$7.39		Resolution 806
		Volume Charge per dwelling unit	$148.14		
		Total Billing Cycle Charge		$155.53	
		Low Income/Senior/Disabled Rate (40% Discount)		$93.32	
	Effective January 1, 2018	Account Charge	$7.57		Resolution 806
		Volume Charge per dwelling unit	$151.85		
		Total Billing Cycle Charge		$159.42	
		Low Income/Senior/Disabled Rate (40% Discount)		$95.65	
	Effective January 1, 2019	Account Charge	$7.76		Resolution 806
		Volume Charge per dwelling unit	$155.64		
		Total Billing Cycle Charge		$163.40	
		Low Income/Senior/Disabled Rate (40% Discount)		$98.04	
7	Late Fee 1 late fee per account per year refundable with General Manager's approval			10% of past due utility services balance	RCW 57.08.081(3)
8	Bulk Sewage Disposal			$100.00 + $0.0018/gallon	Latest actual bill from COB

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

Billing - Water Sales				
Item	**Item Description**		**Fee/Charge**	**Reference**
9	**Regular Customer Charge Per Billing Cycle - Up to 600 cubic feet of water**			
	Effective January 1, 2015	5/8 x 3/4 Inch Meter	$52.68	Resolution 806
		Low Income/Senior/Disabled Rate	$31.61	
		1 Inch Meter	$69.88	
		1.5 Inch Meter	$96.40	
		2 Inch Meter	$133.19	
		3 Inch Meter	$263.40	
		Usage over 600 cubic feet (per 100 cubic feet)	$7.48	
		Low Income/Senior/Disabled Rate	$4.49	
		Usage over 2,500 cubic feet (per 100 cubic feet)	$9.35	
		Low Income/Senior/Disabled Rate	$5.61	
	Effective January 1, 2016	5/8 x 3/4 Inch Meter	$57.29	Resolution 806
		Low Income/Senior/Disabled Rate	$34.37	
		1 Inch Meter	$75.99	
		1.5 Inch Meter	$104.83	
		2 Inch Meter	$144.84	
		3 Inch Meter	$286.45	
		Usage over 600 cubic feet (per 100 cubic feet)	$8.13	
		Low Income/Senior/Disabled Rate	$4.88	
		Usage over 2,500 cubic feet (per 100 cubic feet)	$10.17	
		Low Income/Senior/Disabled Rate	$6.10	
	Effective January 1, 2017	5/8 x 3/4 Inch Meter	$62.31	Resolution 806
		Low Income/Senior/Disabled Rate	$37.39	
		1 Inch Meter	$82.64	
		1.5 Inch Meter	$114.00	
		2 Inch Meter	$157.52	
		3 Inch Meter	$311.51	
		Usage over 600 cubic feet (per 100 cubic feet)	$8.85	
		Low Income/Senior/Disabled Rate	$5.31	
		Usage over 2,500 cubic feet (per 100 cubic feet)	$11.06	
		Low Income/Senior/Disabled Rate	$6.64	
	Effective January 1, 2018	5/8 x 3/4 Inch Meter	$67.60	Resolution 806
		Low Income/Senior/Disabled Rate	$40.56	
		1 Inch Meter	$89.67	
		1.5 Inch Meter	$123.69	
		2 Inch Meter	$170.91	
		3 Inch Meter	$337.99	
		Usage over 600 cubic feet (per 100 cubic feet)	$9.60	
		Low Income/Senior/Disabled Rate	$5.76	
		Usage over 2,500 cubic feet (per 100 cubic feet)	$12.00	
		Low Income/Senior/Disabled Rate	$7.20	

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

Billing - Water Sales (cont'd)				
Item	**Item Description**		**Fee/Charge**	**Reference**
9	**Effective January 1, 2019**	5/8 x 3/4 Inch Meter	$70.31	Resolution 806
		Low Income/Senior/Disabled Rate	$42.19	
		1 Inch Meter	$93.25	
		1.5 Inch Meter	$128.64	
		2 Inch Meter	$177.74	
		3 Inch Meter	$351.51	
		Usage over 600 cubic feet (per 100 cubic feet)	$9.98	
		Low Income/Senior/Disabled Rate	$5.99	
		Usage over 2,500 cubic feet (per 100 cubic feet)	$12.48	
		Low Income/Senior/Disabled Rate	$7.49	
10	Late Fee 1 late fee per account per year refundable with General Manager's approval		10% of past due utility services balance	RCW 57.08.081(3)

Miscellaneous Water Charges			
Item	**Item Description**	**Fee/Charge**	**Reference**
11	**Water Interruption - Voluntary - With Billing Suspension**		
	Lock Curb Stop Valve - during normal business hours	$150.00	Resolution 661
	Lock Curb Stop Valve - outside normal business hours	$175.00	
	Unlock Curb Stop Valve - during normal business hours	No charge	
	Unlock Curb Stop Valve - outside normal business hours	$150.00	
	Water Interruption - Voluntary - Without Billing Suspension		
	Lock Curb Stop Valve	$50.00	Resolution 661
	Unlock Curb Stop Valve - during normal business hours	No charge	
	Unlock Curb Stop Valve - outside normal business hours	$150.00	
12	**Water Interruption - Involuntary**		
	Delinquent Account - Lock curb stop valve	$50.00	Resolution 661
	Unlock Curb Stop Valve		
	During Normal Business Hours	No charge	
	Outside Normal Business Hours	$150.00	
13	**Water Interruption - Other**		
	Failure to comply with emergency order	Same as above	Resolution 661
	Failure to eliminate cross connection	Same as above	
	Failure to repair leak	Same as above	
	Request of agency/higher authoirty	No charge	
	Visible leak in vacant building or disaster	No charge	
14	**Unauthorized Lock Removal Fee** When customer cuts or removes lock from meter without District authorization	$150.00	Resolution 726
15	**Damaged Meter** If meter is damaged by the customer	Material & labor to repair meter + $150.00	Resolution 726

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

Miscellaneous Water Charges (cont'd)			
Item	**Item Description**	**Fee/Charge**	**Reference**
16	**Clear obstructed water meter** after request to customer to remove is refused	$50.00	Board Meeting 11/10/99
17	**Hydrant meter, fire hose, fittings**		
	Equipment rental - single continuous use	$35.00	Board Mtg 11/10/99
	Bulk water purchase with hydrant meter		
	Effective Nov 8, 2017 - Per 100 cubic feet	$8.85	Resolution 839
	Effecitve Jan 1, 2018 - Per 100 cubic feet	$9.60	
	Effective Jan 1, 2019 - Per 100 cubic feet	$9.98	

Developer Extension Agreements			
Item	**Item Description**	**Fee/Charge**	**Reference**
18	**Initial Fees**		
	Application - Good for 60 days	$300.00	Resolution 680
	Conformance Deposit	$1,000.00	Resolution 680
	General Administration	$750.00	Resolution 680
19	**Final Design Review**		
	By District Engineer	Cost + 2%	Resolution 680
20	**Design Review and Inspection** *(Previously called "Facilities Inspection")*		
	Initial Deposit	$5,000.00	Resolution 680
	Supplemental Deposit	$2,000.00	Resolution 680
21	Contract noncompliance	Cost + 2%	Board Mtg 5/14/97
22	Latecomers Reimbursement Agreements, Reimbursement processing	$185.00 per connection	Board Mtg 6/10/09 + Resolution 753
23	Special Agreements	Cost + 2%	Board Mtg 5/14/97
24	Third Party Claims	Cost + 2%	
25	**Time Extension**		
	Before Expiration Date	$250.00	
	After Expiration Date	$750.00	

Permitting - Water Permits

	Meter Size	Continuous Flow Rating	Meter Capacity Ratio
Meter Information	5/8 x 3/4	15	1
	1 Inch	30	2
	1.5 Inch	75	5
	2 Inch	120	8
	3 Inch Compound	330	22
	4 Inch Compound	440	29

Permitting - Water Permits (cont'd)					
Item	**Item Description**			**Fee/Charge**	**Reference**
26	**Water General Facilities & Installation**				
	** Installation fees marked with an * vary by project, please see District Engineer with questions.*				
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2009	5/8 x 3/4	$4,110.00	$700.00	Resolution 747
		1 Inch	$8,220.00	*	
		1.5 Inch	$20,550.00	*	
		2 Inch	$32,880.00	$4,200.00	
		3 Inch Compound	$90,420.00	*	
		4 Inch Compound	$120,546.30	*	
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2018	5/8 x 3/4	$5,742.00	$700.00	Resolution 835
		1 Inch	$11,484.00	*	
		1.5 Inch	$28,710.00	*	
		2 Inch	$45,935.00	$4,200.00	
		3 Inch Compound	$126,322.00	*	
		4 Inch Compound	$168,411.00	*	
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2019	5/8 x 3/4	$5,885.00	$700.00	Resolution 835
		1 Inch	$11,771.00	*	
		1.5 Inch	$29,427.00	*	
		2 Inch	$47,084.00	$4,200.00	
		3 Inch Compound	$129,480.00	*	
		4 Inch Compound	$172,621.00	*	
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2020	5/8 x 3/4	$6,033.00	$700.00	Resolution 835
		1 Inch	$12,065.00	*	
		1.5 Inch	$30,163.00	*	
		2 Inch	$48,261.00	$4,200.00	
		3 Inch Compound	$132,717.00	*	
		4 Inch Compound	$176,936.00	*	
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2021	5/8 x 3/4	$6,183.00	$700.00	Resolution 835
		1 Inch	$12,367.00	*	
		1.5 Inch	$30,917.00	*	
		2 Inch	$49,467.00	$4,200.00	
		3 Inch Compound	$136,035.00	*	
		4 Inch Compound	$181,360.00	*	
27	Permit Administration & Processing			$40.00	Board Mtg 1/30/03
	Initial Water Inspection			$25.00	Resolution 667
	Subsequent Water Inspection			$75.00	Board Mtg 8/16/96

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

Permitting - Water Permits (cont'd)			
Item	**Item Description**	**Fee/Charge**	**Reference**
28	**Water Permit - Special Charges**		
	Blaine Water Main Extension Latecomer's (North Shore)	$10,910.00	Expires 8/25/2024
	Columbus Street Water Latecomer's Fee (Geneva)	$528.50	Expires 3/24/2018
	Coronado Heights Phase 2 Water	$1,627.58	Expires 3/24/2018
	North Shore and Eagleridge/COB Reimbursement	$300.00	6/10/88 Agreemt
	South Geneva Class A Water	$17,088.97	Expires 7/22/2026
	South Geneva Class B Water	$5,981.14	Expires 7/22/2026

Permitting - Sewer Permits

	Meter Size	Meter Capacity Ratio
Meter Information	5/8 x 3/4	1
	1 Inch	2
	1.5 Inch	5
	2 Inch	8
	3 Inch Compound	22
	4 Inch Compound	29

Item	**Item Description**			**Fee/Charge**	**Reference**
29	**Sewer General Facilities**				
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2009	5/8 x 3/4	$5,201.00	Done by owner's bonded side sewer contractor	Resolution 747
		1 Inch	$10,402.00		
		1.5 Inch	$26,005.00		
		2 Inch	$41,608.00		
		3 Inch Compound	$114,422.00		
		4 Inch Compound	$152,545.33		
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2018	5/8 x 3/4	$7,726.00	Done by owner's bonded side sewer contractor	Resolution 835
		1 Inch	$15,452.00		
		1.5 Inch	$38,631.00		
		2 Inch	$61,809.00		
		3 Inch Compound	$169,975.00		
		4 Inch Compound	$226,607.00		
		Meter Size	Connection Fee	Installation	
	Effective January 1, 2019	5/8 x 3/4	$7,919.00	Done by owner's bonded side sewer contractor	Resolution 835
		1 Inch	$15,839.00		
		1.5 Inch	$39,596.00		
		2 Inch	$63,354.00		
		3 Inch Compound	$174,224.00		
		4 Inch Compound	$232,273.00		

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

Item	Item Description			Fee/Charge	Reference
Permitting - Sewer Permits (cont'd)					
	Effective January 1, 2020	Meter Size	Connection Fee	Installation	Resolution 835
		5/8 x 3/4	$8,117.00	Done by owner's bonded side sewer contractor	
		1 Inch	$16,235.00		
		1.5 Inch	$40,586.00		
		2 Inch	$64,938.00		
		3 Inch Compound	$178,580.00		
		4 Inch Compound	$238,079.00		
	Effective January 1, 2021	Meter Size	Connection Fee	Installation	Resolution 835
		5/8 x 3/4	$8,320.00	Done by owner's bonded side sewer contractor	
		1 Inch	$16,640.00		
		1.5 Inch	$41,601.00		
		2 Inch	$66,562.00		
		3 Inch Compound	$183,044.00		
		4 Inch Compound	$244,031.00		
30	Service Installation - If District installed stub exists			$755.00	
	Permit Processing			$40.00	
	Initial Sewer Inspection			$75.00	
	Subsequent Sewer Inspection			$100.00	
31	**Sewer Permit - Special Charges**				
	Bergen Sewer Latecomer's Fee			$4,195.67	Expires 7/24/2018
	Edgewood Long Plat Sewer			$4,102.00	Expires 2/24/2019
	Lakewood/Grand Blvd Special Benefit Fee			$6,000.00	District Funded
	La Salle Sewer Extension			$4,761.73	Expires 7/13/2021
	South Geneva Class A Sewer			$22,406.50	Expires 7/22/2026
	South Geneva Class A Sewer Vault			$1,704.55	Expires 7/22/2026
	ULID #18 Latecomers Fee - see table below			See table	Resolution 672
32	**Other Sewer Charges**				
	Grinder Pump Installation - Customer own/maintain			$150.00	Resolution 645
	Review waiver of claim agreements for customer owned side sewers with less than 2% slope			$50.00	Resolution 645
	Unauthorized Connection to Sewer				
	Investigation, testing, inspection			$500.00	Resolution 645
	Repair and Correction			Cost + 2%	Resolution 645
	Disconnect monitoring/enforcement after 90 days			$25.00/day	Board Mtg 8/29/03
	Voluntary Sewer Service Interruption				
	Permit to install two-way clean out			Permit processing & inspection fee	
	Suspend billing - insert plug into side sewer			$250.00	Resolution 709
	Resume billing/remove plug - during regular business hours			No charge	
	Resume billing/remove plug - outside regular business hours			$150.00	

MASTER FEES & CHARGES - SCHEDULE 25

Effective Date November 8, 2017 (Resolution 839)

ULID #18 Latecomer Fee

	Year	Equivalent to Assessment	Latecomer Penalty	Total Fee	Reference
33	2016	$2,792.78	$3,714.40	$6,507.18	Resolution 672
	2017	$2,792.78	$3,979.71	$6,772.49	
	2018	$2,792.78	$4,245.03	$7,037.81	
	2019	$2,792.78	$4,510.34	$7,303.12	
	2020	$2,792.78	$4,775.65	$7,568.43	
	2021	$2,792.78	$5,040.97	$7,833.75	
	2022	$2,792.78	$5,306.28	$8,099.06	

NOTE: As described in Resolution 672, ULID #18 Latecomer Charges were created to put parcels not assessed on the same footing as those that were assessed for the ULID. Assessed parcels could, and many did, prepay their assessments. To provide the same opportunity for non-assessed parcels, prepayment of ULID 18 Latecomer Charges will also be accepted. Therefore, paid in full ULID Latecomer Charges satisfy the ULID Latecomer Charges permanently.

Violations of Administrative Code

34	Labor	Staff hourly rates - See page 2	Resolution 798
	Equipment Use	Hourly rate - See page 2	
	Materials	Cost of materials used	
	Attorney's Fees and Expenses	Reimburse District's Costs	
	Administrative Fee	10% of total expenses	

Any person who violates any provision of the Administrative Code shall be liable to the District for any expense, loss, damage, cost of inspection or cost of correction incurred by the District by reason of such violation, including any expenses and attorney fees incurred by the District in collecting from such person of such loss, damage, expense, cost of inspection or cost of correction, plus an administrative fee equal to 10% of the total expenses.
(Reference: Administrative Code Section 3.3.1 Liability to District)

Appendix G – District Standard Document Templates

Water and/or Sewer Permit Application
Developer Extension Agreement Application
Developer Extension Agreement

2018 New Customer

Water & Sewer Permit Application Packet

Last updated 12/7/2017

Table of Contents

PERMITS ARE ISSUED BY APPOINTMENT ONLY

- Complete your permit application packet and return to the Lake Whatcom Water & Sewer District office.
- When the permit is ready a District representative will contact you to set up your permit intake and payment appointment.

Engineering Office Hours | Monday to Thursday, 8 am to 4 pm

Connection Fee Components & Charges

Last Updated 11/1/2017

	2017	EFFECTIVE DATE January 1 2018	January 1 2019	January 1 2020	January 1 2021
WATER					
General Facilities (5/8"x3/4" Water Meter)	$ 4,110	$ 5,742	$ 5,885	$ 6,033	$ 6,183
Service Installation	$ 700	$ 700	$ 700	$ 700	$ 700
Permit Processing	$ 40	$ 40	$ 40	$ 40	$ 40
Initial Inspection	$ 25	$ 25	$ 25	$ 25	$ 25
Total Water Connection Charge	**$ 4,875**	**$ 6,507**	**$ 6,650**	**$ 6,798**	**$ 6,948**
SEWER[1]					
Sewer Facilities	$ 5,201	$ 7,726	$ 7,919	$ 8,117	$ 8,320
Permit Processing	$ 40	$ 40	$ 40	$ 40	$ 40
Initial Inspection	$ 75	$ 75	$ 75	$ 75	$ 75
Total Sewer Connection Charge	**$ 5,316**	**$ 7,841**	**$ 8,034**	**$ 8,232**	**$ 8,435**
Total Water & Sewer Connection Charge	**$ 10,191**	**$ 14,348**	**$ 14,684**	**$ 15,030**	**$ 15,383**

Other Fees or Charges

ITEM	WATER	SEWER	EXPIRES
Bergen Sewer		$4,195.67	7/24/2018
Blaine Water Main Extension	$10,910.00		8/25/2024
COB Reservoir Reimbursement Fee[2]	$300.00		N/A
Columbus St. Water Latecomer's Fee[3]	$528.50		3/24/2018
Coronado Heights Phase 2 Water	$1,627.58		3/14/2018
Edgewood Long Plat Sewer		$4,102.00	2/24/2019
Lakewood/Grand Blvd Special Benefit Fee[4]		$6,000.00	N/A
La Salle Sewer Extension		$4,761.73	7/13/2021
South Geneva Class A Sewer		$22,406.50	7/22/2026
South Geneva Class A Sewer Vault		$1,704.55	7/22/2026
South Geneva Class A Water	$17,088.97		7/22/2026
South Geneva Class B Water	$5,981.14		7/22/2026
ULID #18 Latecomer Fee[5] (See Resolution 672 for details)		2017 $6,772.49 2018 $7,037.81 2019 $7,303.12 2020 $7,568.43 2021 $7,833.75 2022 $8,099.06	1/1/2023

Footnotes

(1) An additional $755 is charged for some lots in Sudden Valley where the District installed a sewer lateral from the sewer main to the property line.

(2) Water permits connecting to the Eagleridge water system

(3) Geneva Columbus St. (Pennington) benefit area, see benefit area map

(4) $6,000.00 in Special Benefit fees will be added to connection fees where the collector system has been extended to provide sewer service

(5) Properties which are not subject to assessment as part of ULID #18 but which are within the south shore service area benefitting from the Lake Louise Road interceptor shall pay a latecomer charge in lieu of the ULID assessment.

LAKE WHATCOM WATER AND SEWER DISTRICT
Application for Water/Sewer Permit

PART 1 - Customer Billing / Lot Owner Information

Name: ____________________ Phone Number: ____________________

Mailing Address: ____

City: ____________________ State: _______ Zip: ______________

PART 2 - Project Site Information

Tax Parcel Number: ____________________ Sudden Valley Division: _______ Lot(s): _______

Street Address: ____

City: ____________________ State: _______ Zip: ______________

PART 3 - Type of Permit (check all that apply)

☐ **Water Service**
- ☐ Single Family Residence
- ☐ Commercial or Other Type of Building. Describe: ______________________________

  Water Supply Fixture Units (WSFU) per Uniform Plumbing Code: ____________

☐ Customer Pressure Reducing Valve will be Installed. (show location of PRV on site plan)

Special plumbing or activities that will be present on this site: ☐ None

- ☐ Underground sprinkler system
- ☐ Water treatment system (e.g. water softener)
- ☐ Solar heating system
- ☐ Residential fire sprinkler system
- ☐ Sewage pumping facility or grey water system
- ☐ Boat moorage with water supply
- ☐ Home-based business. Description: ______________________________

  (e.g. beauty salon, machine shop, etc…)
- ☐ Radiant In-floor Heat
- ☐ Boiler
- ☐ Swimming pool or spa
- ☐ Other water supply

☐ **Sewer Service**

List Bonded Side Sewer Contractor Installing Sewer: ______________________________
- ☐ Gravity Side Sewer
- ☐ Private Grinder Pump to Gravity Sewer Main (Submit Grinder Pump Service Checklist)
- ☐ Private Grinder Pump to Sewer Force Main (Submit Grinder Pump Service Checklist)

PART 4 – County Permits & Water/Sewer Service Site Plan

☐ **Copy of Whatcom County Building Permit** (new construction only)
☐ **Copy of Whatcom County Revocable Encroachment Permit** (required if work is in County Right-of-Way)
☐ **Site Plan.** Plan must be to scale, neat, legible, and include the following information as applicable:

Existing Features. Property lines, buildings, driveways, ditches, culverts, sewer mains, manholes, sewer cleanouts, fire hydrants, water main valves, sewer cleanouts.

Proposed Features. Buildings, driveways, sewer service alignment, cleanouts, connection to sewer main, grinder pump, location of customer pressure reducing valve, easements, backflow preventer.

Note: Tree removal for sewer and water service lines must be coordinated with Sudden Valley Community Association.

Application Submitted By: ______________________ Date: ____________ Phone: ____________
(print name)

	Water And Sewer Permit **Lake Whatcom Water and Sewer** 1220 Lakeway Dr Bellingham, WA 98229 (360) 734-9224	**Date Issued:** [redacted] **Permit #:** [redacted]

PERMIT CONDITIONS

BILLING. Water and sewer billing both begin on the date the water meter is turned on by the District. For sewer-only customers, billing begins on the date connection is made to the sewer main.

CONSTRUCTION STANDARDS. All water and sewer services shall be installed per the District's current Design and Construction Standards. Copies of the standards are available at the District office.

WATER SERVICE INSTALLATION. The District will set a meter adjacent to the property line within the public right-of-way or easement corridor at a location determined by the District. If required, the District will install a new service line from the public water main to the meter location. The owner is responsible for installing a private water service line from the meter to the building. Properties not adjacent to the public water main such as those located beyond the end of the main or behind lots fronting the main will require a longer private water service line installed by the owner or potentially be required to extend the public water main past and through their lot as determined by the District. Lot clearing and rough grading must be completed prior to the District installing a service and meter. A $50 re-inspection fee will be charged to the account if the District mobilizes to install the service and finds the lot not cleared and rough graded. A water service and meter is typically installed within two weeks from the date of request for water service. All customers are required to install a Pressure Reducing Valve (PRV) on the meter side of the service to protect their plumbing systems from high pressure surges. A PRV Inspection is required prior to occupancy.

SEWER SERVICE INSTALLATION. Sewer service lines from the public sewer main to the cleanout adjacent to the building must be installed by a contractor on the District's Bonded Side Sewer Contractor List. A current list of bonded side sewer contractors is available at the District office. Three inspections are required prior to occupancy. The owner is responsible for requesting the inspections. The owner or the owner's contractor may request inspections. A $100 re-inspection fee will be charged to the account for a no-show preconstruction meeting or re-inspection of deficient work. Required inspections are:

1. Onsite Preconstruction Meeting
2. Pipe Bedding and Backfill Inspection prior to covering any pipe
3. Leak Test Inspection after pipes are backfilled.

Owner or authorized agent agrees, by signing this permit, to comply with all the conditions of the Water and/or Sewer Service Permit Conditions, Design and Construction Standards, and all District Resolutions.

PERMIT EXPIRATION. Property owners issued connection permits shall have 365 days from the date of issuance of said connection permit to make a District-approved connection to the District water and/or sewer system without being subject to any increase or additional fees in the connection charge. After 365 days have elapsed, the connection permit shall be subject to any increase or additional fees in the connection charge adopted subsequent to the date of issuance of the permit.

___________________________ Applicant's Printed Name

___________________________ Applicant's Signature

___________ Date

(District Use Only) Permit Issued By		
Printed Name	Receipt #	Date
Account Number:		

Initials ______

LAKE WHATCOM WATER AND SEWER DISTRICT
Grinder Pump Service Checklist

DESIGN/PUMP SELECTION

Grinder Pump System Tax Parcel Number: ____________________

- ☐ E-One 2000 Series Package Grinder Pump System
- ☐ Hydromatic Package Grinder Pump System
- ☐ Liberty Pumps 2448LSG, 2472LSG, or 2484LSG Simplex Grinder Package System
- ☐ Myers Package Grinder Pump System
- ☐ Other (System must be reviewed and approved by District. Submit drawings, specifications, & calculations)

Static Head (feet):______________(Vertical distance, or height, effluent is pumped)

Dynamic Head (feet):_____________ (Friction losses due to pipe, bends, valves, fittings)

Total Dynamic Head (feet):_____________ (Static Head + Dynamic Head)

Pump Operating Point (gpm):_____________ (Flow rate of pump at Total Dynamic Head)

MINIMUM SPECIFICATIONS

Grinder pump systems shall be in accordance with Section C1-10.1 and C1-10.2 of the current edition of the Criteria for Sewage Works Design published by Washington State Department of Ecology. Specific section references from the design manual are noted in parentheses below.

Installed grinder pump system shall meet the criteria for the maximum hydraulic gradeline and be able to meet the pumping requirements of the structure where it is installed. (C1-10.1.5)

☐ **Connection to Gravity Sewer Main**

- ☐ Pressure service line shall be 1-1/4” HDPE SDR11 between grinder pump and gravity sewer stub.
- ☐ Minimum pipeline velocity of 2 feet per second. (C1-10.1.4)
- ☐ Maintenance shut-off ball valve on discharge line at grinder pump. (C1-10.2.1A)
- ☐ One check valve required. Can be installed on grinder pump. (C1-10-2.1A)

☐ **Connection to Force Main**

- ☐ Pressure service line shall be 1-1/4” HDPE SDR11 between grinder pump and check valve vault.
- ☐ Minimum pipeline velocity of 2 feet per second. (C1-10.1.4)
- ☐ Maintenance shut-off ball valve on discharge line at grinder pump.
- **Two check valves required. (C1-10.2.1A)**
  - ☐ Check valve #1: Installed at Grinder Pump. Can be installed on grinder pump.
  - ☐ Check valve #2: Installed at property line. Check valve in vault per Standard Detail S12.
- ☐ Tapping saddle, 2” corp stop, resilient seat gate valve, and valve box at force main. (C1-10.2.1A)
- ☐ 2” HDPE SDR11 service line between forcemain and check valve vault.

☐ **Control Panel / Electrical Requirements**

- ☐ Grinder pump UL Listed for use in raw sewage. (C1-10.2.2A)
- ☐ Pump control panel and level-sensing mechanism UL Listed for use in raw sewage (C1-10.2.2C)
- ☐ High level visual and audio alarm with battery backup. (C1-10.2.2C)
- ☐ Audio alarm capable of being silienced until repair can be made. (C1-10.2.2C)

☐ Power transfer switch with an emergency generator plug for vessels with less than 24 hours of storage (1000 gallons for single family residence). (C1-10.1.6D&E)

☐ Electrical components in compliance with National Electrical Code and state Labor and Industries Electrical Inspection Division. (C1-10.2.2D)

☐ **Ventilation**

- ☐ Grinder pump storage tank shall have a separate vent system from structure plumbing. (C1-10.2.2E)

DESIGNER/SUPPLIER CONTACT INFORMATION

Designer:________________________________Phone:_____________________ Date:_______________
(print name)

Supplier:_________________________________Phone: ____________________Date:_______________
(print name)

Rev. 10/11/2007

WATER AVAILABILITY FORM
PUBLIC WATER SYSTEM

Complete and submit form with original signatures to WCHD
(copies are not accepted)

WHATCOM COUNTY
HEALTH DEPARTMENT
509 Girard Street
Bellingham, WA 98225
Telephone: 360-778-6000
Fax: 360-778-6001

Applicant Information:

Property Owner(s): ______________________________ Phone: ______________
Address: ______________________________ City: ______________ State: ____ Zip: __________
Contact Person: ______________________________ Phone: ______________
Email and/or Alternate Contact: ______________________________

I certify that I am the owner or authorized representative of the below noted property. I have examined this form and know the same to be true and correct. I understand that this approval expires one year after the PWS Authorized Representative signature date and that application for final plat approval and/or building permit must be made before the expiration date. I understand that information submitted is subject to the Public Records Act.

Sign: ______________________ Print: ______________________ Date: ______________

Property Information: Project Type: ☐ Single ☐ Multi-Family ☐ADU ☐ Commercial ☐ Plat

Tax Parcel Number (12 digit number)**:** ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
Address of Project: ______________________________
Building Permit Number: ______________________ Plat Name: ______________________ Lot: ________

- Briefly describe project (attach site plan and additional pages as needed)______________________

____

____

Certification of Public Water Availability: to be Completed by the PWS Authorized Representative

Lake Whatcom Water & Sewer District

Group B water systems must have current water tests - bacteriological less than one year old and nitrate less than three years old.

Public Water System Name: Lake Whatcom Water & Sewer District DOH ID#: ____________
The above Public Water System (PWS) is approved by the WA State Department of Health or the WCHD for __________ service connections and currently serves __________ service connections. The PWS has the necessary water system infrastructure in place to adequately provide service to the above property per WAC 246-290 or WAC 246-291. The PWS is capable of and willing to supply water to the above property, residence, project or plat for _______ ☐ **New** service(s) and/or _______ ☐ **Existing** service(s).

I certify that I am an authorized representative of the above PWS. I understand this certification expires one year after the PWS signature date. I understand that information submitted is subject to the Public Records Act 42.56.

1220 Lakeway Drive, Bellingham WA 98229 360-734-9224

Sign: ______________________ Print: ______________________ Date: ______________
Title: ______________________ Address: 1220 Lakeway Drive, Bellingham WA 98229 Phone: 360-734-9224

For Health Department Use Only:

☐ Approved Date: ______________ Approval Expires: ______________
☐ Denied
By: ______________________ Comments or Conditions: ______________________

____

____

Notify Via: ☐ Email ☐ Phone ☐ Mail ______________________________

The subdivision/building permit is located in an area that is governed by chapter 173-501 WAC and in which instream flows are not met and/or are subject to closure. In compliance with ch 58.17 RCW/RCW 19.27.097 the County has determined adequate potable water is available for this subdivision/building permit on the basis of evidence supplied by the Applicant. Other authorities, including courts of competent jurisdiction and the Department of Ecology, exercise jurisdiction over water resources in the state of Washington. Those authorities may determine that the proposed source of water for this project identified by the Applicant is not a valid water right appropriation or is subject to curtailment or seasonal restrictions on availability that could impact its reliability for the intended use. The County's issuance of this subdivision/building permit should not be relied upon by the Applicant or any successor in interest as an assurance, warranty or guarantee of the future availability of water to serve the subdivision/building permit.

March 2017

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LAKE WHATCOM WATER & SEWER DISTRICT
1220 Lakeway Drive (360) 734-9224
Bellingham, WA, 98229 Fax 738-8250

{Date}

Re: Sewer “Will Serve” Letter for
{Address}
{Assessor Parcel Number}

To Whom It May Concern:

The District can currently provide sewer service to the above parcel. Currently water is not available to this parcel. Prior to issuance of a sewer permit, a Covenant Binding Property Regarding Future Water Service must be recorded at the Whatcom County Auditor’s Office. See attached covenant form.

This determination, however, is not indefinite, nor irrevocable. Nothing stated herein constitutes a commitment to provide water and sewer service to you in the future. The information used to arrive at this determination of availability is believed to be accurate at this time, but future demands are not always predictable. Similarly, new laws, regulations, or ordinances could also limit the ability to provide water and sewer service in the future. Accordingly, any expenditure which you make in anticipation of future sewer service is strictly at your own risk. Any statements in paragraph(s) above which are inconsistent with this paragraph should be disregarded.

Please call if you have any questions.

Sincerely,

LAKE WHATCOM WATER & SEWER DISTRICT

{District Representative}
{Title}

Lake Whatcom Water & Sewer District

Bonded Side Sewer Contractor List

Updated 11.8.2017

Lake Whatcom Water & Sewer District
1220 Lakeway Drive
Bellingham, WA 98229
(360) 734-9224

Name	Address	City	Zip	Contact	Phone	Cell	Fax	Email
Blythe Plumbing & Heat	2201 Humboldt St	Bellingham	98225		(360) 733-7810		(360) 671-3787	lorrieg@blytheinc.com
Bode's Electric/Plumbing	7666 Woodland Rd	Ferndale	98248	Wolfgang Sellinger	(360) 384-4087		(360) 384-0524	admin@bodeselectric.com
Boss Construction	4945 Guide Meridian	Bellingham	98226	Gary Christie	(360) 398-2300		(360) 507-1621	
Coast Construction	6188 Portal Way	Ferndale	98248	Chuck Westfall	(360) 306-1391		(360) 384-3417	info@coastconst.com
Dahlgren Excavating	PO Box 573	Everson	98247	Rick Dahlgren	(360) 380-5533			
Exxel Pacific, Inc.	323 Telegraph Rd	Bellingham	98226	Josh Visser	(360) 734-2872		(360) 671-7616	joshv@exxelpacific.com
Faber Construction Corp	131 E Grover St	Lynden	98264		(360) 354-3500	(360) 815-4713		info@faberconstruction.com
Favinger Plumbing Inc.	1700 Kentucky St	Bellingham	98226	Art Favinger	(360) 676-1774			info@favingerplumbing.com
Fountain Construction	4185 Chance Rd	Bellingham	98226	Lee Breakey	(360) 734-9167	(360) 303-3942		fc.wedig@gmail.com
Harkness Contracting	PO Box 233	Acme	98220	Rick Harkness	(360) 595-1128			
Iverson Earth Works LLC	2330 Birch Bay Lynden Rd	Custer	98240		(360) 366-3476		(360) 366-5617	iewtb@startouch.net
Kramer Construction	1442 Sunset Ave	Ferndale	98248		(360) 312-9739	(360) 303-0515		
Len Honcoop Gravel Inc.	8911 Guide Meridian Rd	Lynden	98264	Jodi Tjoelker	(360) 354-4763			info@honcoop.com
McFarlane Construction	PO Box 29047	Bellingham	98228		(360) 733-1555	(360) 303-6993	(360) 724-6602	brian@mcfarlaneconstruction.com
Moceri Construction Inc.	1013 Donovan Ave	Bellingham	98225	Levi Nyberg	(360) 671-3381	(360) 319-9737		info@mocericonstruction.com
Monks Excavation LLC	959 West Lake Samish Dr	Bellingham	98229	Jeff Monk	(360) 676-5958	(360) 393-1957		
Olsson Construction	5750 Silverstar Rd	Bellingham	98226	Duane Olson	(360) 961-7388			
On the Level Construction	PO Box 1072	Bellingham	98227	Joe Denhartog	(360) 671-1957	(360) 223-7673		
P&P Excavating	2499 Smith Rd	Bellingham	98226	Tom Pullar	(360) 592-5374	(360) 815-4473		tpullar@aol.com
Plumb-Rite	1706 Front St #668	Lynden	98264	Bill Zaiss		(360) 815-2576		
Premium Septic Service	3212 Mt Baker Hwy	Bellingham	98226		(360) 410-1764	(360) 393-7272	(360) 392-6119	
Presco Construction	4921 Lewis Ave	Bellingham	98229		(360) 671-9837			
R & R Excavating	6595 Northwest Rd	Ferndale	98248		(360) 815-5914			ron5326@gmail.com
Ram Construction	4290 Pacific Hwy	Bellingham	98225	Mike Hammes	(360) 715-8643			info@ramconstruction-wa.com
Skeers Construction Inc.	1249 Birch Falls Drive	Bellingham	98225	Dave Monks	(360) 671-0911	(360) 305-7660		sales@skeers.com
SML Construction	855 40th St	Bellingham	98229	Sean Logan	(360) 305-5190		(360) 933-4546	
Sorenson Construction	PO Box 388	Everson	98247	Lyle Sorenson	(360) 966-2628	(425) 508-1490		
Twilight Excavation Inc.	6900 Northwest Dr	Ferndale	98248		(360) 380-1769	(360) 201-9351		
Upland Developers Inc	PO Box 2706	Ferndale	98248	Phil Perkins	(360) 319-6981			uplanddevelopers@hotmail.com
VP Stone & Tile Inc.	1 Autumn Vista Pl	Bellingham	98229	Vitaliy Pikalov	(360) 201-3698			vitalka240@yahoo.com
Matt Weeks' Excavating	2318 Birch Bay Lynden Rd	Custer	98240		(36) 036-6314	(360) 410-6939		mwkjweeks@yahoo.com
Winterburn Construction	4590 Sand Rd	Bellingham	98226	Chris Winterburn	(360) 592-1305	(360) 815-0269		winterburnconstruction@gmail.com

Assessor Parcel Number:___________________________________

Address (if known):____

Water/Sewer Permit and Construction Checklist

➢ Additional fees and credits associated with property

ULID #18 – is property located within the south shore sewer service area?

- ☐ **NO**, then ULID 18 does do not apply.
- ☐ **YES**, then check if property **has Restrictive Covenant?**
  - ☐ **YES**, then property cannot be served by sewer. *Owner might be able to trade restriction for assessment from another property.*
  - ☐ **NO**, then property can be served by sewer.

    Has ULID 18 assessment?
    - ☐ **YES**, then can be served with no additional fees.
    - ☐ **NO**, then Charges-in-Lieu of Assessment apply.

      Charges-in Lieu of Assessment: **$**______________ for Year ___________.

Is property located in a Latecomer Area?

- ☐ **NO**, then no additional fees apply
- ☐ **YES**, then following Latecomer Fees apply:

  ______________________________ **$**_______________

  ______________________________ **$**_______________

  ______________________________ **$**_______________

District installed Sewer Stub?

- ☐ **NO**, then no additional fees apply
- ☐ **YES**, then an additional charge applies. **$**_______________

Applicable credits?

- ☐ Pre-Paid Connection Certificate Credit: **$**_______________
- ☐ Expired Permit(s) Credit: **$**_______________

➢ Water Availability Form, Water/Sewer Availability Form, or Sewer-Only Will-Serve Letter

Property is located within Urban Growth Area (UGA) or Local Area of More Intense Rural Development (LAMIRD)?

- ☐ **NO**, then City of Bellingham must confirm lot existed prior to May 1, 2005 in accordance with the Interlocal Agreement for Sewage Services between the City and District prior to District issuing an availability for sewer.

  Process for confirmation with City of Bellingham.

  - ☐ Property owner provides District with copy of deed or Whatcom County Lot of Record determination that proves lot existed prior to May 1, 2005.
  - ☐ District will send information to City for confirmation
  - ☐ When District receives confirmation from City that lot can be served, District can continue with sewer availability checklist.
- ☐ **YES**, then continue to next checklist item.

Conditions for water and/or sewer availability.

Property is adjacent to water and sewer?

- ☐ **YES**, then prepare Water and Sewer Availability Form
- ☐ **NO**, then check next condition

Property is adjacent to Sewer only?

- ☐ **YES**, then Covenant Regarding Future Water Service is required prior to Sewer-Only Will-Serve Letter, or if within 200-Feet of Water System, Developer Extension may be required.
- ☐ **NO**, then check next condition

Property is adjacent to Water only?

- ☐ **YES,** then Covenant Regarding Future Sewer Services is required prior to Water Availability Form, or if within 200-Feet of Sewer Main, Developer Extension may be required (if located within LAMIRD or UGA).

➢ Submit Application for Water/Sewer Permit forms to District. Include the following:

- ☐ Copy of Whatcom County Building Permit
- ☐ Copy of Whatcom County Revocable Encroachment Permit (Required if work is in County Right-of-Way)
- ☐ Site Plan to include Existing and Proposed Features
- ☐ Pressure Reducing Valve(PRV) shown on Site Plan
- ☐ Special Plumbing or Activities to be listed
- ☐ Submit Grinder Pump Checklist if required
- ☐ Designate Bonded Side Sewer Contractor performing side sewer installation

➢ Pay Connection Fees, Sign Water/Sewer Permit

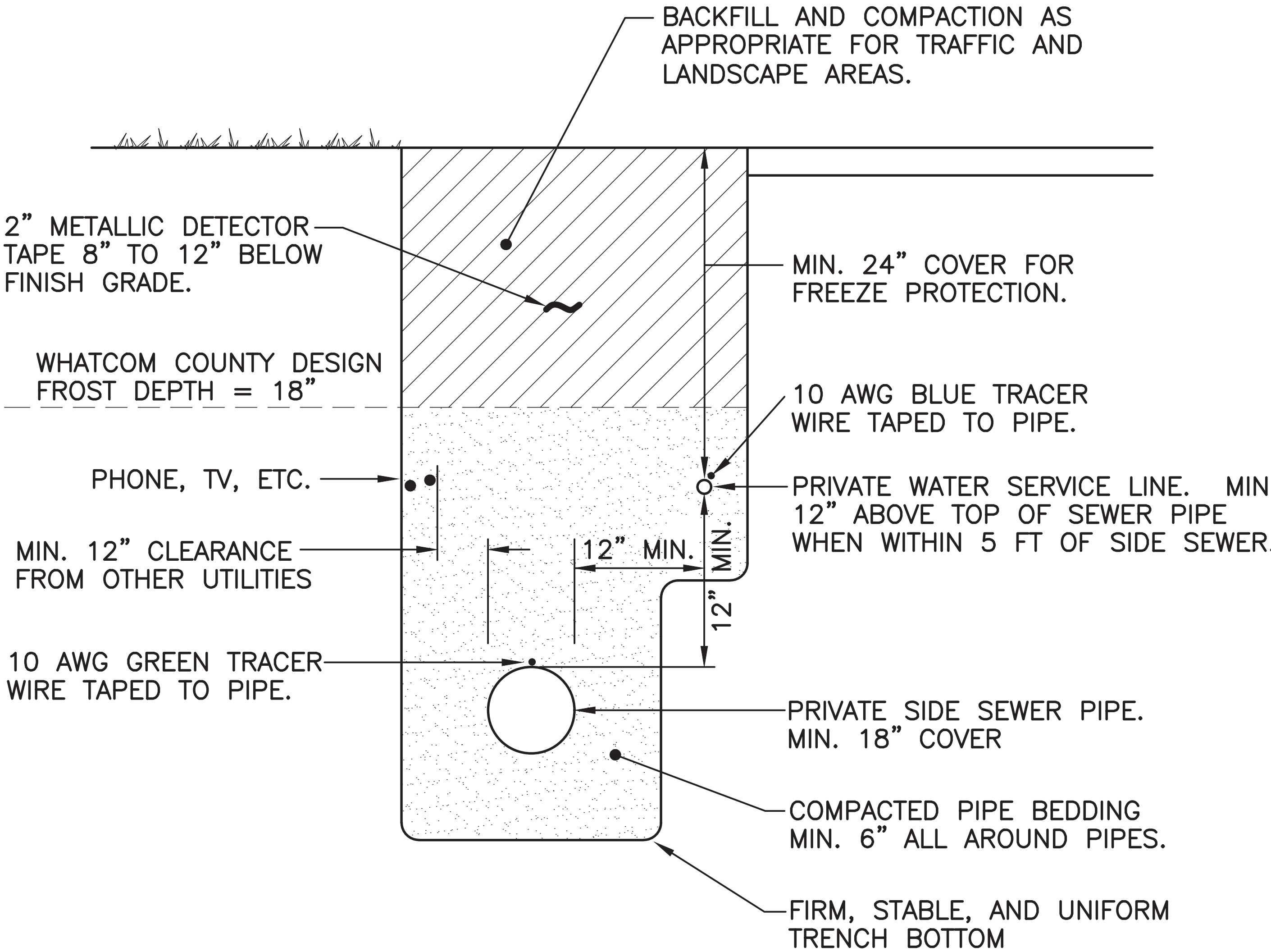
- ☐ District will prepare Water/Sewer Permit and call to schedule time for payment and pickup (typically 1 business day after submittal of Application for Water/Sewer Permit).

➢ Connection to Water

- ☐ District will install water meter adjacent to property. Typically takes 2 to 14 days depending on whether a service line exists from the public water main to the property.
- ☐ Customers can install their own water service lines from the water meter to the house per District standards.
- ☐ Customer requests inspection of private pressure reducing valve required (PRV) on the service line at the entry of the house. The PRV protects internal plumbing from pressure spikes in public water system. The District's distribution system has over 50 large PRV's located throughout the system. These large PRV's have the potential to stick open and cause high water pressure with no warning. Customers may elect not to install a private pressure reducing valve after recording a Hold Harmless Agreement Concerning Owner's Desire Not to Install a Pressure Reducing Valve.
- ☐ Billing for both water and sewer (if also served by sewer) begins the date the water meter is unlocked by the District at customer's request.

➢ Connection to Sewer

- ☐ Installation of the side sewer from the public sewer main to the house must be performed by a contractor on the District's Bonded Side Sewer Contractor List.
- ☐ Contractor requests a pre-construction meeting with District prior to any work.
- ☐ Contractor requests sewer pipe bedding and backfill inspection prior to covering any pipe.
- ☐ Contractor requests sewer leak test Inspection
- ☐ Billing for sewer-only customers begins the date the side sewer is connected to the public sewer main.



NOTES:

1. Side sewer pipe material (PVC ASTM D3034 SDR 35) shall comply with most current International Plumbing Code (IPC) Table 702.3 Building Sewer Pipe. Separation of water service and side sewer shall comply with IPC 603.2 requirements.

2. Water service lines and side sewers shall be bedded in material meeting WSDOT 9–03.12(3) Gravel Backfill for Pipe Zone Bedding as shown in following table:

Sieve Size	Percent Passing by Weight
1.5"	99–100
1"	75–100
5/8"	50–100
U.S. No. 4	20–80
U.S. No. 40	3–24
U.S. No 200	10.0 max
Sand Equivalent	35 min.

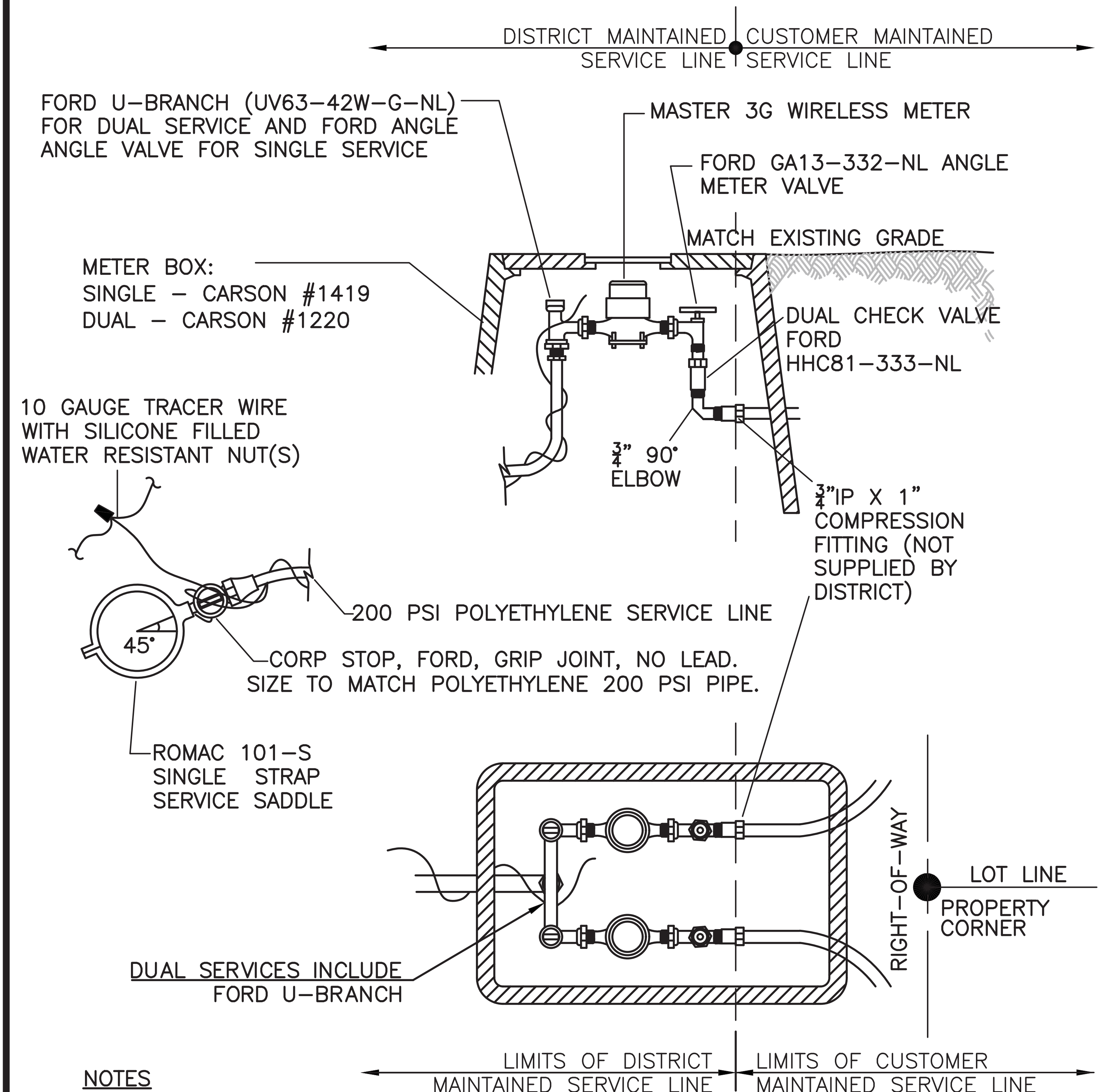
LAKE WHATCOM WATER & SEWER DISTRICT

PRIVATE WATER SERVICE LINE AND SIDE SEWER TRENCH DETAIL

STANDARD DETAIL

G7

9/20/2017



NOTES

1. Service fittings shall be in accordance with WSDOT 9–30.6 except that only compression (grip joint) fittings on service lines are allowed.
2. All fittings shall be Ford brass.
3. The water service pipe shall have a minimum of 30 inches depth and a maximum of 36 inches depth, including under ditch sections.
4. Meter boxes in traffic areas shall be concrete with a reader lid.

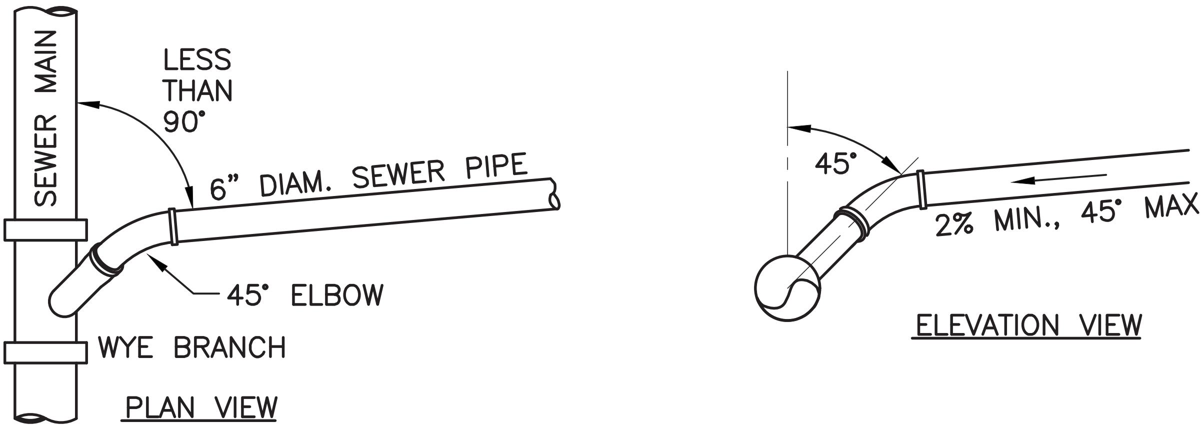
LAKE WHATCOM WATER & SEWER DISTRICT

WATER METER ASSEMBLY

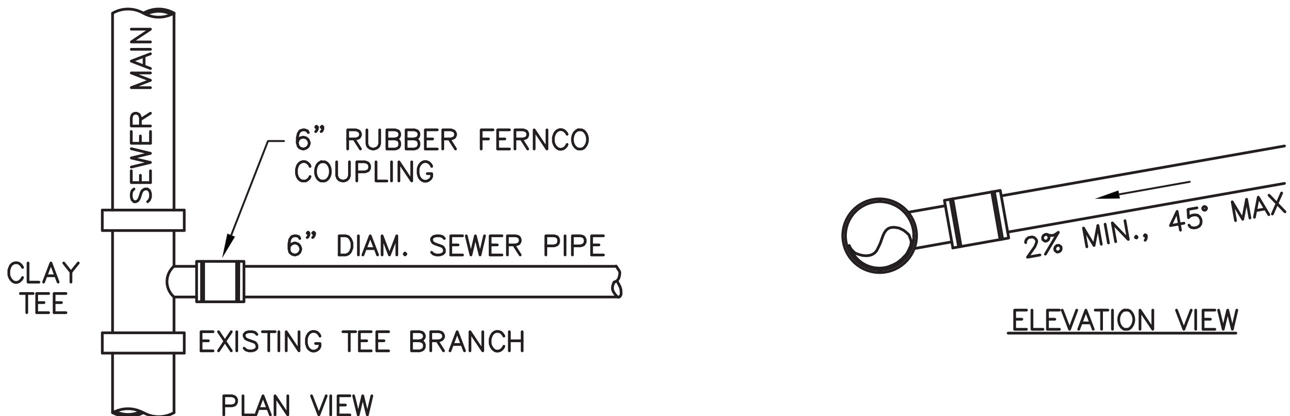
STANDARD DETAIL

W8

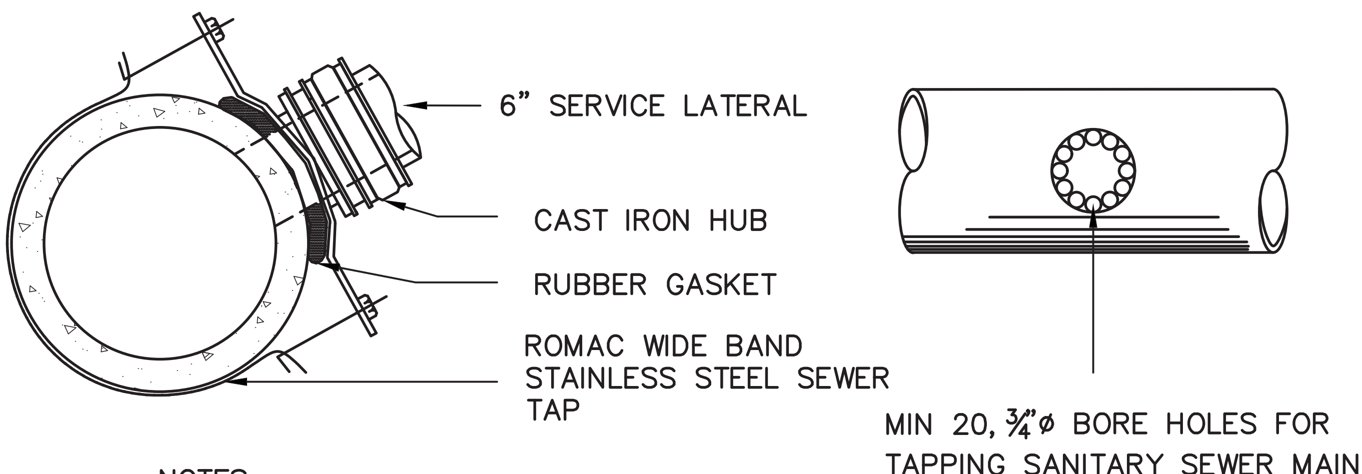
9/20/2017



SERVICE LATERAL INSTALLED WITH NEW MAINS



CONNECTION TO EXISTING TEE



NOTES;

1. Install wye fitting with gaskets for new sewer installations
2. Pipe bedding shall be sand or pea gravel 6" all around.
3. Minimum cover to finish grade is 30".
4. Drill multiple 3/4' holes (20 min for 6") then break out

CONNECTION TO EXISTING SEWER (TAP)

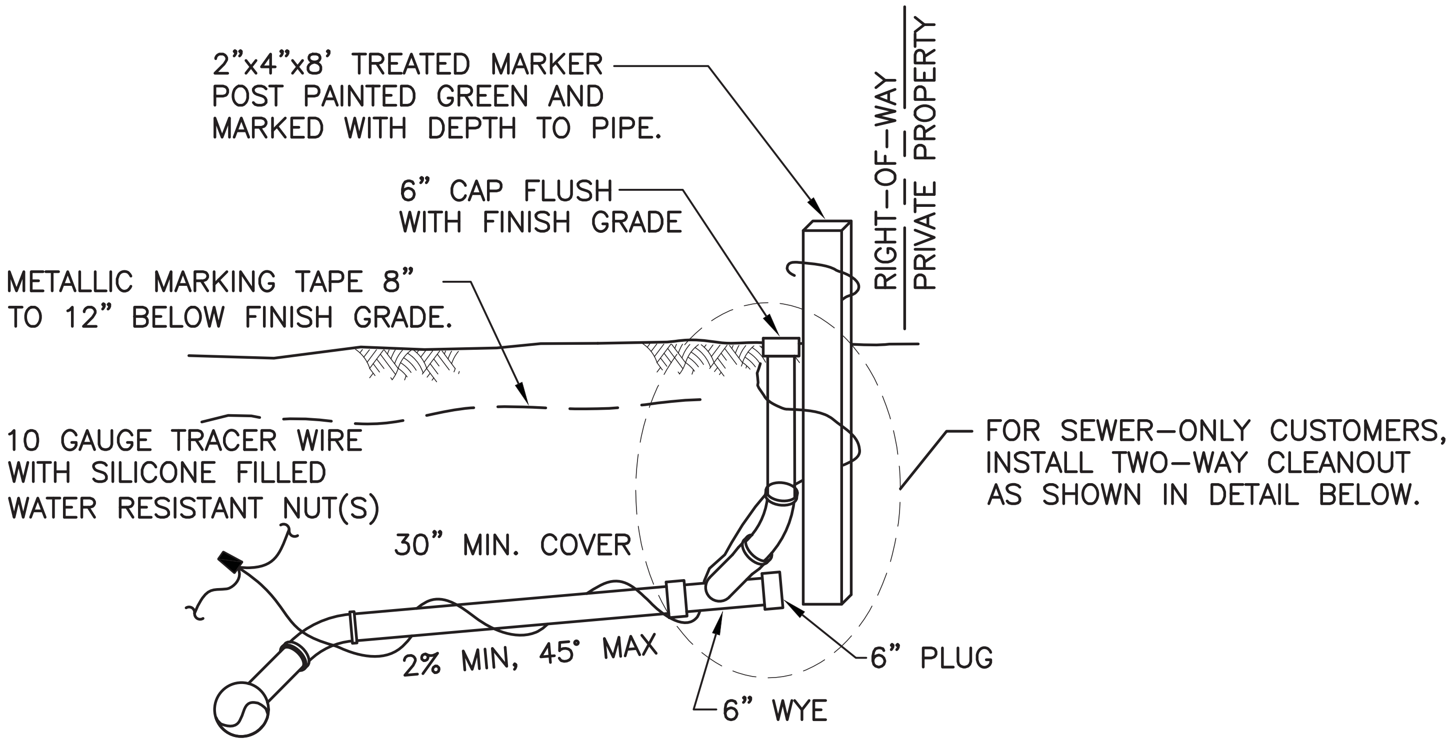
LAKE WHATCOM WATER & SEWER DISTRICT

SEWER LATERAL CONNECTION TO MAIN

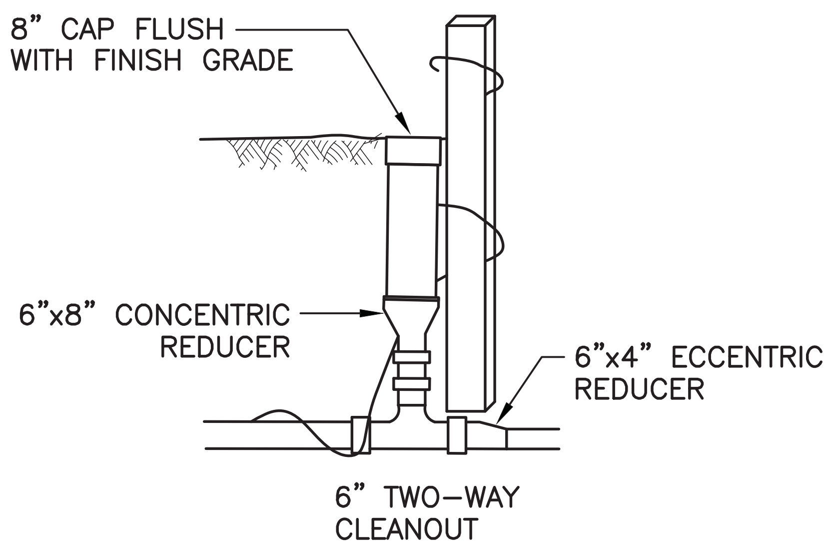
STANDARD DETAIL

S6

5/1/2014

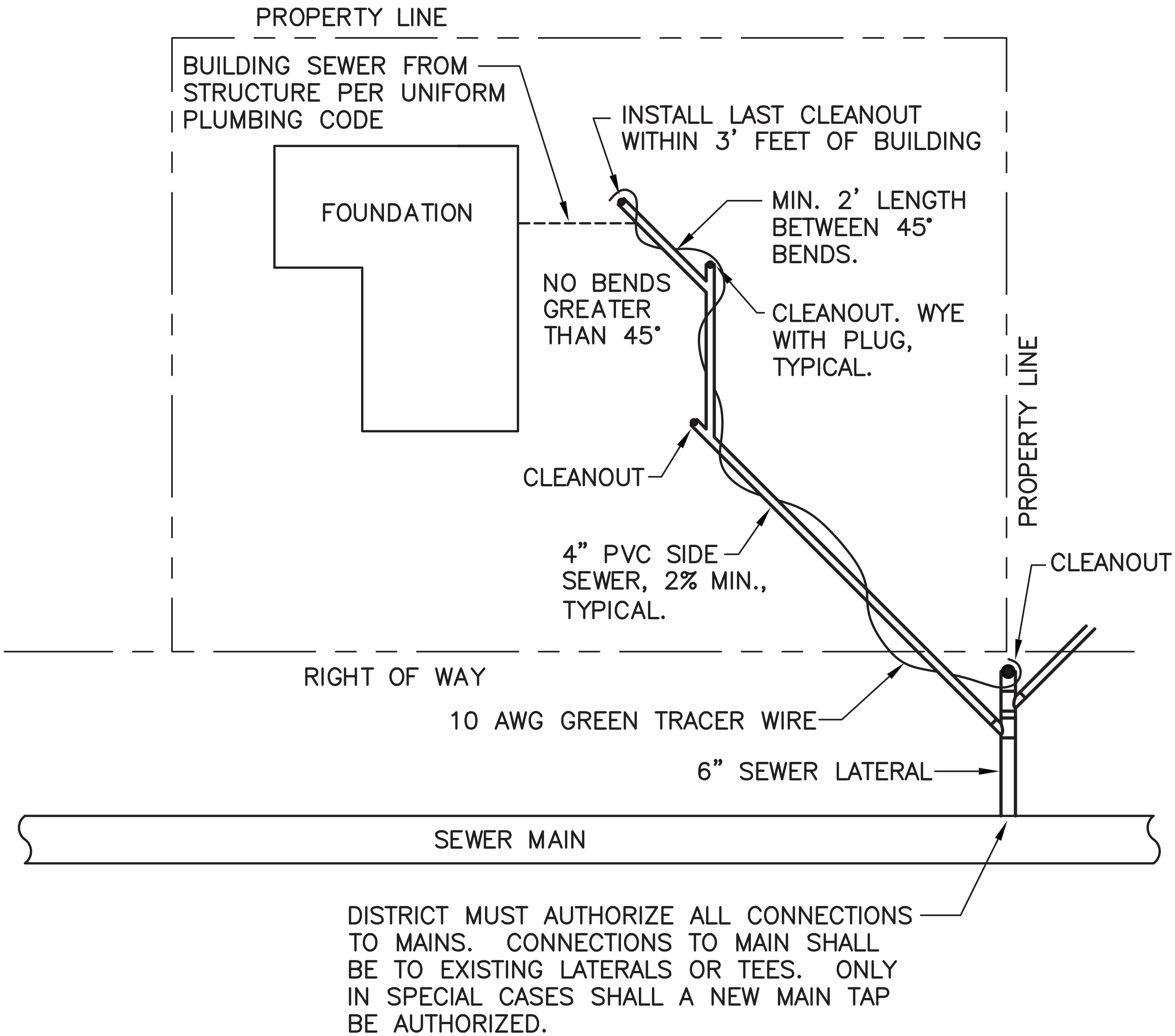


TYPICAL SEWER LATERAL & CLEANOUT



CLEANOUT FOR SEWER-ONLY CUSTOMERS.

LAKE WHATCOM WATER & SEWER DISTRICT	SEWER LATERAL AND CLEANOUT	STANDARD DETAIL S7 5/1/2014



Notes:

1. All pipe from main to cleanout at foundation shall be PVC ASTM D3034 SDR 35, joints shall conform to ASTM D3212 using elastomeric gaskets conforming to ASTM F477. Fittings shall be injection molded, factory welded, or factory solvent cemented.
2. Minimum 18" of cover from property line to building.
3. Down spouts, sump pumps, and outside drains shall not be connected to the sewer line.
4. Bends greater than 45° will not be accepted.
5. Minimum size for sewer lines will be 4" for single family residence and 6" for multi–family residence up to a 4 plex.
6. Cleanouts on service lines shall be installed at every change in alignment or grade in excess of 22 1/2 degrees.
7. Cleanouts shall be spaced no greater than 100' apart.
8. A cleanout shall be installed within 3' of the building.

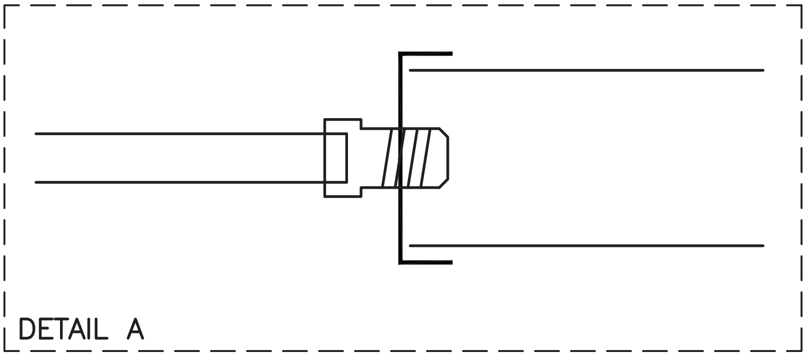
LAKE WHATCOM WATER & SEWER DISTRICT

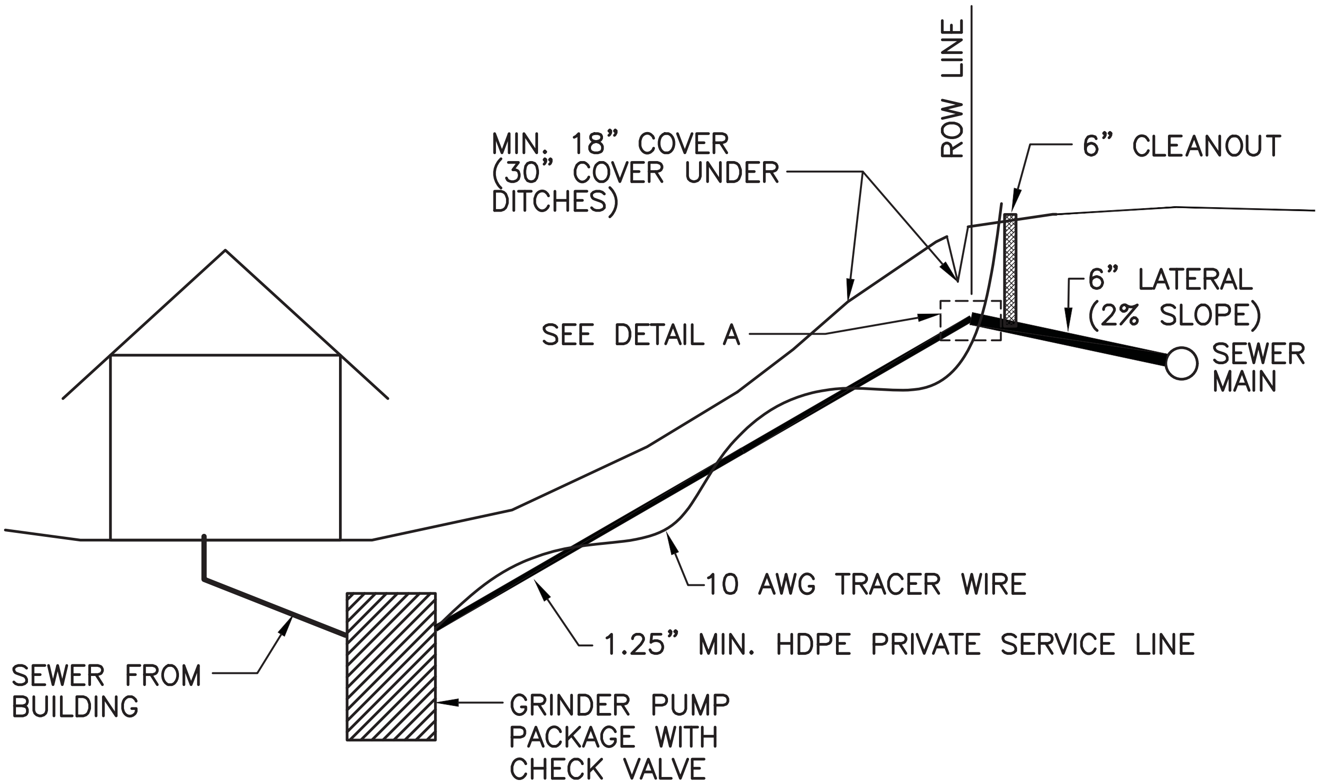
GRAVITY SIDE SEWER INSTALLATION

STANDARD DETAIL

S8

5/1/2014





SEE DOE'S CRITERIA FOR
SEWAGE WORKS DESIGN,
SECTIONS C1-10.1 & C1-10.2
FOR GRINDER PUMP DESIGN &
COMPONENT INFORMATION

NOTES:

1. Pressure sewer service pipe shall be PE 3408 HDPE conforming to the requirements of ASTM D-3350. Piping shall be SDR11, IPS (OD), pressure rated at 160 PSI, conforming to the requirements of AWWA C901 and ASTM F714.

2. Brass compression fittings only - no hose clamps.

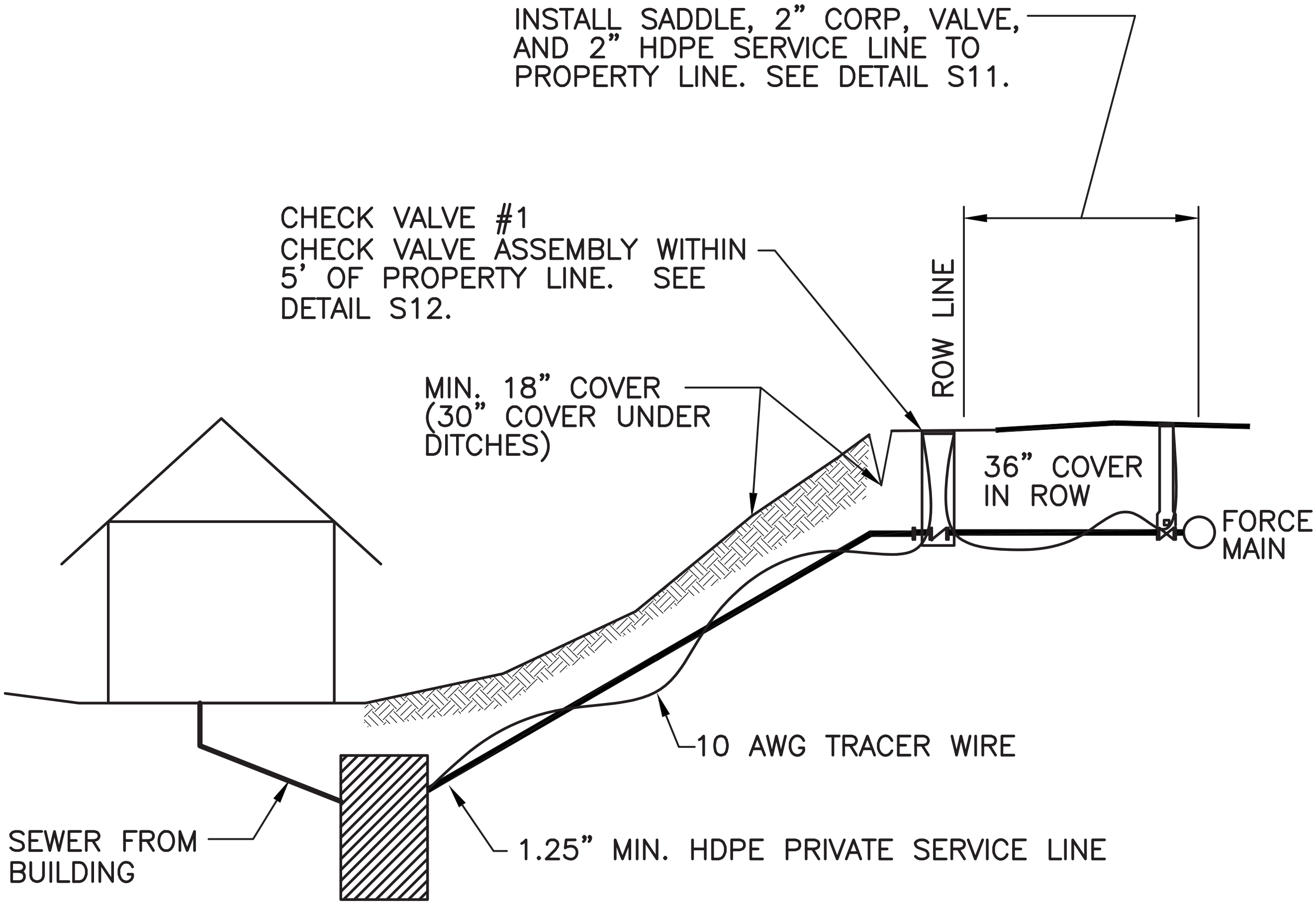
LAKE WHATCOM WATER & SEWER DISTRICT

GRINDER PUMP SERVICE TO GRAVITY MAIN INSTALLATION

STANDARD DETAIL

S9

9/20/2017



GRINDER PUMP (CHECK VALVE #2 AT GRINDER PUMP)

SEE DOE'S CRITERIA FOR SEWAGE WORKS DESIGN, SECTIONS C1–10.1 & C1–10.2 FOR GRINDER PUMP DESIGN & COMPONENT INFORMATION

NOTES:

1. Pressure sewer service pipe shall be PE 3408 HDPE conforming to the requirements of ASTM D–3350. Piping shall be SDR11, IPS (OD), pressure rated at 160 PSI, conforming to the requirements of AWWA C901 and ASTM F714.

2. Two check valves are required between the pump station and the force main. One check valve shall be installed within 5' of the right–of–way in the check valve vault. The second valve shall be installed at the grinder pump.

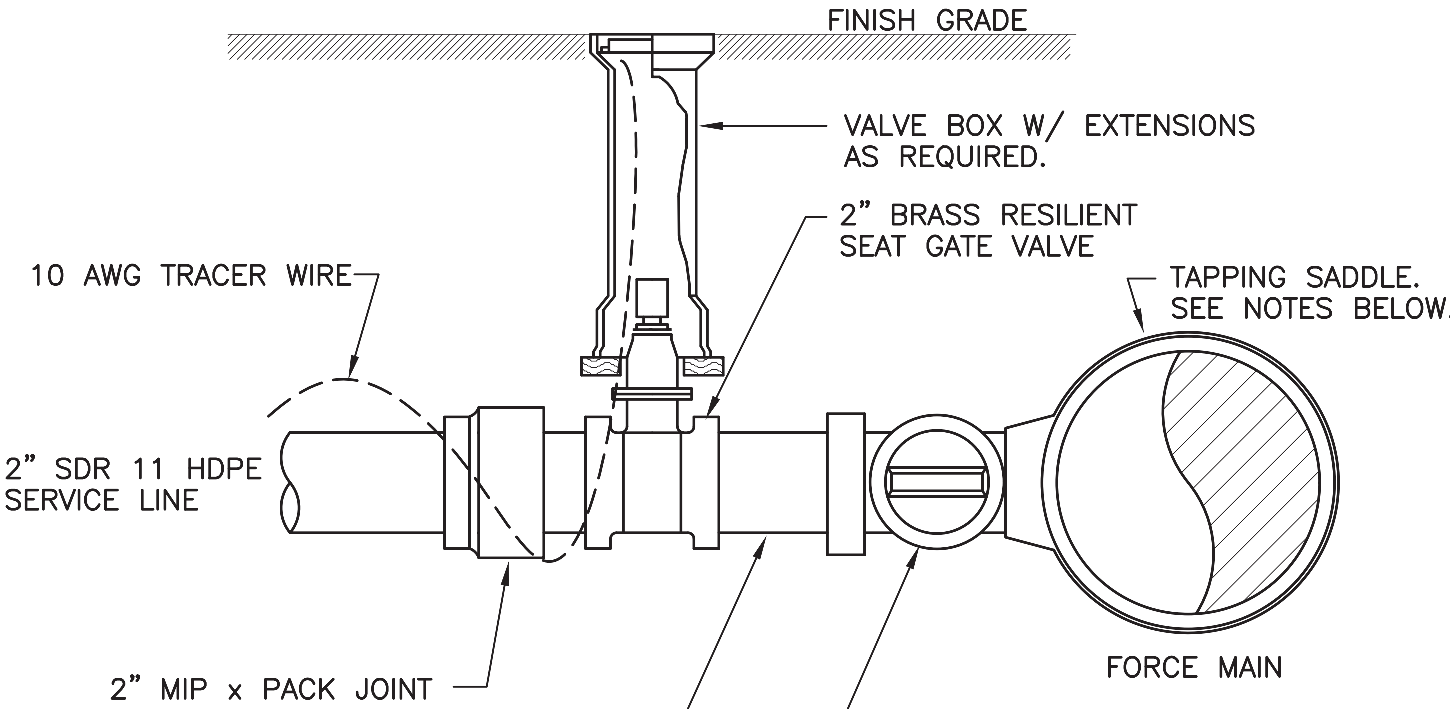
LAKE WHATCOM WATER & SEWER DISTRICT

GRINDER PUMP SERVICE TO FORCE MAIN INSTALLATION

STANDARD DETAIL

S10

5/1/2014



** NOTE! FUSED HDPE TEES SHALL BE INSTALLED WITH NEW HDPE FORCE MAINS. (NO TAPPING SADDLE OR CORP STOP.)

NOTES:

1. HDPE Service Saddles. Saddles for use on SDR 17 HDPE mains shall be epoxy or nylon coated ductile iron tapping saddles with a double stainless steel strapping mechanism specifically recommended by the manufacturer for use on HDPE piping. Saddles shall be Romac style 202N–H or approved equal.

2. PVC Service Saddles. Saddles for use on AWWA C900 PVC mains shall have epoxy or nylon coated ductile iron tapping saddles with a double strap stainless steel strapping mechanism. Service saddles shall be Romac style 202N or approved equal.

3. Ductile Iron Service Saddles. Saddles for use on ductile iron mains shall have epoxy or nylon coated ductile iron tapping saddles with stainless steel tapping mechanism. Service saddles shall be Romac style 101NS or approved equal.

4. Customer Service Shutoff Valves. Shutoff valves shall be resilient wedge type gate valves in conformance with AWWA C515. Valves shall be suitable for sewage service and be equipped with transition gaskets where needed. Gate valves shall have a non–rising stem and be fusion–bonded epoxy coated inside and out meeting AWWA C550. Gate valves shall be Clow resilient wedge gate valves or approved equal.

5. Valve boxes shall have the word "SEWER" cast into the cover.

6. Fittings. All fittings shall be brass.

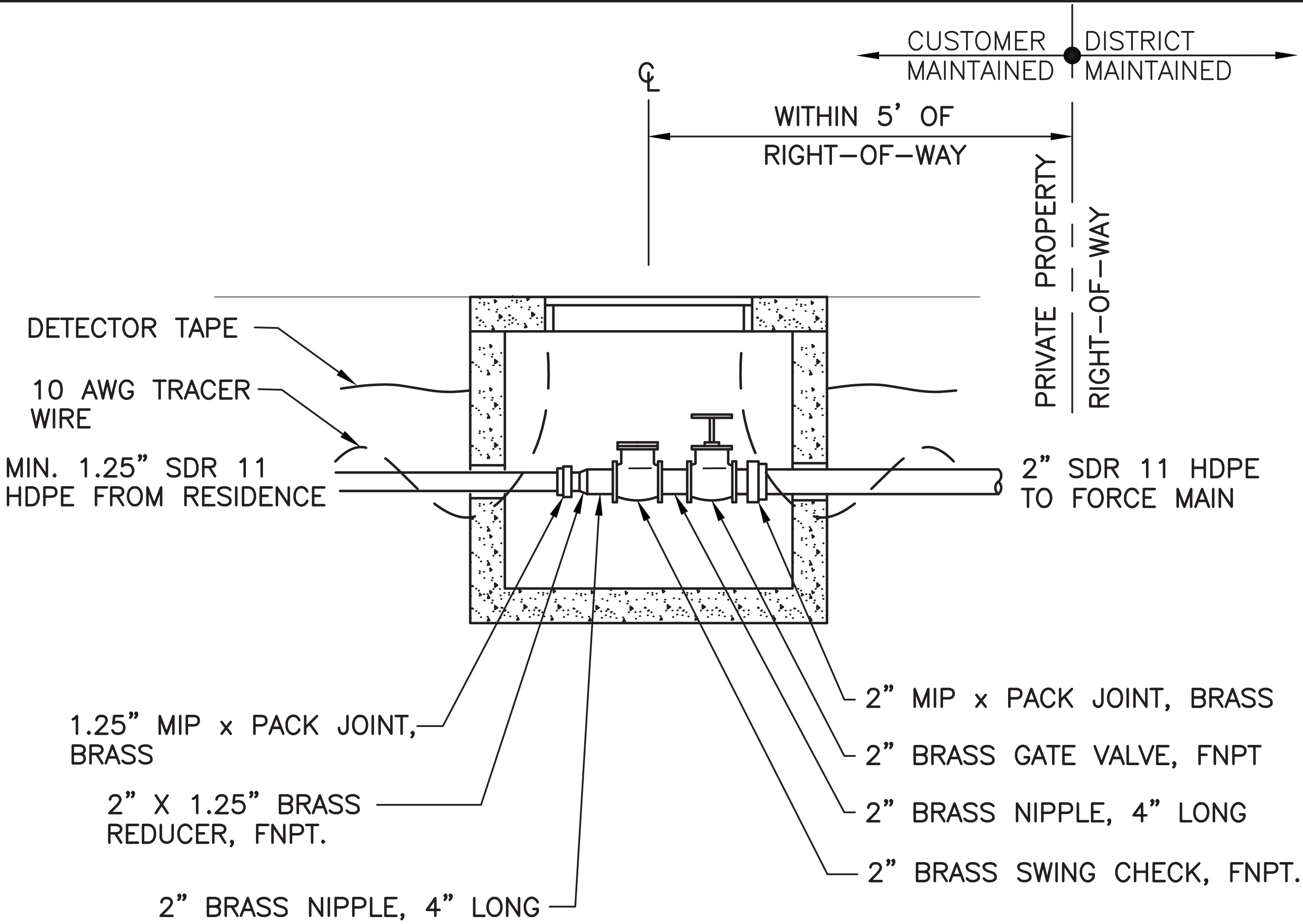
LAKE WHATCOM WATER & SEWER DISTRICT

CONNECTION TO FORCE MAIN

STANDARD DETAIL

S11

9/20/2017



Notes

1. Check Valve. Check valve shall be horizontal swing type manufactured out of brass and be pressure rated to 125 psi. Valve shall have metal to metal seal and threaded NPT end connections. Valve shall be a Milwaukee Valve UP509 or equal.

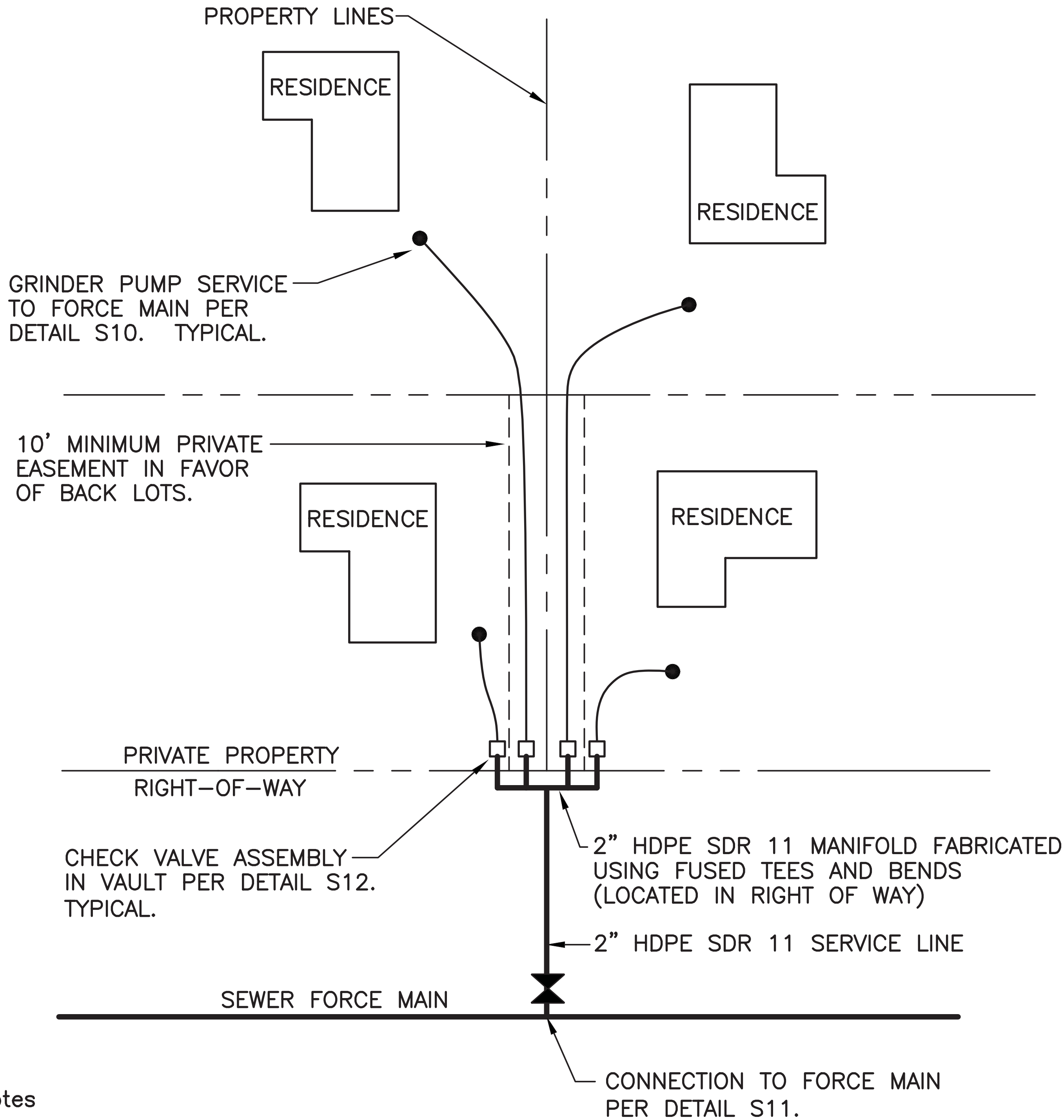
2. Gate Valve. Gate valve shall be manufactured out of brass and be pressure rated to 200 psi. Valve shall have threaded bonnet and non-rising stem. Valve shall be a Watts Regulator Company Series WGV-X or equal.

3. Vault. Vault shall be a pre-cast concrete hand hole with a 2'-0" by 3'-0" inside diameter and a maximum 4'-0" inside depth. Hand hole and access hatch shall be traffic rated. Access hatch shall be galvanized steel checker plate with pick holes and bolt down holes in plate. Check valve vaults shall be Utility Vault Model 2436 hand hole or approved equal.

4. Air/Vacuum Valve. Where required, air relief and combination air relief/ vacuum relief valves shall be as manufactured by Orenco, Apco, Crispin, ARI, or equivalent for sewer service. All valves shall be on private property and be fully accessible to enable customer's operation, maintenance and repair.

5. Fittings and Adapters. All fittings and adapters shall be brass.

LAKE WHATCOM WATER & SEWER DISTRICT	FORCE MAIN SERVICE CHECK VALVE	STANDARD DETAIL S12 9/20/2017

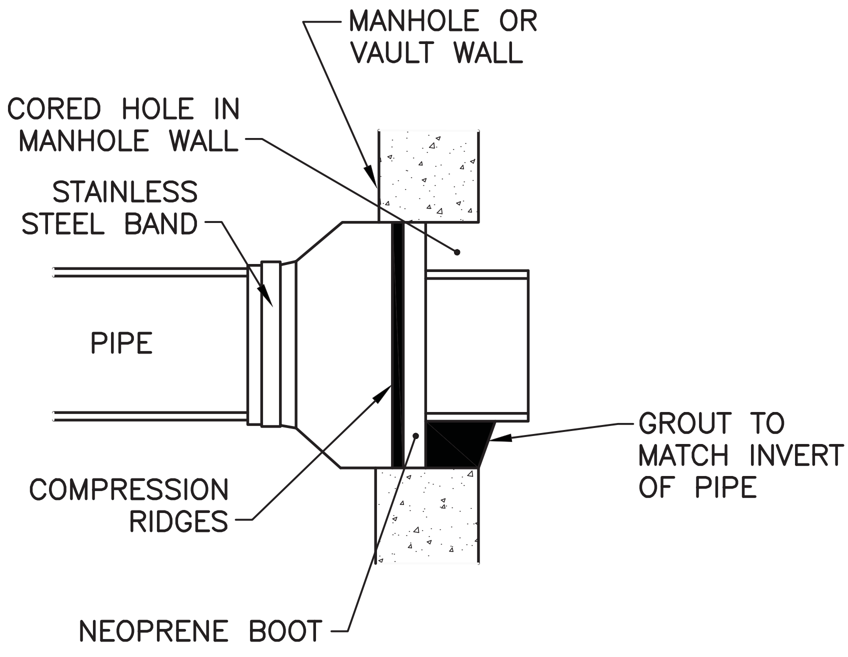


Notes

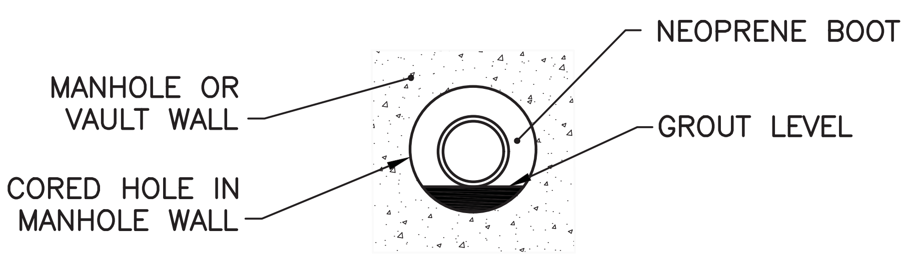
1. If approved by the District Engineer, a single 2" service tap may be shared with multiple residences. District will review requests for shared taps on a case by case basis. Property owners desiring to install a shared tap, shall individually but at the same time, submit a sewer permit application with the grinder pump check list for review by the District.

2. Manifold must be fabricated using fused HDPE tees and bends by a contractor certified by a HDPE pipe or fusion machine manufacturer.

LAKE WHATCOM WATER & SEWER DISTRICT	SHARED FORCE MAIN SERVICE TAP	STANDARD DETAIL S13 5/1/2014



FLEXIBLE SEAL ADAPTER

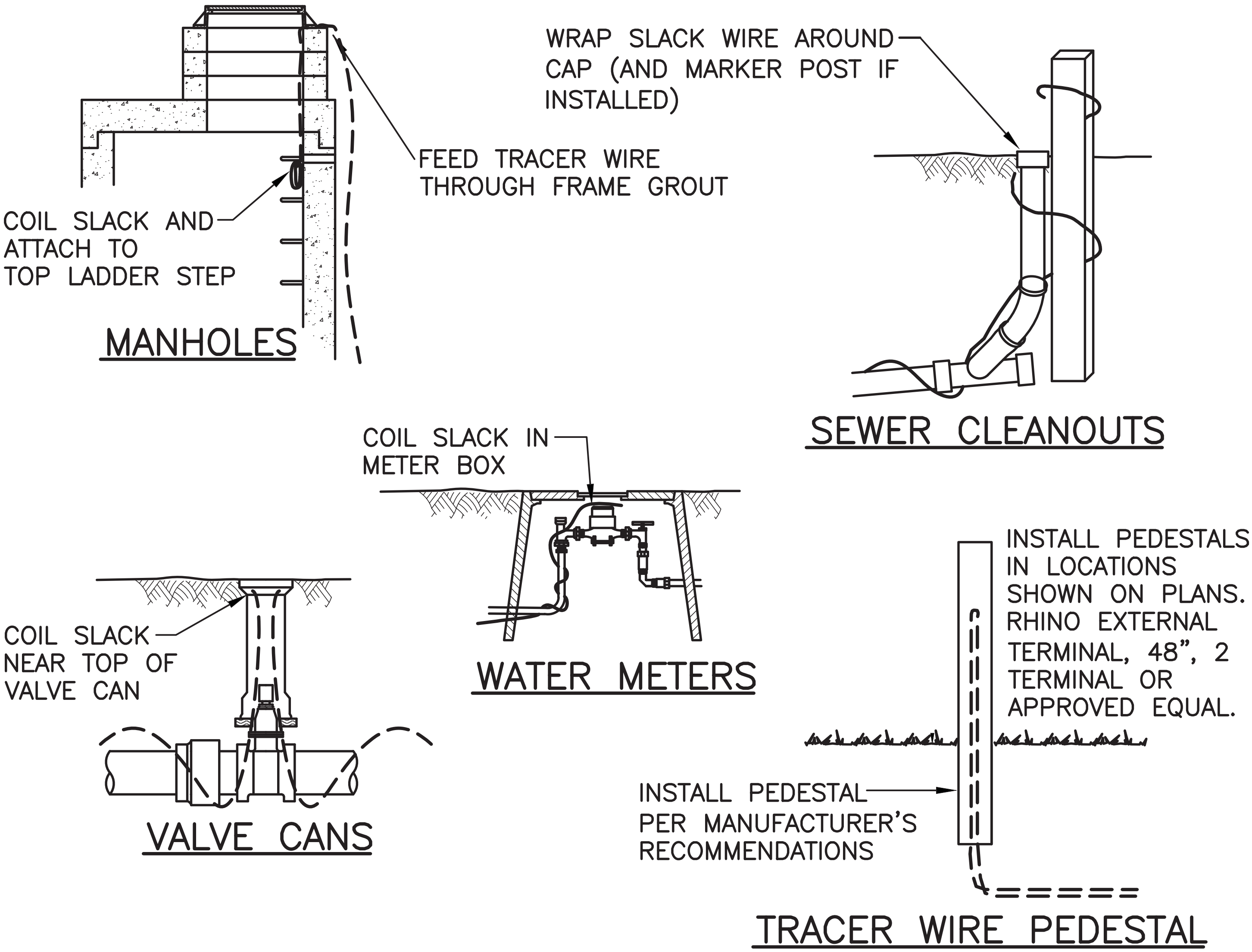


GROUT DETAIL

NOTES:

1. ALL MANHOLE CONNECTIONS SHALL BE 100% WATERTIGHT.
2. ALL PIPE SHALL EXTEND 2" INTO MANHOLE.
3. NEOPRENE BOOT ON THE FLEXIBLE SEAL ADAPTER SHALL BE A MINIMUM OF $\frac{3}{8}$" THICK PER ASTM C-443, AND SHALL BE HELD IN PLACE WITH AN INTERNAL EXPANDING STAINLESS STEEL BAND SUCH AS "KOR-N-SEAL" OR APPROVED EQUAL.
4. DEFLECTION AT THE ADAPTER MUST NOT EXCEED MANUFACTURER'S RECOMMENDATION. IF SLOPE OF PIPE AT PENETRATION EXCEEDS RECOMMENDED DEFLECTION, CAST OR CORE HOLE AT AN ANGLE SUCH THAT DEFLECTION DOES NOT EXCEED MANUFACTURER'S RECOMMENDATION.

LAKE WHATCOM WATER & SEWER DISTRICT	MANHOLE PIPE PENETRATION DETAILS	STANDARD DETAIL S15 9/20/2017



NOTES:

1. Tracer wire installation is required on all District owned pipe and communication lines. Tracer wire is also required on private side sewers.

2. Tracer wire shall be 10 AWG insulated copper wire rated for direct burial in wet locations. Use green insulation for sewer, blue insulation for water, and orange insulation for fiber/communication related utilities.

3. Install tracer wire in continuous lengths (no splices) between surface access points. Any direct bury splices shall be approved and inspected by the District Engineer prior to cover. Splices shall be made with silicone filled wire nuts rated for direct burial in wet locations such as "Ideal Underground Wire Connectors", "Ideal Mudbug Connectors," "Copperhead Snakebite Connectors," or "3M DBR Direct Bury Splice Kit."

4. Tape tracer wire to pipe at 10-foot intervals.

5. Provide at least 2-feet of coiled tracer wire slack at surface access points.

LAKE WHATCOM WATER & SEWER DISTRICT

TRACER WIRE

STANDARD DETAIL

E5

9/20/2017

LAKE WHATCOM WATER & SEWER DISTRICT

APPLICATION TO ESTABLISH DEVELOPER EXTENSION AGREEMENT (DEA)

1. Printed Name	2. Signature	3. Date Signed

4. Address	5. Phone	
	Home	
	Work	
	Fax	

6. Attach Following Maps (11 x 17 or smaller):

- ☐ Assessor map with parcels highlighted (black and white copies only, please)
- ☐ Proposed plat or lot layout with proposed water and/or sewer improvements. Show existing and proposed utility easements and public right-of-ways

7. Project Name

8. Site and Project Information

List of Parcel Numbers:	Proposed Number of Water Services:	
	Proposed Number of Sewer Services:	
Current Zoning:	Total Acres:	
Anticipated Start of Construction:	Anticipated Construction Duration:	

Provide a brief narrative description of the proposed development and requested water and/or sewer services. (If you require more space, please attach a separate sheet of paper):

To be completed by District

9. Application Complete	10. Application Fee Received	11. Receipt #	12. Received by
Yes ☐ No ☐	Yes ☐ No ☐		

13. General Manager Signature	14. Date Signed

*****SPECIAL NOTICES TO APPLICANT*****

- When you request to establish a DEA with the District, we will provide you with an Application and a sample of a Developer Extension Agreement. The sample is provided to you for information and planning purposes only.
- Once the District approves your application, you will be asked to complete and submit the DEA.
- Application processing steps are printed on the reverse of this form.
- This Application, once accepted and approved by the District, does not constitute, nor does it imply, a guarantee by the District to provide water or sewer service.
- This is NOT a “Will Serve” document.

OVERVIEW OF DEVELOPER EXTENSION PROCESS

Application Process:

A. Developer identifies basic facilities needed for the project.
B. Developer completes a Developer Extension Agreement (DEA) Application Form.
C. Board of Commissioners evaluates whether or not to allow extension.

After Board of Commissioners decides to allow extension:

D. District and Developer sign a Developer Extension Agreement.
E. Developer designs facilities using District Design Standards.
F. Developer constructs facilities using District's Construction Standards.
G. District accepts inprovements.
H. If applicable, District creates a Latecomer's Agreement with Developer per RCW's 56 & 57.

APPLICATION PROCEDURES

1. Applicant furnishes information required on reverse and pays application processing fee.

2. District performs preliminary Application completeness evaluation. If evaluation proves unsatisfactory, the District will return the application package to applicant citing deficiencies, and advise that application revision and resubmission is necessary.

3. Using information provided on the reverse, District ascertains proposed project conformance to the latest approved version of the District's Comprehensive Plan and other relevant District planning requirements. If found that:

   3.1. The information provided is insufficient to allow a determination, the District General Manager notifies the Applicant accordingly, citing discrepancies, and advises that Application revision/resubmission is necessary.

   3.2. In full conformance, the District General Manager advises the Applicant accordingly, and automatically petitions the District's Board of Commissioners to authorize the creation of a Developer Extension Agreement (DEA).

   3.3. In non or partial conformance, the District General Manager notifies Applicant accordingly, citing discrepancies, and advises that Application revision/resubmission is necessary.

   If a Comprehensive Plan Amendment is required, the Applicant petitions the District's Board of Commissioners to have the District attempt a formal amendment to the latest approved version of the District's Comprehensive Plan. Applicant is hereby cautioned that:

   - The Commissioners are not obligated to grant Applicant's request to attempt to amend the Comprehensive Plan.
   - Applicant shall fund all expenses associated with said amendment attempt, (current minimum estimate $1,000.)
   - Amendment approval is not guaranteed since amendments require approval by multiple State and County agencies.

After recording, return to:
Robert A. Carmichael
Carmichael Clark, PS
P.O. Box 5226
Bellingham, WA 98227

DOCUMENT TITLE:
DEVELOPER EXTENSION AGREEMENT

GRANTORS:
???? NAME ????

GRANTEE:
LAKE WHATCOM WATER AND SEWER DISTRICT, a municipal corporation

ABBREVIATED LEGAL DESCRIPTION:
???? SHORT LEGAL ????
Full legal descriptions at Page _______ of this document.

ASSESSOR'S PROPERTY TAX PARCEL NUMBERS:
???? APN ????

LAKE WHATCOM WATER AND SEWER DISTRICT

DEVELOPER EXTENSION AGREEMENT

(DEA)

Contract #	#D16__

Project Information			
Title	**???? Project Name ????**		
	Developer	Developer's Engineer	Developer's Contractor
Name			
Address		______ ______ ______	______ ______ ______
Phone #s		______ ______ ______	______ ______ ______

Table of Contents

1. DEFINITIONS

- Agreement or DEA – *This Agreement (known as Developer Extension Agreement or Application) for construction of Facilities by Developer intended for transfer to the District following Final Acceptance per Section 20, in accordance with all terms herein.*

- Connection Charge – *The current total monetary charge for general facilities charges, ULID or latecomer fees, as well as an administrative charge, which is paid to the District for system capacity. The connection charge is applicable for the calendar year issued, and thereafter shall be subject to such additional or higher fees as may thereafter be adopted by the District.*
- Construction - *Activities that execute or implement the Design.*
- Design - *Plans, specifications, drawings, and other related documents prepared by a qualified professional engineer licensed in the State of Washington, plus any other helpful visual or technical aids, such as graphics and mock ups, that communicate the details of the proposed* facilities.
- Design and Construction Standards – *District's 2016 Design & Construction Standards dated January 4, 2016, and as thereafter updated or amended.*
- Developer Conformance Deposit – a deposit identified as "Conformance Deposit" in Exhibit A1 schedule on fees and charges to be retained pursuant to the terms set forth in Section 13.
- Developer/Owner - *Person/entity making application to construct water, sewer, and/or stormwater* facilities. *The terms Developer and Owner are interchangeable in this Agreement.*
- Developer Extension Agreement ("DEA") - *the contract between the District and the Developer to construct water and/or sewer Facilities on property owned by the Developer, and in roads, easements, or other rights of way described in the approved application.*
- Developer's Contractor - *The entity selected by the Developer to perform* construction.
- Developer's Engineer - *The engineering entity preparing the design for the proposed Facilities. The Developer's Engineer shall be qualified under Section 4.3 below, but shall NOT be the District's Engineer.*
- District - *Lake Whatcom Water and Sewer District.*
- District Engineer - *The professional engineer employed by the District that administers the Developer Extension Agreement.*
- Facility/Facilities - *Water, sanitary sewer, and/or stormwater infrastructure and hardware; including but not limited to pipes and fittings, valves, pump stations,*

hydrants, associated electrical-mechanical devices, telemetry, buildings, and shelters which are proposed for construction under this Agreement..

- Notice to Proceed with Construction ("NTPC") - *A District generated document to the Developer that specifically authorizes the Developer to execute the District's Engineer's approved Design at the site. Conversely, the Developer shall not install water and sewer utilities at the site without prior receipt of a Notice to Proceed with Construction.*

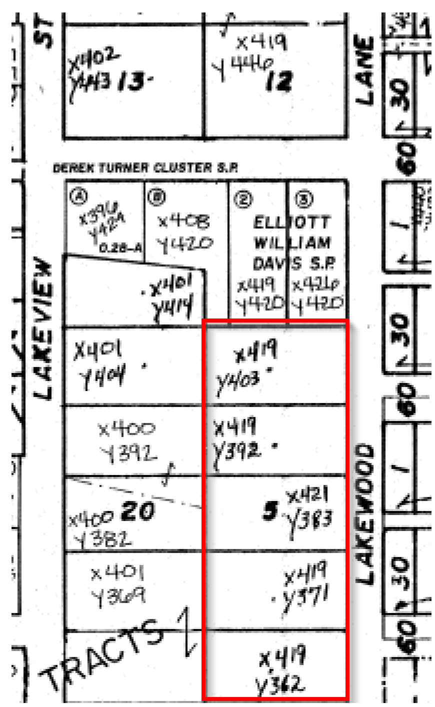
- Pre-paid Connection Certificate – *The certificate that the District issues when a Developer makes the required payment to reserve capacity in District-owned water and/or sewer Facilities as part of a Developer Extension Agreement.*

2. LOCATION OF PROPOSED FACILITIES

Developer shall install the proposed water and sewer Facilities on property owned by the Developer, and in roads and/or easements and/or other approved rights of way as described in an approved application for water and sewer. ????Insert any conditions of approval specified by Board of Commissioners during application review????. The Application was approved for ???X??? water and sewer connections on ________________, 2016.

The properties owned by the Developer ("Property") to be used for these Facility extensions have the following Whatcom County Tax Parcel number(s) (as of the date of this agreement):

Tax Parcel Number	Owner
000000-000000-0000	Name Address Address
00000-000000-0000	Name Address Address
00000-000000-0000	Name Address Address



The legal description of the Property is attached at Exhibit B.

3. COMPREHENSIVE PLAN

Developer represents that the proposed Facilities are consistent with the District's most current approved Comprehensive Plan.

4. FACILITIES DESIGN

4.1. Design Standards

The proposed Facility extension will consist of approximately 707 lineal feet of water line and 635 lineal feet of sewer line, plus appurtenances. The Facilities shall comply with the District's Design & Construction Standards in effect on the date the Notice to Proceed with Construction (NTPC) is issued by the District. The District reserves the right to update the Design and Construction Standards at any time. The Facilities shall also comply with Washington State Department of Health and Washington State Department of Ecology design standards and requirements. The Developer shall prepare all plans submitted in AutoCad Release 2002 or later format.

4.2. Design Standards Compliance Determination

The District Engineer retains exclusive and sole authority to determine when the Developer's Engineer's design complies with the Design and Construction Standards. The District Engineer is the Final Design approval authority. The Developer shall reimburse the District for all costs incurred to review project Final Design. The Developer shall not commence construction until the District Engineer approves the design and Developer receives the NTPC. It is the responsibility of the Developer to ensure that the plans prepared by the Developer's Engineer conform in all respects to District specifications. Failure by the District to discover errors, omissions, or discrepancies in the plans shall not relieve the Developer of this responsibility.

4.3. Developer's Engineer

<u>4.3.1. Qualifications</u>

Licensed Professional Engineer per RCW 18.43.

<u>4.3.2. Authority</u>

The Developer's Engineer shall design the Facilities that are the subject of this Agreement, prepare and submit for approval any construction-phase revisions, and prepare record drawings of the completed Facilities.

4.4. Changes

Failure of the District to require changes in the plans prior to approval of them shall not be deemed a waiver of the District's right to require such changes in the plans as the District may deem necessary during the course of work.

4.5. Ownership

The originals of all plans, including all electronic file media, prepared by the Developer's Engineer shall be delivered to the District upon completion of the project and shall become the property of the District. Neither Developer nor Developer's Engineer shall have any rights of ownership, copyright, trademark or patent in the plans.

4.6. Information Provided by District to Developer

The District shall make available to the Developer information it may have regarding existing utilities and obstructions. Such information is not guaranteed to be complete or accurate. Incompleteness or errors in this information shall not be the cause of a claim against the District or its consultants, nor shall it relieve the Developer of responsibility for repairing any damage its activities may cause to such utilities.

5. FACILITIES CONSTRUCTION

5.1. Prerequisites to Commencing Construction

- ❑ Developer pays District Administrative, Legal Services, Design Review, and Inspection Deposit (see Schedule A1) to District.
- ❑ District Engineer approves the design (see Section 4.2).
- ❑ Developer reimburses District for design review costs (see Section 4.2 and Section 6.1-6.2).
- ❑ Developer delivers copy of insurance policy (see Section 7) to District.
- ❑ Developer delivers copies of easements (see Section 9) to District.
- ❑ Developer delivers copies of permits (see Section 10) to District.
- ❑ Developer pays Developer Conformance Deposit (see Section 13) to District.
- ❑ Developer delivers performance bond (see Section 14) to District.
- ❑ Developer pays 25% of total amount of general facilities connection fees due (see Schedule A1) to District.
- ❑ District issues **Notice to Proceed with Construction** (NTPC) to Developer.

5.2. Construction Standards

The construction of the proposed Facilities shall comply with the design approved by the District Engineer and shall incorporate the District's Design and Construction Standards in effect on the date the Notice to Proceed with Construction (NTPC) is issued by the District. The District reserves the right to update the Design and Construction Standards at any time. The District retains exclusive and sole authority to determine Developer compliance with this requirement. A District designated inspector shall be present on the project site at all times wherever project construction activities occur that involves underground utility work or other work that is to be buried or covered. The Developer shall reimburse the District for costs incurred to perform site inspections. The Developer shall collect accurate field information and provide record drawings to the District. The District inspector's notes will also be made available, but should not be relied on as the only source of "as-built" information. Before final acceptance, the Developer shall provide the District with record drawings on mylar, together with their digital files (both Adobe PDF and AutoCAD DWG files). The District shall issue a "Final District Acceptance of Facilities" notification to the Developer when the Facilities are accepted. The Developer's professional land surveyor shall perform construction staking.

6. FEES AND CHARGES PAYABLE TO DISTRICT

6.1. Developer Obligation to for Fees and Charges

The Developer shall bear all costs, including those incurred by the District, associated with the administration, legal services, planning, design, construction, and required governmental agency approvals of the proposed Facilities project. District costs to be borne by Developer under this Agreement shall be based upon actual time and expenses including without limitation: District staff, engineering, inspections, certified operator, legal, financial, or other services. District staff labor rates are as listed in the most recent Master Fees and Charges schedule adopted by the District. The Developer shall be responsible for the payment of all such costs incurred by the District prior to Final Acceptance by the District and for two (2) years thereafter. The meaning of the term "Final Acceptance" as used in this Agreement is set forth in Section 20 herein.

The Developer shall have deposited with the District an Initial DEA Processing/General Administration Fee with application or submission of a request for entry of this Agreement and shall further deposit a District Administrative, Legal Services, Design Review and Inspection Deposit concurrent with signing this Agreement, in accordance with Exhibit A1.

Prior to commencement of Facilities construction, the District may, at its sole discretion, require the Developer to submit for District approval, a Facilities Construction Estimate (Exhibit A2) identifying the estimated cost and funding source of each Facilities element. If applicable, the Facilities Construction Estimate shall specify which Facilities Construction elements are General Facilities and which elements are to be subject to a Reimbursement Agreement, if any. The parties recognize that the actual costs of construction may vary from the Facilities Construction Estimate and that the Facilities Construction Estimate is to be used as a guide for development of a Reimbursement Agreement herein and determination of fees and charges during Final Acceptance.

6.2. General Fee Schedule

See separate attached DEA Fees and Charges Schedule (Exhibit A1). Fees and charges shall be collected at such times and in such amounts as set forth in Exhibit A1.

7. INSURANCE AND HOLD HARMLESS

The Developer shall take out and maintain during the life of this contract Public Liability Insurance for bodily injury and property damage liability, including without limitation, coverage for explosion, blasting, collapse and destruction of underground utilities and contingent liability, including products and completed operations and blanket contractual liability, as shall protect Developer, the District and its consultants. The Developer shall provide the District a signed certificate of insurance and CG2026 additional insured endorsement naming the District and its consultants specifically as additional named insured in said policies, all at no cost to the District. The Developer shall also require their Contractor and Subcontractors provide the same certificate and endorsement. The insurance shall cover the District and its consultants for all claims or damages for bodily injury, including wrongful death, as well as other claims for property damage which may arise from operations under this Agreement whether such operations be by the Developer, its contractor, or by any subcontractor or anyone directly or indirectly employed by them. The Developer agrees, in addition, to indemnify and save harmless the District, and the District's officers, agents, consultants, and employees, from all suits, claims, demands, judgments and attorneys fees, expenses or losses occasioned by the performance of this Agreement by Developer, any contractor, subcontractor, or persons working directly or indirectly for Developer, or on account of or in consequence of any act or omission of any such person, including but not limited to neglect in safeguarding the work or failure to conform to the safety standards for construction work adopted by the Safety Division of the Department of Labor and Industries of the State of Washington.

The Developer and the Developer's contractor shall not begin any work under this Agreement until all required insurance has been approved by the District and is in effect. Required insurance include:

1. Commercial general liability insurance in an amount not less than one million dollars ($1,000,000.00) per occurrence and one million dollars ($1,000,000.00) in the aggregate in any one year.

2. **Automobile Liability**
   $1,000,000 per accident Bodily Injury and Property Damage Liability, covering
   Any owned automobile
   Hired automobile
   Non-owned automobile

3. **Umbrella Liability**
   $2,000,000 per occurrence
   $2,000,000 aggregate

As an alternative to the above indicated Commercial General Liability and Umbrella Liability insurance policies, the Developer or his Contractor may provide the District with a District and Contractors Protective Policy with a limit of coverage of $5,000,000.

The Developer shall not cause any policy to be canceled or permit it to lapse, and all policies shall include a clause to the effect that the policy or certificate shall not be subject to cancellation or to a reduction in the required limits of liability or amounts of insurance or any other material change until notice has been mailed to the District stating when, not less than thirty (30) days thereafter, such cancellation or reduction or change shall be effective. In the event the District or Developer receives notice of cancellation, the Developer shall immediately obtain other comparable insurance acceptable to the District and provide proof thereof to the District. In the event the Developer is unable to obtain and provide such insurance, he shall immediately cease all work on the project, save and except that which is necessary to secure the site and prevent injury.

All certificates of insurance, authenticated by the proper officer of the insurer, shall state in particular those insured, the extent of the insurance, the location and operations to which the insurance applies, the expiration date, and the above mentioned notice of cancellation clause. The Developer shall provide a copy of insurance policy as well as the signed certificate of insurance and CG 2026 additional insured endorsement to the District prior to commencing construction.

8. SPECIAL CONDITIONS

This Agreement is conditioned upon Whatcom County's determination that the provision of water and/or sewer service to the proposed development complies with the Washington State Growth Management Act, RCW 36.70A. The Developer agrees to indemnify, defend, and hold harmless the District from any and all claims, suits, actions, or administrative proceedings, and any liability, loss or damage of any kind or nature, based upon any such actual or alleged violation.

9. EASEMENTS AND RIGHTS-OF-WAY

The Developer shall provide all necessary easements at its sole cost regardless of changes in the design, together with evidence of title, all subject to approval of the District. A licensed land surveyor shall prepare legal descriptions for easements across the property of others. Developer shall deliver to District on the standard District form these recorded easement(s) prior to the time Developer commences construction hereunder. Any required easements shall state that its purpose is to allow extension of District water and/or sewer services to the Property, as applicable, and shall name the District as grantee of the easement.

In accordance with the District's Standards, the Developer shall include in any preliminary plat documents the easements for all water and sewer facilities not located in public rights-of-way. A licensed land surveyor shall prepare legal descriptions for easements that cannot be clearly delineated on the plat map.

Prior to acceptance of Facilities, Developer shall deliver to the District all original recorded easements, and copies of the recorded plat (if there is a new plat) or other proof of dedication to Whatcom County of any newly designated or existing but unopened rights-of-way.

Developer shall provide a title insurance policy establishing clear title in grantor to District in sum not less than $1000.00 per 500 lineal feet of easement.

10. PERMITS AND COMPLIANCE

Developer shall obtain all necessary permits and approvals. Developer shall provide the District with a copy of all such permits and approvals before construction begins. Construction shall proceed in accordance with all permits, approvals, and other governmental requirements, including without limitation the Whatcom County Development Standards and other District requirements. The District reserves the right to cancel, suspend, or not renew or extend this Agreement in the event that the Developer, or its agents, are not in compliance with this Agreement, the Plans and Specifications, the terms of any permits and approvals, the Whatcom County Development Standards, or other governmental requirements.

11. USE OF EXISTING FACILITIES

Until execution and acceptance of the Bill of Sale there shall be no water and/or wastewater flow through any on-site or off-site mains or facilities, unless otherwise authorized in writing by the District.

12. LATECOMER REIMBURSEMENT AGREEMENT

At the request of the Developer prior to District final acceptance of facilities, subject to determination by the District that the Developer constructed Facilities qualify for a Latecomer Reimbursement Agreement, the District will prepare a Latecomers Reimbursement Agreement with Developer per Title 57 RCW in substantial conformance with Exhibit C. Developer shall submit to the District all contracts and costs related to the Facilities. The District's Engineer will determine the benefit area of the new Facilities and verify those costs that are eligible for reimbursement. If the District determines that no benefit area per Title 57 RCW exists, then no Latecomers Reimbursement Agreement will result. The Latecomers Reimbursement Agreement shall be signed and notarized by the Developer prior to final acceptance of Facilities. The District will record the Reimbursement Agreement with the county auditor at the Developer's expense. Requests by the Developer to establish a Latecomer Reimbursement Agreement after District's Final Acceptance of Facilities pursuant to Section 20 will not be considered.

13. DEVELOPER CONFORMANCE DEPOSIT

The Developer Conformance Deposit shall be held until the Developer has filed with the District a copy of the recorded plat and any adjustments, amendments, or additions to the easement documents or as-built records of the District that are required due to changes in the development, including but not limited to the following: lot lines, greenbelt area legal description, easement descriptions, right-of-way dedication.

The District will retain the Developer Conformance Deposit until all items requiring adjustment, amendment, or addition have been completed. All costs of such changes for engineering, legal and administration shall be deducted from the Developer Conformance Deposit and any balance remaining shall be returned to the Developer. The Developer Conformance Deposit shall not constitute a limit on the amount to be paid to the District for any such adjustments, nor shall it limit the District's authority to require any other deposit provided for in this Agreement. Connections to the system will not be allowed until the District has been reimbursed for the full amount thereof if in excess of the amount of the Developer Conformance Deposit.

14. PERFORMANCE AND PAYMENT BOND; INSTRUMENT IN LIEU OF BOND

Prior to commencement of the work, the Developer shall furnish to the District a performance and payment bond between Developer and the District upon a Developer-provided form with sureties approved by the District and in an amount equal to 150% of the estimated cost of the project as determined by the District Engineer. The performance and payment bond shall require the Developer to faithfully perform all the provisions of this Agreement, including the execution of the approved Plans in accordance with the District Design & Construction Standards, and to pay all laborers, mechanics, and subcontractors and materialmen, and all persons who supply such person or persons, or subcontractors, with provisions and supplies for the carrying on of the work. The performance and payment bond shall also hold the District harmless from any claims thereof, whether any such claims would arise under the public works lien statutes, or the mechanic lien statutes of the State of Washington or any other source, and compliance with the formal requirements of any such statutes shall not be a condition to recovery upon said bond.

In lieu of a performance and payment bond the Developer may provide the District with refundable cash deposit, assignment of savings, or an irrevocable letter of credit in the amount of 150% of the estimated cost of the Facilities, to be held by the District until completion of construction. Any assignment of savings or irrevocable letter of credit shall be issued by a Bellingham bank in a form acceptable to the District and payable to the District upon demand. Any such account shall be insured by the Federal Deposit Insurance Corporation ("FDIC") for up to Two Hundred Fifty Thousand Dollars ($250,000.00).

Should the work not be completed within the time allowed under this Agreement, the District may complete the Facilities and charge the bond, or other account or instrument accepted in lieu of bond, for its costs.

15. MAINTENANCE BOND

In addition to the performance and payment bond or other instrument in lieu of bond required by Section 14, the Developer shall provide a maintenance bond in the amount of ten percent (10%) of the construction costs as documented by the Developer, but in no event in an amount less than three thousand dollars ($3,000.00). The maintenance bond shall guarantee that the Facilities transferred to the District by bill of sale shall remain free of defects and in proper working order without the need for maintenance for two (2) years after acceptance of the Facilities by the District and shall be in a form acceptable to the District.

16. GRADING OF ROADS

Developer shall grade all roads to the design subgrade elevation prior to the start of construction and shall advise the District, in writing, of any changes, which may be contemplated during construction. If the Developer changes the subgrade elevation of the road after completion of the Facilities, or any part thereof, the Developer shall be responsible for all costs incurred for the Facilities as a result of said change in subgrade elevation. This obligation shall remain in full force until Whatcom County or other municipality releases the road construction maintenance bond or bond of other description in connection with the Developer's obligation for completion of roads within the area.

17. CONNECTION TO THE DISTRICT'S SYSTEM

New Facilities shall not be eligible for connection to the District system until after there is Final Acceptance of the new Facilities by the District pursuant to Section 20 and after satisfaction of the terms in Section 21. Written application for permission to make the actual connection to the District's system at a specified time shall be made by Developer or its contractor not less than 48 hours prior to the time that connection to the District's system is desired. All connections to the existing system and all testing of the new Facilities shall require prior authorization of the District or its authorized representatives and shall be conducted in the presence of the District's representatives. All inspections, connections and testing shall be made during normal working hours, unless prior arrangements have been made with the District.

Openings of valves and use of water from the District's system will be done by the District or its authorized representative. The District reserves the right to require that connections be made by live tap where disturbance of water service would in the opinion of the

District, be unduly detrimental. The District may elect to make connections to the existing system and the Developer shall pay all costs for the connection.

The District shall supply flushing water (approximately two fillings of the pipe system) for the Facilities. Water for additional or excessive flushing or other purposes such as settling and dust control shall be purchased by the Developer from the District at the current cost established by the District for such purpose.

18. PRE-PAID CONNECTION CERTIFICATION

The District will issue a Pre-paid Connection Certificate for each approved connection after the Developer makes the required payment of all General Facilities Connection Fees. The Pre-paid Connection Certificate reserves capacity in District-owned water and/or sewer facilities. The connection charge paid is applicable for the calendar year issued, and thereafter shall be subject to such additional or higher fees as may thereafter be adopted by the District.

19. BILL OF SALE AND WARRANTY

Developer agrees to execute a Bill of Sale prepared by the District prior to acceptance of system and furnish it to the District. The Developer shall deliver a copy of the recorded plat, short plat, or legal description of the property. A legal description, prepared by the Developer's professional land surveyor, is required for inclusion into the Bill of Sale. Said Bill of Sale will provide for transfer of title of the extension Facilities from the Developer to the District and will state that Developer grants the Facilities to the District in consideration of the District incorporating the Facilities into its overall system. The Bill of Sale will also include the following statements, each of which shall be a warranty for the benefit of the District:

A. Developer is the lawful Owner of said Facilities and the Facilities are free from any encumbrances.
B. Developer has the right to transfer said title and will warrant and defend the same against all claims and demands of all persons.
C. A statement of the costs, separating the costs of the water Facilities from the cost of the sewer Facilities, including administration, legal and engineering fees.
D. All bills for labor and material have been paid and the Developer has provided a certificate from the contractor installing the Facilities, and the Developer's Engineer, acknowledging that the contractor and engineer have been paid in full and/or do fully release, transfer, assign and set over to the District all of their rights, title, claims and interest therein.
E. Construction of the Facilities was performed in compliance with all laws, regulations, and ordinances and the Facilities and in accordance with District Design and Construction Standards.
F. There are no claims or lawsuits involving the Facilities.
G. Developer further warrants that for a period of two (2) years from the date of the Bill of Sale that the facilities will remain in good working order and condition except where abused or neglected by the District. The Developer will repair or replace at its own expense any unsatisfactory work or material during the two (2) year period of warranty. The District will inspect the facilities at the end of the 2-year period.

Developer shall indemnify, hold the District harmless from, and defend all claims and demands made against the District which implicate any of the above warranties for a period of two (2) years from the date of the Bill of Sale.

Developer shall support the foregoing warranties and indemnification obligation by a warranty bond or other form of security in an amount equal to five percent (5%) of the total cost of the Facilities for the 2 year warranty period at the request of the District. The District will inspect the Facilities at the end of the 2 year warranty period. The security will be released after the warranty period following inspection of the Facilities and any necessary repair or replacement.

20. FINAL ACCEPTANCE

Formal Final Acceptance of the Facilities shall occur when all of the following conditions occur.

- ❑ District inspects and approves facilities as 100% complete.
- ❑ District receives water meters (Master Meter Dialog 3G Wireless RF) for each service. (see District Design and Construction Standards)
- ❑ District receives and accepts record drawings (see Section 5).
- ❑ District receives and accepts easements and title insurance (see Section 9).
- ❑ District receives warranty bond or like security (See Section 19).
- ❑ District receives Maintenance Bond (see Section 15).
- ❑ District receives and approves Bill of Sale (see Section 19).
- ❑ District receives a copy of recorded plat, short plat, or legal description (see Section 19).
- ❑ District receives legal description of property (see Section 19).
- ❑ District receives Latecomers Reimbursement fees due to other Developers, if Latecomers Reimbursement Agreement(s) apply to Developer's property.
- ❑ Developer pays to District any Supplemental DEA Processing/General Administrative Fees, if due.
- ❑ District receives signed and notarized Latecomers Reimbursement Agreement prepared by the District, if applicable.
- ❑ Developer has reimbursed the District for all costs it has incurred associated with this Agreement and paid the District for all costs due and owing to District (see Section 6; Section 21).
- ❑ Developer has met and completed all local, state, and federal permit requirements (including completion of the Notice of Termination for the Department of Ecology Construction Stormwater General Permit)

21. CONDITION PRECEDENT

Compliance with the terms and conditions of this DEA and all applicable resolutions of the District shall be a condition precedent to the District's obligation to accept a Bill of Sale and a condition precedent to the District's agreement to maintain and operate the Facilities and to provide utility service to the real property described herein. Without limiting the generality of the preceding sentence, the District shall be under no obligation to allow connections to the water or wastewater system of any portion of the real property described in this DEA if there are any fees or costs due and owing to the District arising from this DEA or from regulations, resolutions or ordinances of any government agency.

The District shall not be obligated to provide utility service to the property described in this DEA if construction by third parties of facilities to be deeded to the District have not been completed and title accepted by the District if said third party facilities are necessary to provide utility service to the said property.

22. BREACH OF CONTRACT - ATTORNEY'S FEES

A breach of any provision of this DEA shall constitute a total breach hereof, and shall subject the Developer to cancellation of the DEA, forfeiture of deposits, and claim for costs and damages, as allowed by law. The parties agree that in the event of litigation regarding the terms or performance of this DEA, the substantially prevailing party shall be entitled to an award of reasonable attorney fees and costs, in addition to any other appropriate remedy.

23. LIMITATION OF PERIOD FOR ACCEPTANCE

There must be Final Acceptance of the completed Facilities by the District pursuant to Section 20 prior to any building permit applications being submitted to Whatcom County for the construction of any building on the Property and prior to commencement of any such construction. The Facilities shall be completed and accepted by the District within three (3) years of this Agreement. If the Facilities are not completed and accepted within three (3) years from the date below, then the Developer's rights under this DEA shall cease. The Developer may submit a written request along with the DEA Renewal Fee to request a DEA renewal from the Board of Commissioners. The Board of Commissioners has the right to reject or accept the renewal request in its sole discretion. If the Board of Commissioners accepts the renewal request, the Developer shall pay all administrative, legal, engineering, and other costs incurred to renew the DEA, all as determined by the Board of Commissioners. A DEA renewal requires both the Developer and Board of Commissioners signing a new DEA. In the event that a renewal request is not forthcoming from the Developer or in the event the District in its sole discretion rejects such renewal request, upon mailing a notice of forfeiture from the District to the Developer the performance and payment bond posted pursuant to Section 14 shall be immediately forfeited and paid to the District in its entirety in cash without further notice. The District is not responsible for notifying the Developer of pending Contract expiration.

24. RESPONSIBILITY FOR PROJECT MANAGEMENT

The Developer shall be responsible for project management and coordination. Project management includes without limitation overall project coordination, utility and road locations and elevations and conflicts of same.

25. NO THIRD PARTY RIGHTS CREATED

This agreement is made entirely for the benefit of the District and the Developer and successors in interest. No third party shall have any rights hereunder, whether by agency or as a third party beneficiary or otherwise.

26. COMPLETE AGREEMENT

This Agreement constitutes the entire agreement between the Developer and the District. This Agreement may be modified in writing only, upon mutual agreement of the parties.

27. JOINT AND SEVERAL LIABILITY

Each and every person or entity party to this Agreement as "Developer" and/or "Owner" shall be jointly and severally liable for performance of the obligations in this Agreement. The District shall have the right to full performance of this Agreement from each and every person identified as "Developer" or "Owner" without regard to the respective obligations that such persons or entities may have to each other. The joint and several liability of all persons and entities identified as Developer and/or Owner for performance of the obligations herein is a material part of this Agreement.

28. BINDING OF PROPERTIES

Parcels listed in this Agreement are bound by the terms of the Agreement until the Agreement expires or the defined improvements are completed per the Agreement. While the Agreement is in force, requests for Denial of Service from parcels which will be served by the defined water and/or sewer improvements will not be considered by the District.

29. AGREEMENT

We, ____, the Owners / Developer of the Property, have read, understand, and fully agree to the terms and conditions set forth in this application and Agreement.

____

Owner Name Date
Address
Address
(Owner of Parcels 000000-000000-0000)

APPROVED as to form:

____
Robert Carmichael
Attorney for Lake Whatcom Water & Sewer District

Dated: ____

APPROVED this ____ day of ________________, _________

LAKE WHATCOM WATER AND SEWER DISTRICT
Whatcom County, Washington

By: _______________________________________
President, Board of Commissioners

LAKE WHATCOM WATER AND SEWER DISTRICT

EXHIBIT A1 - DEA FEES AND CHARGES SCHEDULE

(per current Master Fees and Charges Schedule)

Purpose	Amount	Due	Refundable
Initial DEA Processing/General Administration	$750.00	With application or request for Contract	No
Supplemental DEA Processing/General Administration	If District's actual costs are greater than above amount, District will bill Developer for balance due	Prior to Final District Acceptance of Facilities	No
DEA Renewal District Commissioners approve renewal.	$750.00	With written request for renewal	Yes, if Commissioners deny renewal request.
Final Design Review (Performed by District's Engineer)	District Engineer's direct costs as invoiced to District plus 2% administration fee	With submission of final Drawings and Specifications for review	No
District Administrative, Legal Services, Design Review and Inspection Deposit	District's costs as invoiced to District and as incurred in District staff time, plus 2% administration fee -------------------------------- $5,000.00 minimum initial deposit or such other amount as determined appropriate by District -------------------------------- $2,000.00 minimum supplemental deposit or such other amount as determined appropriate by District	See below. -------------------------------- Upon Signing Contract -------------------------------- Whenever account balance is less than $2,400.00. If account balance is ever less than $800.00, District will issue an immediate stop work order and will suspend the DEA until the account balance is more than $2,400.00	Yes, to extent balance exists on Final District Acceptance of Facilities date
General Facilities Connection	*Total*: Per separate schedule in effect on day of Final District Acceptance of Facilities -------------------------------- *Initial Deposit*: 25% of total amount per separate schedule in effect on day DEA approved/signed -------------------------------- *Balance* = (*Total - Initial Deposit)*	See below for *Initial Deposit* and *Balance* -------------------------------- Prior to Notice to Proceed with Construction -------------------------------- Prior to Final District Acceptance of Facilities	No NOTE: Payment of fees does not guarantee utility service priority if DEA expires or if Developer abandons DEA.
Conformance Deposit (See Section 13)	$1,000.00	Prior to Notice to Proceed with Construction	No
Performance Bond (See Section 14)	150% of estimated project cost	Prior to Notice to Proceed with Construction	No
Maintenance Bond (See Section 15)	10% of constructed facilities cost	Prior to Final District Acceptance of Facilities	No
Latecomers Fees owed to other Developers or District ULID Fees owed	Depends on existence of any Latecomers Reimbursement Agreements or District ULIDs applicable to	Prior to Final District Acceptance of Facilities	Yes, if paid and District does not accept facilities, or if paid and Developer cancels project.

Purpose	Amount	Due	Refundable
	developed property		
Special Agreements (For costs to prepare any special agreement(s) between District and Developer)	Actual cost plus 2% administration fee	Payable in full on demand	No
Third Party Claims (For all costs, damages, and expenses, including reasonable attorneys fees, incurred by District responding to, and/or defending claims made by third parties for acts of Developer, Developer's Engineer, or Contractor)	Actual cost plus 2% administration fee	Payable in full on demand	No
Contract Noncompliance (For all costs, charges, expenses, and damages attributable to failure of Developer to comply with this Contract and/or the requirements of any governing agency)	Actual cost plus 2% administration fee	Payable in full on demand	No

EXHIBIT A2 – FACILITIES CONSTRUCTION ESTIMATE

LAKE WHATCOM WATER AND SEWER DISTRICT
DEVELOPER EXTENSION PROJECT ELEMENTS AND FINANCIAL RESPONSIBILITY

PROJECT ELEMENTS			**FINANCIAL RESPONSIBILITY**			
Description	**Estimated Project Cost**	**% of Project Cost**	**General Facilities**		**Local Facilities**	
			1. District	2. Payback	3. Developer	4. Latecomers
Totals:	**$**	**%**	**$**	**$**	**$**	**$**

1. **Total District Responsibility, General Facilities**
2. **Total Payback for General Facilities**
   (initially paid by Developer, credited against GFC due for water system; remainder, if any, reimbursed per Agreement)
3. **Total Developer Responsibility, Local Facilities**
4. **Total Latecomers for Local Facilities**
   (initially paid by Developer, reimbursed per agreement).

<u>EXHIBIT B – LEGAL DESCRIPTION</u>

To be prepared by developer's licensed land surveyor.

EXHIBIT C

AFTER RECORDING RETURN TO:

CARMICHAEL CLARK, PS
ATTENTION: ROBERT A. CARMICHAEL
P. O. BOX 5226
BELLINGHAM, WASHINGTON 98227

DOCUMENT TITLE:	**REIMBURSEMENT AGREEMENT**
REF. NO. OF RELATED DOCUMENT:	**N/A**
GRANTOR(S):	___________________________________ ___________________________________
GRANTEE(S):	**LAKE WHATCOM WATER & SEWER DISTRICT**
ABBREVIATED LEGAL DESCRIPTION:	___________________________________
Additional Legal Description On Page ____ Of Document.	
ASSESSOR'S TAX/PARCEL NUMBER(S):	___________________________________

REIMBURSEMENT AGREEMENT

THIS AGREEMENT, made and entered into this ______ day of _____________________, 20___ between LAKE WHATCOM WATER & SEWER DISTRICT, a municipal corporation (hereinafter "District") and _________________________________ _________________________________, Developer/Owner (hereinafter "Owner").

RECITALS:

A. The District is a duly organized water district under the laws of the State of Washington, and is empowered to furnish water service, among other things, to property owners within and without the District in the manner provided by law; and

B. Owner heretofore entered into a Developer Extension Agreement ("Agreement") with District for the construction and installation of water and/or sewer system extensions to provide service to the area described on Exhibit "1" ("Developed Area") attached hereto; and Owner completed installation of said system extensions in accordance with the terms of the Agreement, portions of which are a benefit to real property within the District other than the Developed Area, which consists of water and/or sewer lines of a size and location described on Exhibit "2" attached hereto and designated "Water/Sewer Extension Facilities"; and Owner is entitled to reimbursement from developers and real property owners seeking connection to such facilities for the cost of such facilities in excess of Owner's fair pro rata share therefor, which costs have been determined as set forth below; and

C. The District will collect charges from the owners of property within the District, benefiting from the installation of the aforesaid Water/Sewer Extension Facilities; and such charges are the sole source of funds for the District from which reimbursement to the Owner can and will be made, as and when the same are collected; and

D. The District is permitted to enter into a Reimbursement Agreement with Owner under the provisions of RCW 35.91 *et seq.* and 57.08.005; and the parties desire to enter into a written agreement with reference to the foregoing matter; Now, Therefore,

IN CONSIDERATION OF THE FOLLOWING terms and conditions, the District and the Owner agree as follows:

1. **Completion of Facilities**. The installation of the Water/Sewer Extension Facilities ("Extension Facilities") described on Exhibit "2" in the developed area have been completed by Owner under an extension agreement with the District; and title thereto will be transferred to the District, and such Facilities will be a part of the District water/sewer system.

2. **Records/Costs.** Owner has obtained and submitted to the District accurate records which have been provided to the District of the actual cost of installing such Facilities in accordance with the Agreement; and the District Engineer has reviewed and approved the costs of such Facilities as reasonable costs and District accepts such costs as costs which are subject to reimbursement; and District agrees to reimburse Owner in the manner and on the terms and conditions set forth in this agreement, in an amount not to exceed $________________ for water facilities and $_________________ for sewer facilities, less administrative costs incurred by the District in collecting reimbursement charges. Owner agrees to reimburse the District for all administrative costs incurred by the District in collecting reimbursement charges. This reimbursement of collection related administrative costs and charges due from Owner to the District shall be deducted

from the amount reimbursed to the Owner as provided in Paragraph 3.B.2. herein.

3. **Method of Reimbursement**

A. **Benefited Properties.** The properties benefiting from the installation of the Extension Facilities as determined in the sole discretion of the District, and which did not contribute to the original cost thereof are as described on Exhibit "3" attached hereto.

B. **Charges.**

1. **Amount.** Prior to allowing a benefited property to connect to the Extension Facilities, the District shall collect the fair pro rata share of the cost of installing such facilities as a charge from the owners of benefited properties. The benefited properties to which this provision shall apply are set forth on Exhibit "3". The amount of such reimbursement charges to be collected prior to each connection is also set forth on Exhibit "3". Such charges may include, but are not limited to, pro rata share of District legal, engineering, administrative, set-up, handling and actual costs of the facility. Such reimbursement charges shall be in addition to all other District charges in effect at the time of seeking connection to such extension facilities, including without limitation, general facilities fees. Upon application by affected property owners, the District may further segregate reimbursement charges attributed to property benefited by the Extension Facilities. All costs of such segregation shall be borne by the party requesting such segregation.

2. **Payment.** District shall deduct from all reimbursement charges it collects an amount equal to two per cent (__2__%) of each collected amount to cover its administrative collection costs, and the remaining balance shall be paid over to Owner within sixty (60) days after receipt thereof.

C. **Payment Procedure**. The District shall forward reimbursement funds referenced herein to Owner or to Owner's agent as authorized by Owner to the District in writing. Owner hereby directs that reimbursement funds be mailed to the following address, unless later directed by Owner in writing:

____

____

____

As a condition of receiving such reimbursement funds, Owner or Owner's agent shall execute a receipt to the District for such reimbursement amounts so paid upon a receipt form provided by the District. Such form shall include the legal description and name of the owner of the connecting property making payment of such amount to the District. The District shall have no obligation to segregate reimbursement funds to be received among individual property owners. Each payment will be made payable to all parties identified as the Owner in this Agreement in lump sum and it shall be the sole responsibility of the Owner to disburse funds received among individual property owners.

In the event of dispute as to the rightful party to receive such funds, District may pay the same to the Owner referenced herein or interplead such funds to the court; in either event, District shall thereupon be relieved of any further obligation or of any liability hereunder as to such reimbursement funds so paid. The Owner shall indemnify the District for any liability and costs, including attorney fees, incurred by the District in such interpleader action or in otherwise making reimbursement payment in accordance with the terms of this Agreement.

4. **District Authority; Effective Date; and Contract Duration**. The District is authorized to enter into this agreement by virtue of the provisions of RCW 35.91 et seq. and RCW 57.08.005; and this Agreement shall remain in full force and effect for a period of twenty (20) years, beginning from the date of final acceptance of title to the extension facilities by the District's Commissioners. All of Owner's rights to reimbursement shall terminate upon expiration of said twenty (20) year term, regardless of the status of reimbursement at that time.

5. **Recording.** This contract shall be recorded in the office of the Whatcom County Auditor, Whatcom County, Washington, immediately upon execution by the District and the Owner.

6. **Agreement Implementation.** The District will use its best efforts to collect and distribute the funds pursuant to the process set forth in this Agreement. However, the District, its officials, employees or agents shall not be held liable or responsible for failure to implement any of the provisions of this Agreement unless such failure was willful or intentional.

7. **General.** This Agreement constitutes the entire agreement between the parties. All exhibits referred to herein are by this reference made a part of this Agreement as though set forth in full. This Agreement is binding upon the heirs, executors, administrators, successors and assigns, of each of the parties hereto.

8. **Assignment.** The Owner shall not assign the whole or any part of this Agreement without the prior written consent of the District, and in the event of such assignment shall notify the District of the name and address of the assignee.

LAKE WHATCOM WATER & SEWER DISTRICT

____

By: District
Its: Board President

DEVELOPER/OWNER:

____
Name: ______________________________
Address: ___________________________
____
Telephone: _________________________

DEVELOPER/OWNER:

____
Name: ______________________________
Address: ___________________________
____
Telephone: _________________________

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

I certify that I know or have satisfactory evidence that _______________ signed this instrument, on oath stated that he was authorized to execute the instrument and acknowledged it as the <u>President</u> of LAKE <u>WHATCOM WATER & SEWER DISTRICT</u> to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal this _____ day of _______________, 20___.

____
NOTARY PUBLIC
Print Name: ____________________________
My commission expires: _________________

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

I certify that I know or have satisfactory evidence that ___________________ signed this instrument, on oath stated that he/she was authorized to execute the instrument and acknowledged it as the Developer/Owner to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal this _____ day of ______________, 20___.

____
NOTARY PUBLIC
Print Name: __________________________
My commission expires: ________________

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

I certify that I know or have satisfactory evidence that ___________________ signed this instrument, on oath stated that he/she was authorized to execute the instrument and acknowledged it as the Developer/Owner to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal this _____ day of ______________, 20___.

____
NOTARY PUBLIC
Print Name: __________________________
My commission expires: ________________

EXHIBIT 1
DEVELOPED AREA

EXHIBIT 2
EXTENSION FACILITIES

EXHIBIT 3
BENEFITTED PROPERTIES

Appendix H – Water and Sewer Design Standards and Construction Standards and Details

2017
DESIGN & CONSTRUCTION STANDARDS

December 7, 2017

Lake Whatcom Water and Sewer District
1220 Lakeway Drive
Bellingham, WA 98229

(360) 734-9224

Available on the web at http://www.lwwsd.org

TABLE OF CONTENTS

CHAPTER 1 DRAWING STANDARDS

1.1 Construction Drawings

1.1.1 Format and Content

Construction drawings for proposed public water and/or sewer facilities shall be prepared in accordance with the following drawing standards.

Format

- Drawings submitted for review: 50% reduced scale 11”x17” sheets
- Final drawings submitted for approval: full scale 24”x36” sheets
- Minimum text size 0.08” when plotted at full scale size.

Basic Drawing Elements

- North Arrow
- Scale Bar
- Legend (Clearly differentiate between existing and proposed features)
- Vicinity Map
- Overall Project Map
- Vertical Datum and Project Benchmark Information

  All projects in the District must be on either NAVD88 or the “Old” City of Bellingham Vertical Datum (1909 to 2009).
- Horizontal Survey Reference Point Information

  All projects in the District must be based on NAD83 (1998) City of Bellingham monument-derived coordinates. Show bearing and distance information between survey reference points.
- Lake Whatcom Water and Sewer District General Notes. Water System Notes and/or Sewer System Notes as appropriate.
- Lake Whatcom Water and Sewer District Standard Details as applicable for type of improvements

Scale for Plan and Profile Drawings

- 1" = 20' horizontal in areas with existing utilities or improvements
- 1”=50’ horizontal in areas with little or no existing utilities or improvements.
- 1”=2’or 1"= 5' or 1"=10' for vertical as appropriate

Topographic and Survey Information

- Right-of-way
- Easements (with Auditor File Numbers)
- Existing features and improvements
- Contour intervals of 1 or 2 feet as appropriate site and design

- Existing features and improvements such as pavement, concrete, gravel, sidewalks, curbs, utility poles, transformers, telephone pedestals, overhead and underground utilities.

Plans

- Proposed improvements clearly shown and noted
- Design alignment and stake out information. (Stationing, bearings, distances, and offsets)
- For water mains, lineal footage from water main fitting to fitting.
- For sewer mains, lineal footage between exterior faces of manholes.
- Pipe material type called out on each segment

Profiles

- All utility crossings with clearances noted.
- Distances from centerline of manhole to manhole
- Distances from exterior face of manhole to manhole
- Calculated slope between exterior face of manhole to manhole (actual pipe slope)
- Rim and invert elevations for existing and proposed manholes
- Trench dams shown

1.1.2 Plan Review Sets

Submit two sets of 50% reduced scale 11”x17”drawings. If there are review comments, the District will return one redlined original set. For subsequent re-submittals, submit two sets of 50% reduced scale drawings.

1.1.3 Final Approval Sets

Once all District review comments have been addressed, the District will request three full scale sets to stamp “Approved for Construction.” The District will retain two sets and return one approved set.

1.2 Record Drawings

1.2.1 Content

Record drawings shall include the exact location of all water and sewer mains and services and the approximate location of all other underground and above ground utilities and shall include information listed below.

Basic Information

- Each drawing shall include “Record Drawing” boldly noted on each sheet.
- Line-out design text that has changed and note record information.
- Circle plan design elements that changed and show record information.

Water Mains and Services

- Location of all vertical and horizontal bends in the water system. Stationing shall be along the length of the extension.
- Location of all water valves, hydrants, hydrant valves, and blow-offs with distance along centerline and distance from the centerline.
- Location of all utilities within easements. This includes distances to the utilities from the easement lines.
- Stationing of service taps on the main. Stationing shall be cumulative along the length of the extension.
- Distance from main to meter.
- Distance from tap to a point opposite (at 90 degrees) the meter along main, and station this point.
- Distance from this point on the main to the meter (distance 90 degrees).
- Depth of all services.

Sewer Mains and Service Stubs

- Location of all sanitary manholes, inverts, valves and cleanouts on the sewer main.
- Location of all vertical and horizontal bends in the force main system.
- Location of all side sewer saddles on the sewer main from the back-station manhole.
- Stationing of all sewer wyes into the main, located from the back station manhole.
- Length of side service stub, lineal feet, and size of pipe.
- Distance along mainline from side sewer wye to where end equals 90 degrees from mainline.
- Distance from this point on the main to the end of stub. (distance 90 degrees).
- Depth of services at end of stub.
- Location of cleanouts on the sewer stub.

1.2.2 Construction Record Keeping

All District projects must have full time inspection. A District Inspector will document and maintain construction asbuilt information. It is the Contractor's responsibility to ensure that the Inspector has all asbuilt information and measurements recorded prior to backfill of facilities.

1.2.3 Preparation

A copy of the District inspector's notes and sketches will be given to the Engineer of Record for preparing the record drawings. For developer constructed facilities, the developer's engineer prepares and stamps the record drawings. For district constructed facilities, the District's consulting engineer prepares and stamps the record drawings.

1.2.4 Review and Submittal Format

Submit one 50% reduced scale 11"x17" set to the District for review. Upon acceptance, the District will request final record drawings. Final records drawings include one set on Mylar, one set on paper, AutoCAD .dwg files, and an electronic PDF set.

1.2.5 Condition of Final Acceptance

Final record drawings must be received and accepted by the District before final acceptance of the project by the Board of Commissioners.

CHAPTER 2 DESIGN STANDARDS

2.1 Water Projects

2.1.1 Minimum Design Requirements

Minimum design criteria, unless the District criteria is more stringent, shall be in accordance with the current "Water System Design Manual", Washington State Department of Health and Washington Administrative Code Chapter 246-290 Public Water Supplies.

2.1.2 Minimum Pipe Size

Minimum pipe size for new or replaced water lines is eight (8) inches in diameter. Dead-end lines are only permitted where there is a cul-de-sac and where it is not possible to make a loop. Blow-offs or fire hydrants shall be installed at the end of a dead-end line.

2.1.3 Comprehensive Plan Requirements

Water system construction and reconstruction shall be done pursuant to a design that, when fully implemented, will provide the flow requirements of the District's Comprehensive Plan. Minimum pipe size shall be as identified by the District's Water Comprehensive Plan. A Latecomers agreement can be created if the sizing was in excess of that required by the Developer or Utility Local Improvement District.

2.1.4 Minimum Allowable Pressure

The minimum pressures allowed by the District at any time are 30 psi under peak hourly demand, or 20 psi under maximum day demand and fire flow combined.

2.1.5 Increases in Flow Requirements

When any new development increases the flow requirements, the Developer shall upgrade the existing water system to support the changes.

2.1.6 Providing for Future Extensions

Utilities shall be extended through the property to allow for future extension, expansion and continuation of the District's distribution system or for conformance with the Water Comprehensive Plan.

2.1.7 Easements

A minimum ten (10) feet of recorded easement must be provided on each side of the pipe, for a total width of twenty (20) feet.

2.1.8 Valves

Valves shall be installed along the water main at intervals not to exceed 500 feet per NFPA 1142 G.7. Gate valves shall be placed at all junction points, such that there are valves on each leg of a tee (3 valves), or cross (4 valves).

2.1.9 Fire Hydrants

Fire hydrants shall be installed every 600 feet.

2.1.10 Sampling Stations

One sample station per zone is required for each new pressure zone. The District may require sample stations for new developments in existing pressure zones.

2.1.11 Separation from Sanitary Sewer

Minimum separation of water mains and sanitary sewer lines shall be ten (10) feet horizontally for parallel pipe, and eighteen (18) inches vertically with water on top for perpendicular or oblique crossings, measured from the bottom of the water pipe to the crown of the sewer pipe. Situations occurring with less than the minimum separation as required shall be in accordance with Section C1-9.1 Required Separation Between Water Lines and Sanitary Sewers of the current edition of the "Criteria For Sewage Works Design" published by the Washington State Department of Ecology.

2.1.12 Pipe Slope and Air/Vacuum Release Valves

Water mains shall be installed at an upward slope to a high point where a combination air/vacuum release valve shall be installed.

2.1.13 Water Booster Stations

All public/District-owned water booster stations shall have at least two pumps.

2.2 Sewer Projects

2.2.1 Minimum Design Requirements

Minimum design criteria, unless the District criteria is more stringent, shall be in accordance with the current "Criteria for Sewage Works Design", State of Washington Department of Ecology.

2.2.2 Minimum Pipe Size

Minimum pipe size for sewer gravity mains is eight (8) inches except that, in special cases, 6-inch diameter sewer lines may be approved by the District if they meet the Department of Ecology Guidelines for 6-inch sewer lines. Minimum size for side sewers shall be six (6) inches from main to property line. Minimum size pipe for force mains shall be four (4) inches.

2.2.3 Providing for Future Extensions

Utilities shall be extended through the property to be developed to allow for future extension, expansion and continuation of the District's collection system or for conformance with Sewer Comprehensive Plan.

2.2.4 Easements

A minimum ten (10) feet of recorded easement must be provided on each side of the pipe, for a total width of twenty (20) feet.

2.2.5 Separation from Water Mains

Minimum separation of water mains and sanitary sewer lines shall be ten (10) feet horizontally for parallel pipe, and eighteen (18) inches vertically with water on top for perpendicular or oblique crossings, measured from the bottom of the water pipe to the crown of the sewer pipe. Situations occurring with less than the minimum separation as required shall be in accordance with Section C1-9.1 Required Separation Between Water Lines and Sanitary Sewers of the current edition of the "Criteria For Sewage Works Design" published by the Washington State Department of Ecology.

2.2.6 Manholes

Manholes shall be installed in accordance with Standard Details and DOE Guidelines. Manholes shall be placed at each grade and direction change. Distances between manholes shall not exceed 350 feet. Manholes shall be a minimum of five feet deep to the invert of pipe. Manholes shall be installed at the end of each line of 8-inch diameter or greater. Cleanouts shall only be used on 8-inch or smaller lines and shall be located not more than 150 feet from a manhole.

2.2.7 Manhole Drop Connections

An outside drop connection shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Inside drops may be used only at the discretion of the District on existing manholes.

CHAPTER 3 CONSTRUCTION STANDARDS – GENERAL NOTES

3.1 Construction Plan Notes

The General Notes apply for all new public facility construction within the District and shall be included in every construction plan set. Water System Notes and Sewer System Notes shall be included in the plan set as relevant for the type of construction project.

3.1.1 General Notes

See District Standard Detail G1 for General Notes to be included in the construction plans.

3.1.2 Water System Notes

See District Standard Detail W1 for Water System Notes to be included in the construction plans.

3.1.3 Sewer System Notes

See District Standard Detail S1 for Sewer System Notes to be included in the construction plans.

CHAPTER 4 CONSTRUCTION STANDARDS - WATER SERVICES

4.1 General Requirements

4.1.1 District Water Permit

A District water permit is required prior to installation of a water service.

4.1.2 Uniform Plumbing Code

All improvements shall be installed per the most current edition of the Uniform Plumbing Code (UPC).

4.1.3 Easements

Water services shall be installed on only the property being served and in appropriate recorded easements and rights-of-ways.

4.1.4 Developer Extension Agreement Projects

The Developer is responsible for installing the water service from the water main to property line for new main construction. The Property Owner is responsible for installing water service from property line to building. The Developer will provide the District with the meter assemblies. The District will install meter assemblies when the Property Owner requests service.

4.1.5 Installation, Maintenance, & Repair

The Property Owner is responsible for service line installation, maintenance and repair from the meter to the building. For new services, the District taps the water main, installs a service saddle, corp stop, service, meter assembly and meter box.

4.1.6 Separation from Side Sewer Services

Per 2012 UPC 603.2, water service lines located within five (5) feet of side sewer lines shall be installed above the side sewer pipe with a minimum vertical clearance of twelve (12) inches. Maintain a minimum horizontal clearance of twelve (12) inches at all locations except when crossing.

4.1.7 Pressure Reducing Valves

It is the responsibility of the Property Owner to supply and install a pressure reducing valve (PRV) for their service. Pressure reducing valves shall be installed downstream of the meter and dual check valve. Property Owners that elect not to install a PRV must record a hold harmless agreement with the Whatcom County Auditor. Hold harmless agreements are available at the District office.

4.1.8 Privately Owned Water Booster Systems

Privately owned water booster systems are not allowed as a means of obtaining water service where the pressure at the service's meter would be below 30 psi. The only exceptions are certain existing Sudden Valley lots covered by Resolution 410. Each application is subject to cross-connection control analysis by the District. Typical residential applications will require District standard dual check valves at the service meter. Higher risk applications will be required to install backflow prevention devices as determined by the cross-connection control analysis.

4.1.9 Inspections

The District must inspect and approve the pressure reducing valve prior to covering.

CHAPTER 5 CONSTRUCTION STANDARDS - SEWER SERVICES

5.1 General Requirements

5.1.1 Contractor Requirements

Contractors installing side sewer services shall have a current Sewer Services Contractor's Certification Agreement and surety bond on file at the District.

5.1.2 Uniform Plumbing Code

All improvements shall be installed per the most current edition of the Uniform Plumbing Code.

5.1.3 District Sewer Permit

A District sewer permit is required prior to installation of any side sewer service.

5.1.4 Easements

Side sewer services shall be installed on only the property being served and in appropriate recorded easements and rights-of-ways.

5.1.5 Authorization to Connect to Sewer Main

Contractor shall connect the side sewer service to the sewer main at the location identified and authorized by the District. The Contractor shall schedule an onsite pre-construction meeting with the District to obtain authorization to connect prior side sewer installation.

5.1.6 Other Permits

Contractor shall obtain and abide by encroachment permits or other permissions which may be required from the County, State Highway Department, Sudden Valley Community Association, or other entity having jurisdiction over roads and streets, prior to commencing sewer service work. Restoration shall be done in a manner approved by the appropriate jurisdiction.

5.1.7 Surveying and Staking

Lots and/or property lines shall be surveyed and staked to assure sewer service is installed within the property, recorded easements, and/or right-of-ways. Surveying and staking are the responsibility of the Contractor and Property Owner.

5.1.8 Surface Water Drain Connections Prohibited

Downspouts, foundation/crawl space sump pumps, yard drains, or any outside drains shall not be connected to the sanitary sewer service.

5.2 Side Sewer Services into Gravity Mains

5.2.1 Installation, Maintenance, & Repair

The Property Owner is responsible to contract with a Contractor on the District's Bonded Side Sewer Contractor List. The Contractor installs the side sewer service from the sewer main to the residence, which includes installing a service tee on District sewer main, cleanout at property line, the private service line to the building, and restoration per the Standard Drawings.

The Property Owner is responsible for maintenance and repair of the side sewer service from the cleanout at the property line to the residence.

5.2.2 Grinder Pumps

Grinder pumps may be installed in such special circumstances where installation of a gravity system is not possible. The District must authorize the use of a grinder pump system prior to installation. Grinder pump design shall be in accordance with Section C1-10.1 and C1-10.2 of the current edition of the "Criteria For Sewage Works Design" published by the Washington State Department of Ecology.

5.2.3 Pre-Construction Meeting

The Contractor shall schedule a preconstruction meeting with the District prior to beginning construction. At the preconstruction meeting, the District will identify and authorize the location of connection to the sewer main.

5.2.4 Inspections

The District must inspect all side sewer services prior to backfill. Services backfilled without an inspection must be re-exposed and the full length tested at Contractor's expense.

> **Bedding & Backfill Inspection**. The entire sewer service pipe from the main to the cleanout adjacent to building must be inspected and approved by the District prior to backfill. Pipe backfilled before inspection will be rejected.
>
> **Leak Test**. Contractor fills service line with water from a plug inserted in the cleanout at the property line up to the cleanout at the building. The line must hold water with no visible drop in elevation to pass. The test is observed by the District after all lines have been backfilled.
>
> **Grinder Pump Inspection (if applicable)**. The private grinder pump station may be located inside the residence or outside the residence. If located inside the residence, the installation shall be subject to inspection by the Whatcom County Building Official (or his or her designee). If located outside of the residence, the grinder pump station shall be subject to inspection by the District.

5.3 Pressure Side Sewer Services into Force Mains

5.3.1 Design

The Property Owner is responsible for the design of the pressure side sewer service installation including the grinder pump station at the residence. The Property Owner shall engage a civil engineer licensed in the State of Washington to prepare hydraulic calculations, determine pipe size, determine air release and air vacuum valve requirements, and select the appropriate model of grinder pump for the specific residential installation. Grinder pump design shall be in accordance with Section C1-10.1 and C1-10.2 of the current edition of the "Criteria For Sewage Works Design" published by the Washington State Department of Ecology.

The private grinder pump package shall consist of at least a grinder pump, basin, cover, check valve, controls, and interior and exterior visual and audible alarms (with battery backup for high level alarm), provided by a single supplier/manufacturer. Approved grinder pump package manufacturers include Environment-One (E-One Model 2010-IDU Package Grinder Pump System); Myers Residential Grinder Pump System Package; Hydromatic Grinder Pump System Package, and Liberty Pumps simplex grinder package (Models 2448LSG, 2472LSG, & 2484LSG).

Where required, air relief and combination air relief/ vacuum relief valves shall be as manufactured by Orenco, APCO, Crispin or equivalent for sewer service. All valves shall be fully accessible to enable Customer’s operation, maintenance and repair.

5.3.2 Developer Extension Agreement Projects

The Developer is responsible for installing the customer service shutoff valve, check valve, check valve vault and service line from the main to check valve for new main construction.

5.3.3 Installation, Maintenance and Repair

The Property Owner is responsible for installation, maintenance and repair of the side sewer service from the property line to the residence including the grinder pump station, check valve, and check valve vault.

For individual permits, the District taps the force main, installs the saddle, customer service shutoff valve, and service line to the property line. (Note for Developer Extension Agreements, the developer installs these items during construction of the new main.)

5.3.4 Pre-Construction Meeting

The Contractor shall schedule a preconstruction meeting with the District prior to beginning construction. At the preconstruction meeting, the District will identify and authorize a connection to the customer service line at the property line.

5.3.5 Inspections

The District must inspect all side sewer services prior to backfill. Services backfilled without an inspection must be re-exposed and the full length tested at Contractor’s expense.

Bedding & Backfill Inspection. Sewer service pipe from the main to the cleanout adjacent to building must be inspected and approved by the District prior to backfill.

Pressure Test. With all joints exposed, the District must witness a successful hydrostatic pressure test in accordance with WSDOT Section 7-09.3(23) at 150 psi for all pipe and fittings between the grinder pump and the customer service shut-off valve.

Grinder Pump Inspection. The private grinder pump station may be located inside the residence or outside the residence. If located inside the residence, the installation shall be subject to inspection by the Whatcom County Building Official (or his or her designee). If located outside of the residence, the grinder pump station shall be subject to inspection by the District.

CHAPTER 6 CONSTRUCTION STANDARDS - DETAILS

<u>General Details</u>

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G2 Typical Trench and Backfill Detail
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G7 Private Water Service Line and Side Sewer Trench Detail
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<u>Water Details</u>

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W3 Concrete Thrust Block for Convex Vertical Bends
W4 Fire Hydrant Assembly
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S1 Sewer System Notes
S2 Sanitary Sewer Manhole Type 3
S3 Inside Drop Sewer Manhole Connection
S4 Outside Drop Sewer Manhole Connection
S5 Sewer Main Cleanout
S6 Sewer Lateral Connection to Main
S7 Sewer Lateral and Cleanout
S8 Gravity Side Sewer Installation
S9 Grinder Pump Service to Gravity Main Installation
S10 Grinder Pump Service to Force Main Installation
S11 Connection to Force Main
S12 Force Main Service Check Valve
S13 Shared Force Main Service Tap
S14 Manhole Rim & Valve Box Re-adjustment
S15 Manhole Pipe Penetration Details

<u>Electrical/Telemetry Details</u>

E1 Telemetry Panel
E2 Utility Equipment Rack
E3 Schedule 80 PVC Trench
E4 Handhole
E5 Tracer Wire

GENERAL NOTES

1. All work and materials shall conform to the most current edition of the Standard Specifications for Road, Bridge and Municipal Construction (WSDOT) as prepared by Washington State Department of Transportation and the Washington State Chapter of the American Public Works Association, Lake Whatcom Water and Sewer District Design and Construction Standards, and the instructions and recommendations of the Manufacturer of the material concerned. In case of a conflict between the above standards, the more stringent shall apply. All work and materials shall be subject to the approval of the District Engineer.

2. Contractor shall obtain encroachment permits or other permissions which may be required from the County, State Highway Department, Sudden Valley Community Association, or other entity having jurisdiction over roads and streets, prior to commencing work.

3. All pipe shall be bedded in bedding material meeting WSDOT 9-03.12(3). The bedding cross-section shall be blocked with Control Density Fill (CDF) per WSDOT 2-09.3(1)E a minimum of every 800 feet and the trench drained to daylight or to a storm drain.

4. Backfill under pavement, under the roadway section, and at driveway crossings within County ROW shall consist of crushed surfacing top course material conforming to WSDOT 9-03.9(3). Backfill within private roadways shall consist of material conforming to WSDOT 9-03.19. Backfill in other areas shall consist of material conforming to WSDOT 9-03.15, except as shown on the plans or details. Backfilling of trenches shall be in accordance with WSDOT 7.08.3(3). Backfill shall be compacted to 95% modified Proctor within traffic areas, 90% modified Proctor in landscape and open areas.

5. Tracer wire installation is required on all District owned pipe and communication lines. Tracer wire is also required on private side sewers. Install tracer wire per District Standard Detail E5. In addition to tracer wire, install 2-inch wide detectable marking tape 8 to 12 inches below the finish surface. Detectable marking tape shall meet WSDOT 9-15.18 and be color coded blue for water and green for sewer.

6. Water mains crossing over sewers stub service line with less than 18-inches of vertical clearance shall be stabilized with Control Density Fill (CDF) per WSDOT 2-09.3(1)E.

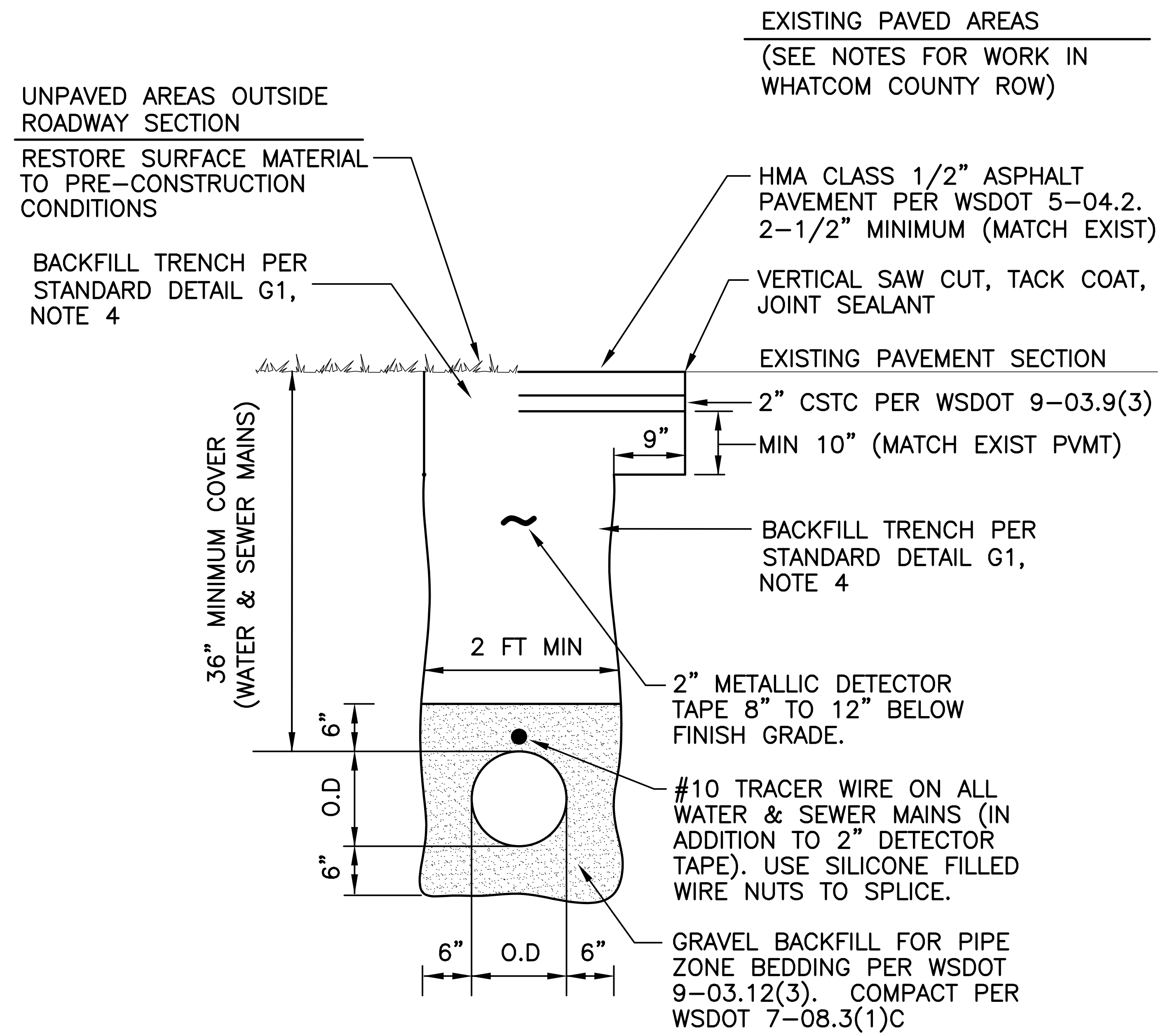
7. From the main to the property line, sewer laterals and water service lines shall maintain a minimum horizontal separation of 5-feet. Separation may be reduced to 1-foot if water service line is a minimum of 12-inches above the top of the sewer lateral.

8. Contractor shall remove all debris and excess excavation; repair all damage, and restore the site, public or private, to pre-construction conditions.

9. Where mains or service lines are placed within a ditch area, the buried depth shall be at least 30-inches below the bottom of the ditch.

10. All work within Whatcom County Right Of Way (ROW) shall comply with Whatcom County Development Standards, Section 512, updated 9/23/2015 or more recent.

LAKE WHATCOM WATER & SEWER DISTRICT	GENERAL NOTES	STANDARD DETAIL G1 9/20/2017



NOTES:

1. With respect to trench repairs and pavement overlays, in the event of conflict between this detail and Whatcom County Standard Drawing Numbers 512.F–1 and 512.F–2, the more stringent standard shall apply.

2. Standard utility locations within county–maintained public road prisms as shown in the 2012.09.25 version of Whatcom County Standard Drawing No. 512.D–1 shall apply.

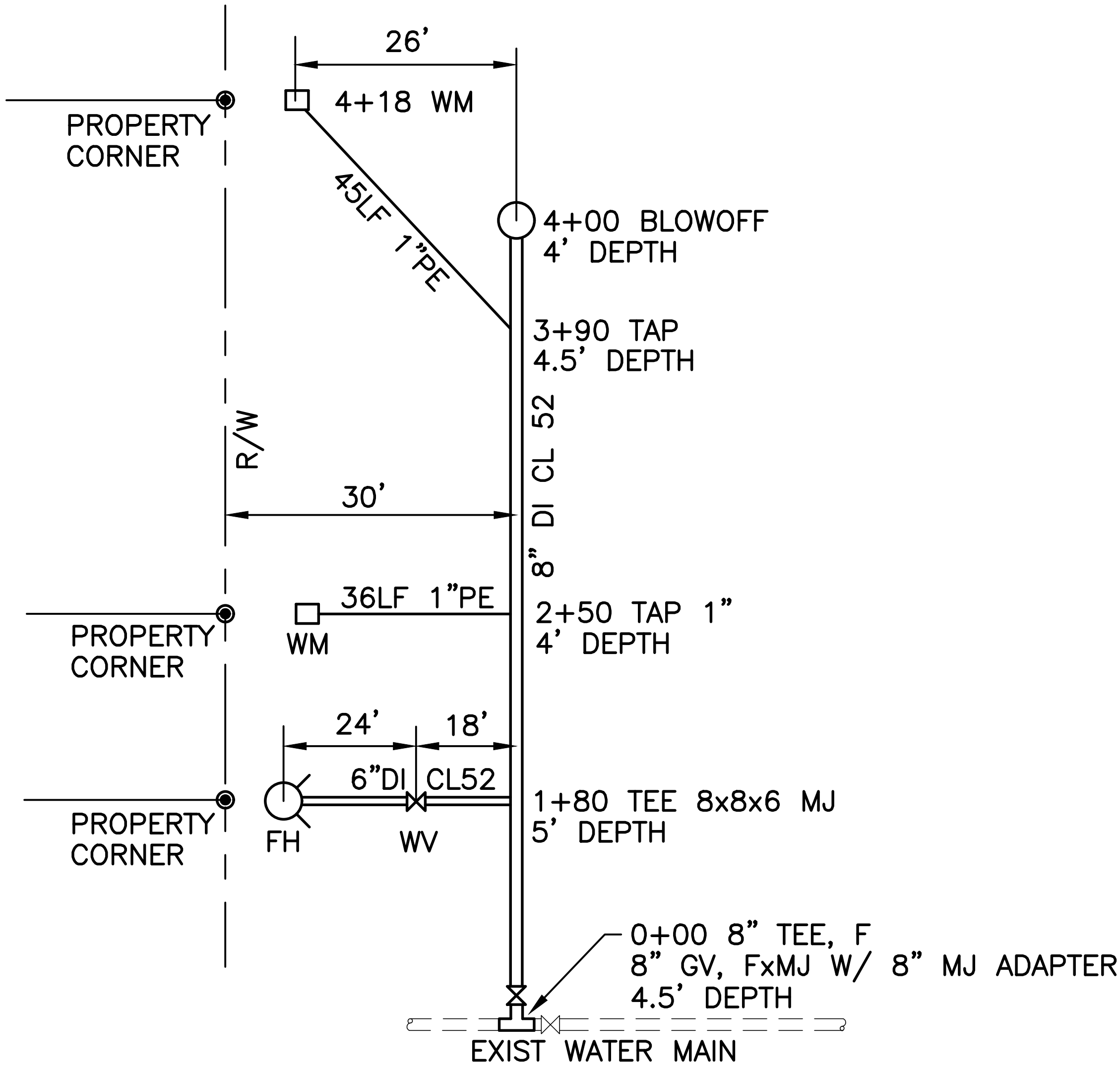
LAKE WHATCOM WATER & SEWER DISTRICT

TYPICAL TRENCH AND BACKFILL DETAIL

STANDARD DETAIL

G2

9/20/2017



EXAMPLE RECORD DRAWING

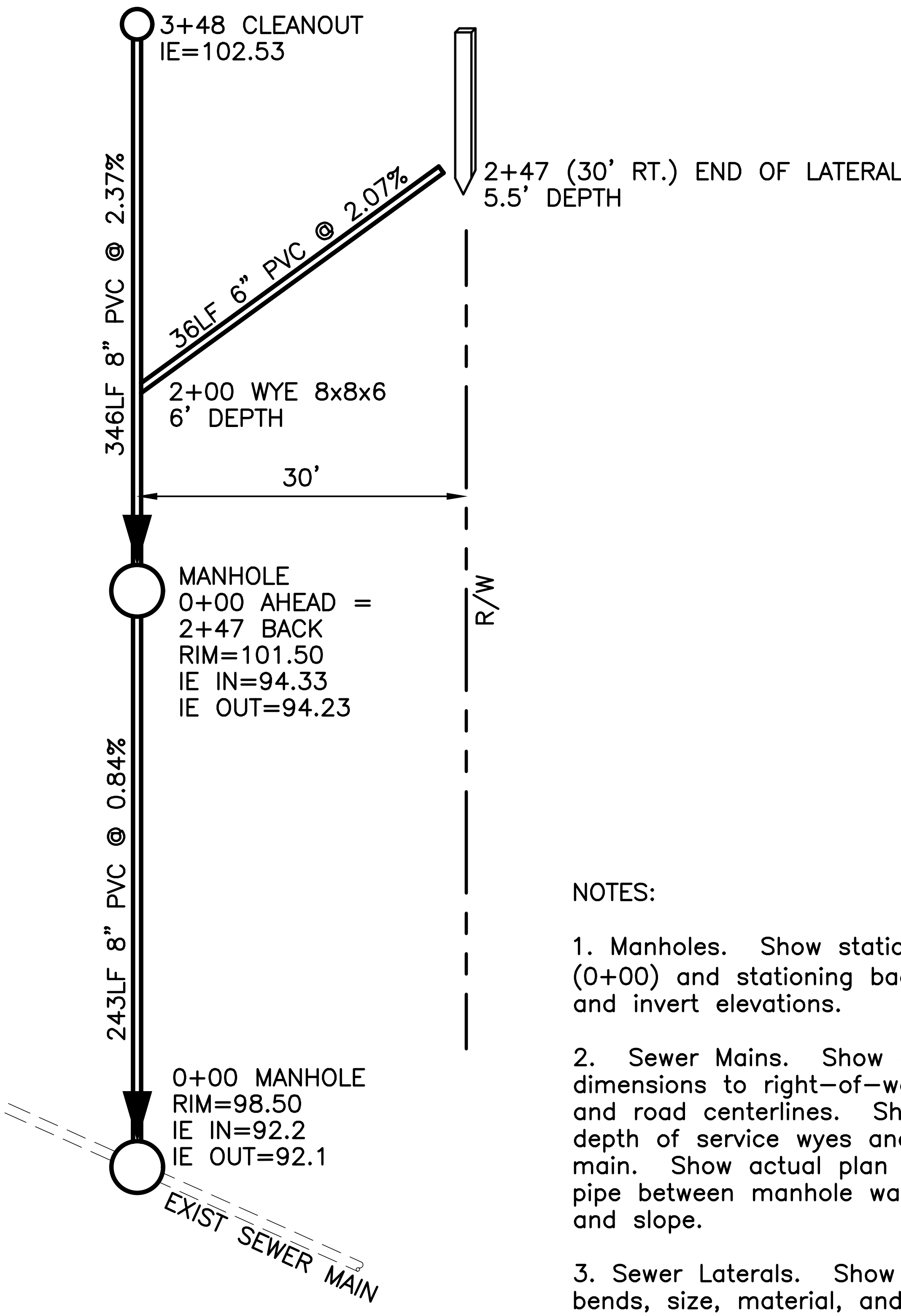
NOTES:

1. Water Mains. Show alignment dimensions to right-of-way, easements, and road centerlines. Show stationing and depth of fittings, valves, and service taps along the main.

2. Fire Hydrants, Blowoffs, and other Appurtenances. Show length & material between tees, valves, hydrants, blowoffs, etc. Show station/offset of appurtenance if skewed from 90-degrees from main.

3. Water Services & Sampling Stations. Show tap station along main and size of tap. Show length & material of service line from main to meter box or sampling station.

LAKE WHATCOM WATER & SEWER DISTRICT	WATER PROJECT RECORD DRAWING DOCUMENTATION	STANDARD DETAIL G3 5/1/2014



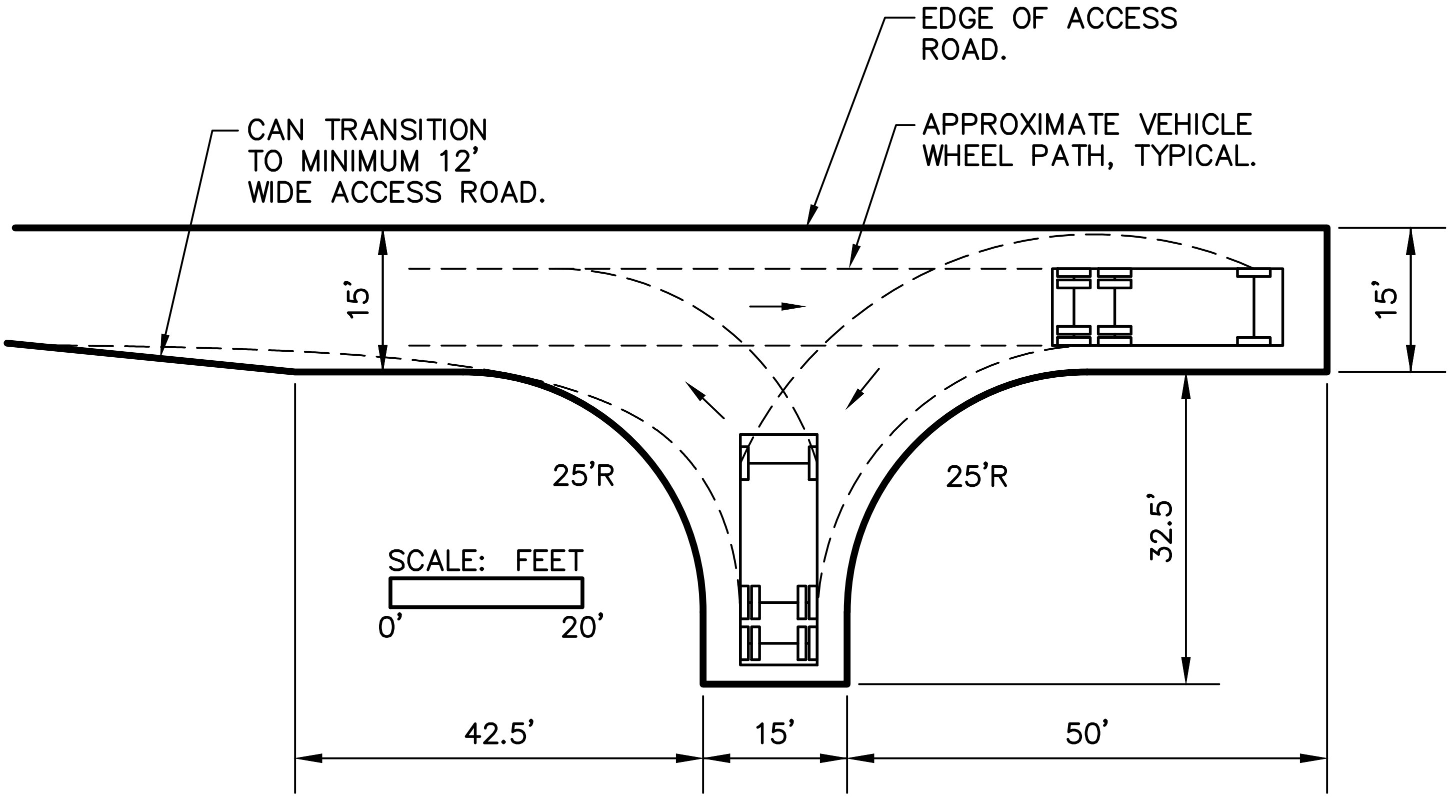
EXAMPLE RECORD DRAWING

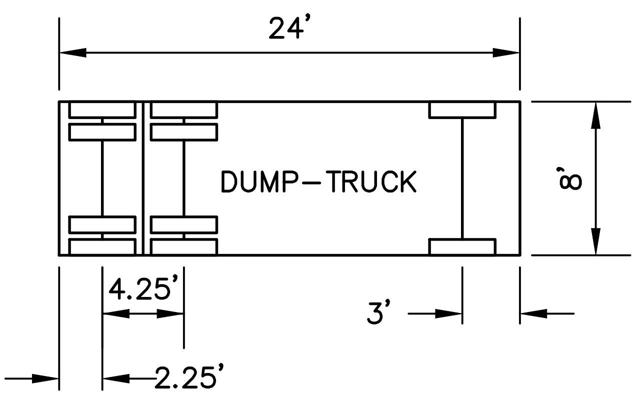
NOTES:

1. Manholes. Show stationing ahead (0+00) and stationing back, rim elevation, and invert elevations.

2. Sewer Mains. Show alignment dimensions to right-of-way, easements, and road centerlines. Show station and depth of service wyes and tees along the main. Show actual plan view length of pipe between manhole walls with material and slope.

3. Sewer Laterals. Show distances between bends, size, material, and length of pipe. Show station, offset, and depth at end of stub or cleanout.





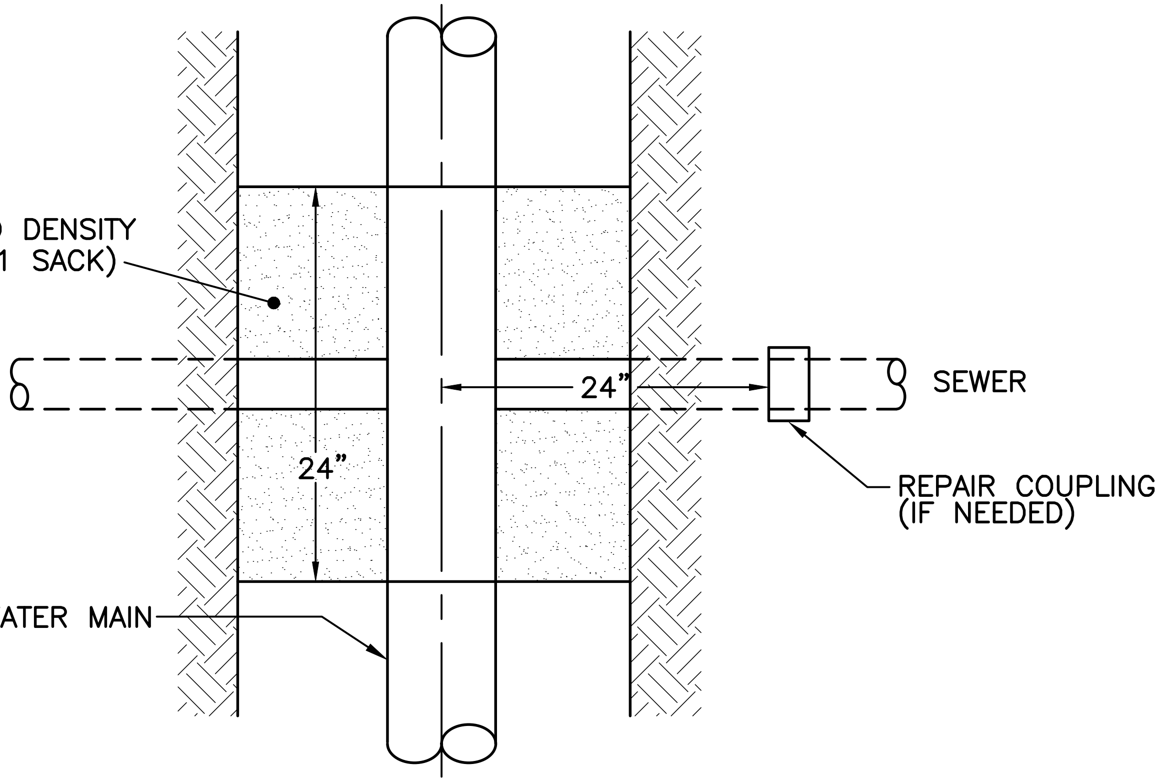
DESIGN VEHICLE

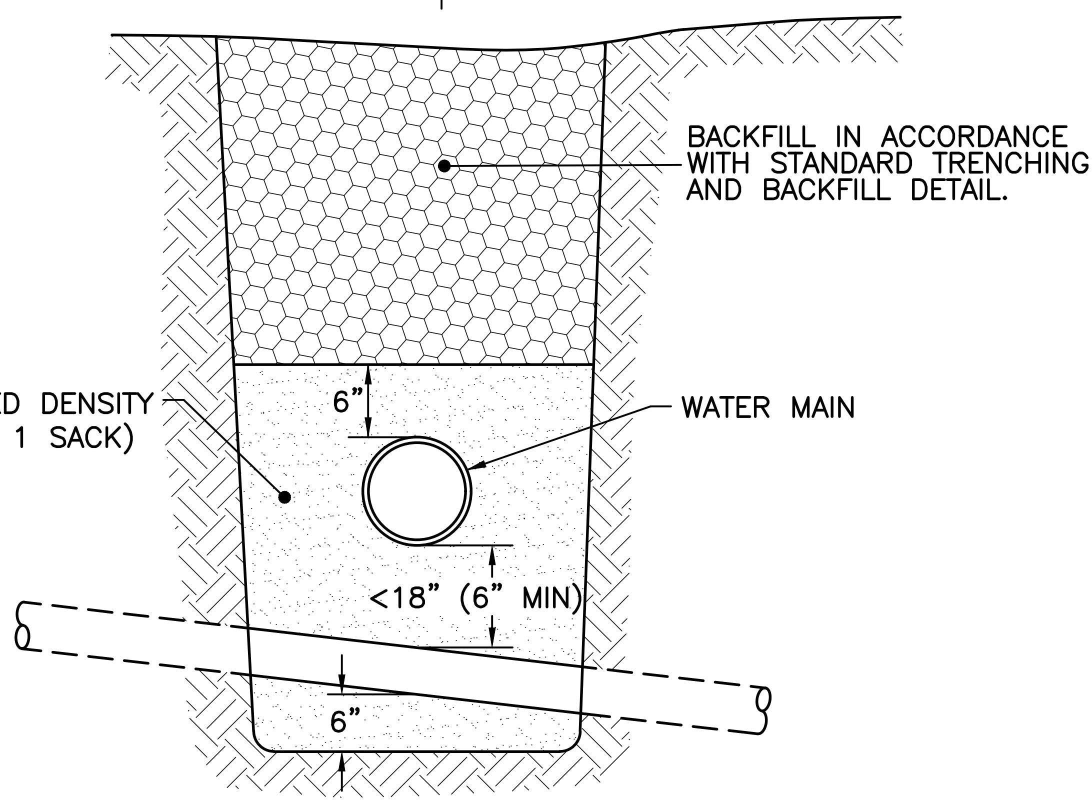
MAINTENANCE VEHICLE TURNAROUND

STANDARD DETAIL

G5

5/1/2014

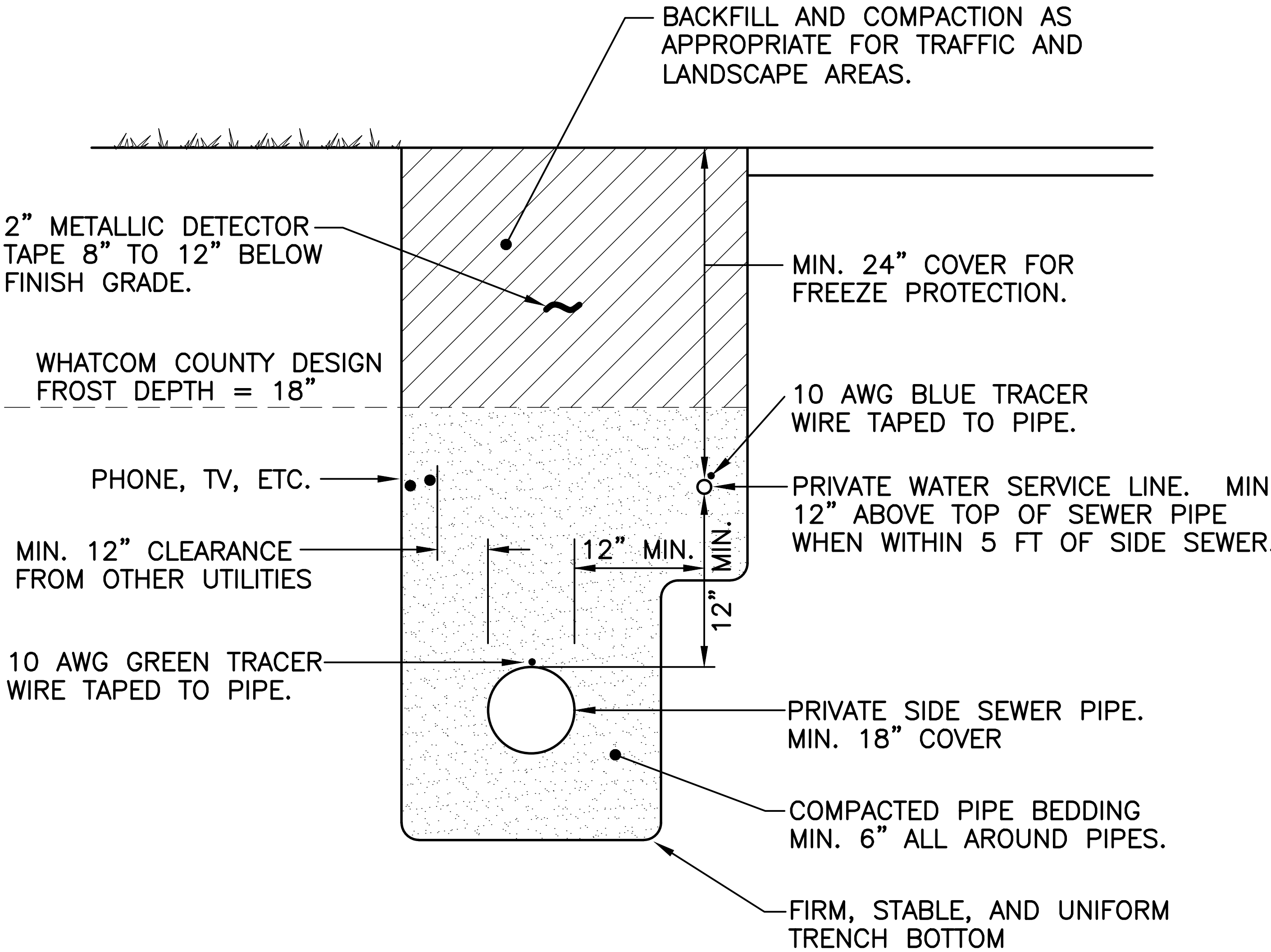




NOTES:

1. Minimum required distance from center of sewer to water main joint is 5'.
2. Minimum required distance from center of water main to sewer joint is 2'.
3. Controlled Density Fill shall surround both pipes with minimum 6" thick.

LAKE WHATCOM WATER & SEWER DISTRICT	WATER MAIN / SEWER NON-STANDARD CROSSING	STANDARD DETAIL G6 01/04/2016



NOTES:

1. Side sewer pipe material (PVC ASTM D3034 SDR 35) shall comply with most current International Plumbing Code (IPC) Table 702.3 Building Sewer Pipe. Separation of water service and side sewer shall comply with IPC 603.2 requirements.

2. Water service lines and side sewers shall be bedded in material meeting WSDOT 9-03.12(3) Gravel Backfill for Pipe Zone Bedding as shown in following table:

Sieve Size	Percent Passing by Weight
1.5"	99-100
1"	75-100
5/8"	50-100
U.S. No. 4	20-80
U.S. No. 40	3-24
U.S. No 200	10.0 max
Sand Equivalent	35 min.

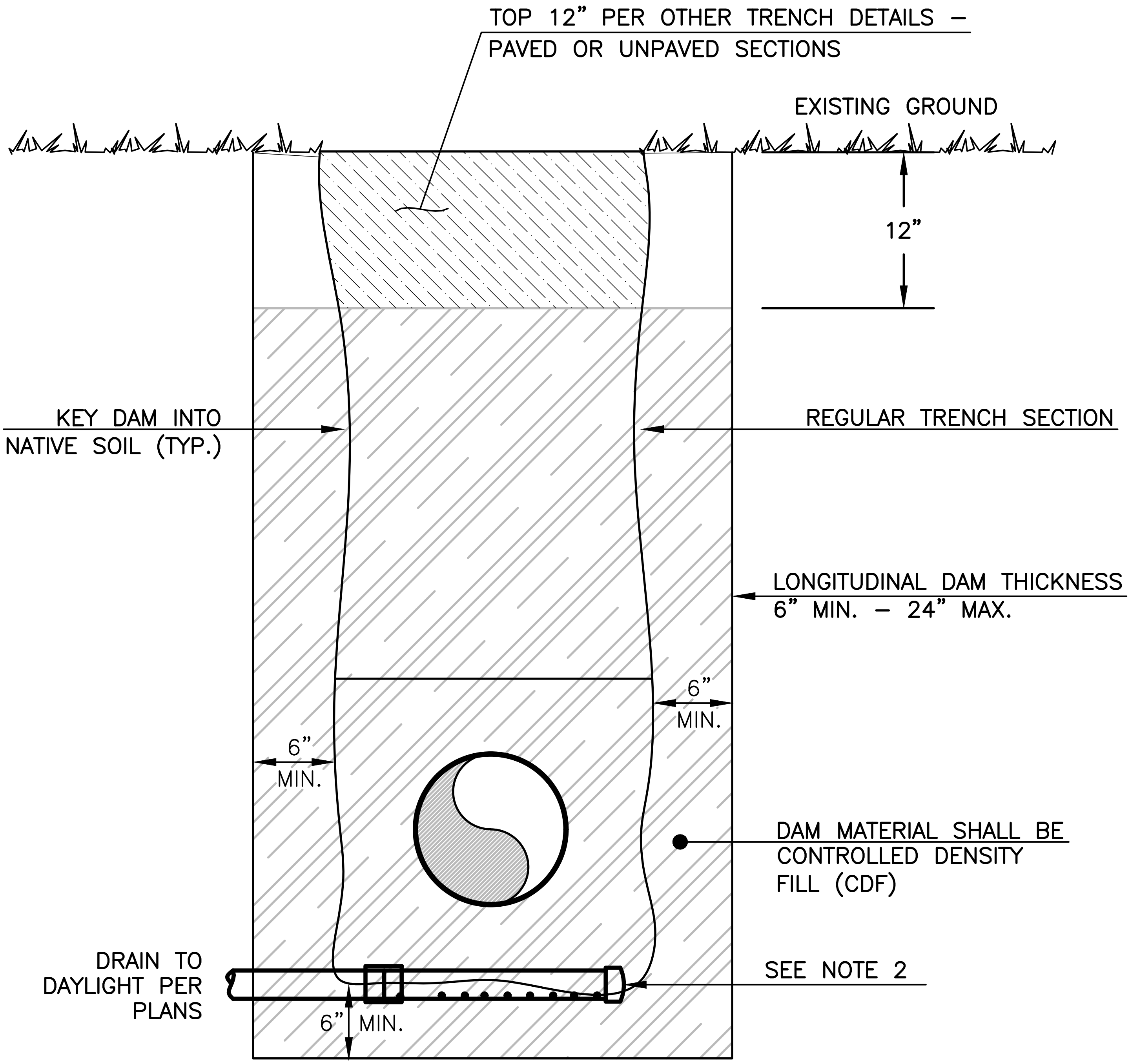
LAKE WHATCOM WATER & SEWER DISTRICT

PRIVATE WATER SERVICE LINE AND SIDE SEWER TRENCH DETAIL

STANDARD DETAIL

G7

9/20/2017



NOTES:

1. SEE PLAN AND PROFILE SHEETS FOR LOCATIONS OF DAMS.

2. INSTALL 4 INCH PVC CAP, PERFORATED DRAIN PIPE WITH HOLES FACING DOWN, COUPLER, AND SOLID PVC PIPE 1 TO 2 FEET OUTSIDE THE LIMITS OF THE CDF ON THE UPHILL SIDE OF THE TRENCH DAM. INSTALL DRAIN ROCK (WSDOT 9–03.12(4)) 6 INCHES ON ALL SIDES OF PERFORATED PIPE. SEPARATE DRAIN ROCK FROM OTHER MATERIAL USING GEOTEXTILE FOR UNDERGROUND DRAINAGE PER WSDOT 9–33.2, TABLES 1&2, MODERATE SURVIVABILITY, CLASS C.

LAKE WHATCOM WATER & SEWER DISTRICT

TRENCH DAM WITH DRAIN

STANDARD DETAIL

G8

9/20/2017

WATER SYSTEM NOTES

1. Water distribution system materials, trenching, bedding, installation, backfilling, disinfection, and testing shall conform to WSDOT 7–09.

2. Water main pipe shall be class 52 ductile iron per WSDOT 9–30.1(1) and encased in polyethylene encasement per WSDOT 9–30.1(2). Fittings for ductile iron pipe shall conform to WSDOT 9–30.2 (1).

3. Valves shall have a minimum pressure rating of 200 psi. Gate valve installation shall conform to WSDOT 7–12. Gate valves shall be resilient–seated gate valves conforming to WSDOT 9–30.3(1) and AWWA C515 Standard for Resilient Seated Gate Valves. A cast iron valve box with a commercial concrete collar (18" x 18" x 6") shall be installed with each valve. An approved marking post shall be installed with each valve in accordance with WSDOT 7–12.3(1) for all valves not installed in pavement. Valves not in pavement shall have a 24" x 24" x 6" concrete collar cast around the valve box. Where a valve operating nut is more than 4–feet lower than grade, an American Flow Control Trench Adapter valve box and stem extension combination (or approved equal) must be installed.

4. Pressure reducing valves (2" and larger) shall be manufactured by Cla–Val, Watts, or approved alternate.

5. Service connections shall be installed per WSDOT 7–15. Lot corners shall be staked prior to service connection installations to assure services are installed in correct locations as shown on the approved plans.

6. District Engineer or their appointed representative shall witness pressure testing and bacteriological test sampling. Contractor shall provide the District Engineer 48 hours notice prior to conducting tests or sampling.

7. Water lines and appurtenances shall be pressure tested in accordance with WSDOT 7–09.3(23).

8. District Engineer must receive a satisfactory bacteriological report before new water mains are connected to existing mains and placed in service. Contractor shall disinfect, flush and provide a satisfactory bacteriological report to the District Engineer in accordance with WSDOT 7–09.3(24). Contractor shall provide two chlorine concentration test reports to show the initial chlorine concentration is at least 50 mg/L, and to show the 24–hour residual chlorine concentration is at least 25 mg/L. All tests must be performed by a DOH–certified testing laboratory and sample–taking shall be witnessed by the District Engineer or their appointed representative. Chlorinated flush water must be disposed of into the sanitary sewer. Contractor shall coordinate with District staff to ensure the rate of disposal does not overload the sewer.

9. New services shall be pressure tested along with the new main. No use of water through a newly installed service shall be allowed until water main and service installation has been inspected, pressure tested, chlorinated and a satisfactory bacteria test received. After installation, the service connection shall be flushed prior to connecting the meter. No service is to be covered until the District's Inspector has inspected the initial installation. All corporations must be in an ON position and all angle valves must be in the OFF position.

10. Service flow testing shall be done after water main pressure testing. During the inspection, every service shall be turned on to its full capacity to check flow and guarantee that each service line has been flushed.

11. No water main tie–ins to existing mains shall be scheduled for Fridays, weekends, or holidays.

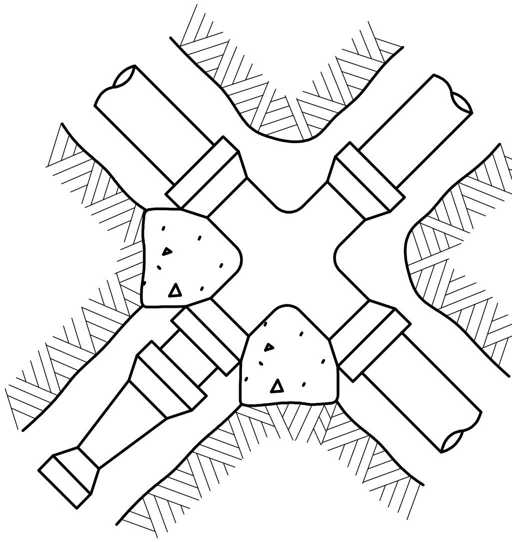
LAKE WHATCOM WATER & SEWER DISTRICT

WATER SYSTEM NOTES

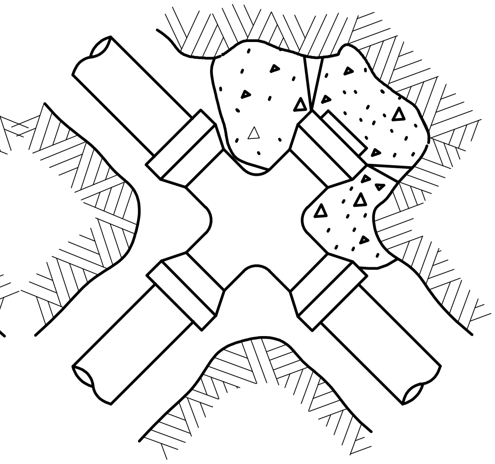
STANDARD DETAIL

W1

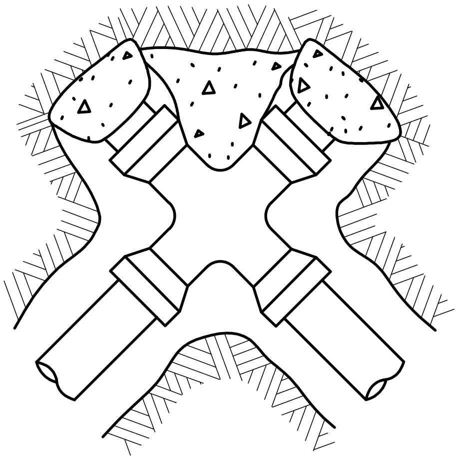
12/7/2017



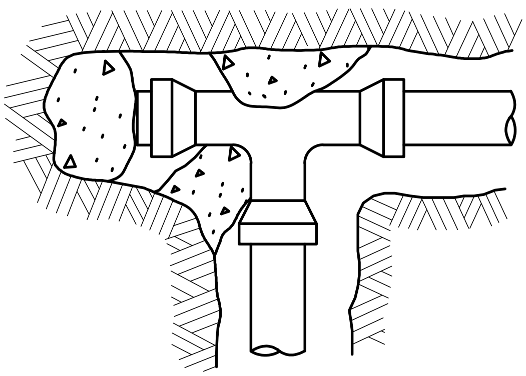
UNBALANCED CROSS
(Use column A)



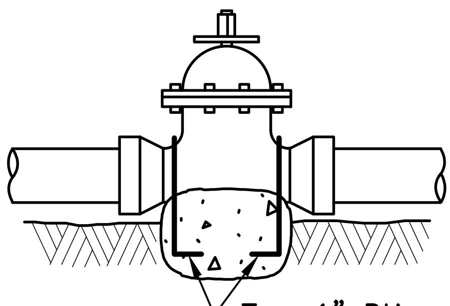
PLUGGED CROSS
(Use column A)



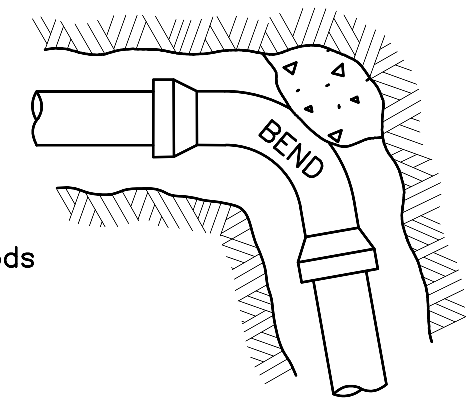
PLUGGED CROSS
(Use column B)

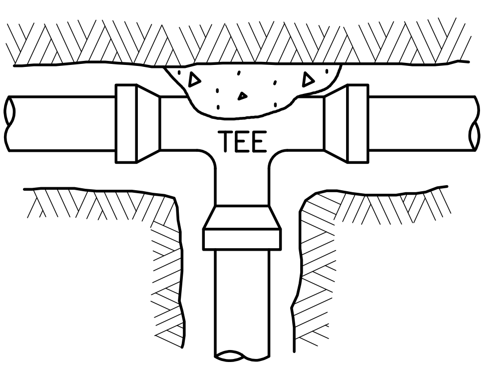


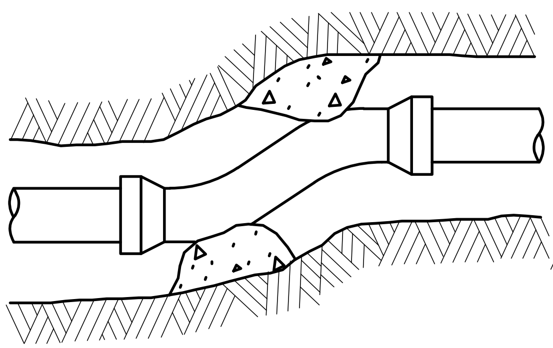
PLUGGED TEE
(Use column B)



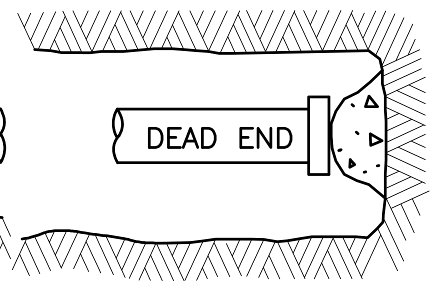
VALVE
(Use column A)







OFFSET
(Use columns B – E)



BASED ON WSDOT STANDARD PLAN B–90.40–00 DATED 6/8/06.

LAKE WHATCOM WATER & SEWER DISTRICT

CONCRETE THRUST BLOCK
Sheet 1 of 2

STANDARD DETAIL

W2

9/20/2017

NOTES:

1. Contractor may substitute restrained joints & fittings with the approval of the district engineer. Calculation of the restrained pipe required length on each side of fittings for max pressure and soil type are required. Calculations shall be sealed by a professional engineer and submitted for review and approval.

2. Contractor to provide blocking adequate to withstand full test pressure.

3. Divide thrust by safe bearing load to determine required area (in square feet) of concrete to distribute load.

4. Areas to be adjusted for other pressure conditions.

5. Provide two 1" minimum diameter rods on valves up through 10" diameter. Valves larger than 10" require special tie rod design.

Size	Test Pressure PSI	Thrust at Fittings in Pounds				
		A	B	C	D	E
		Tee and Dead Ends	90° Bend	45° Bend	22.5° Bend	11.25° Bend
4"	250	3,140	4,440	2,405	1,225	615
6"	250	7,070	9,995	5,410	2,760	1,385
8"	250	12,565	17,770	9,620	4,905	2,465
10"	250	19,635	27,770	15,030	7,660	3,850
12"	250	28,275	39,985	21,640	11,030	5,545
14"	250	38,485	54,425	29,455	15,015	7,545
16"	250	50,265	71,085	38,470	19,615	9,855

Soil Type	Safe Bearing Load PSF
Muck, peat, etc.*	0
Soft clay	1,000
Sand	2,000
Sand and gravel	3,000
Sand and gravel cemented with clay	4,000
Hard shale	10,000

*Restrained joints required in all cases.

BASED ON WSDOT STANDARD PLAN B-90.40-00 DATED 6/8/06.

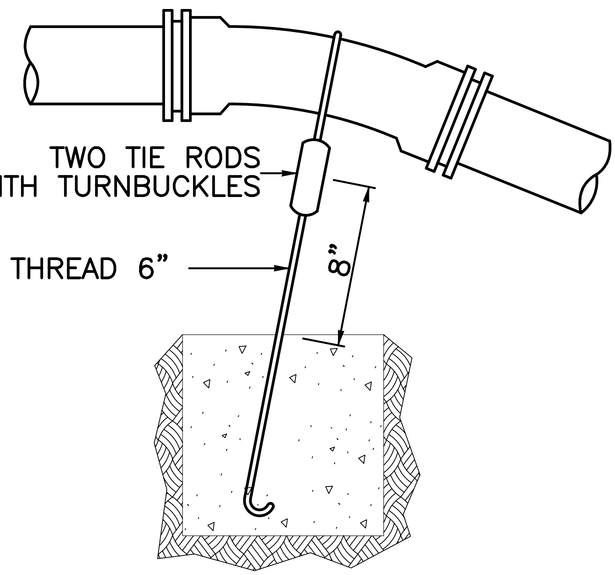
LAKE WHATCOM WATER & SEWER DISTRICT

CONCRETE THRUST BLOCK
Sheet 2 of 2

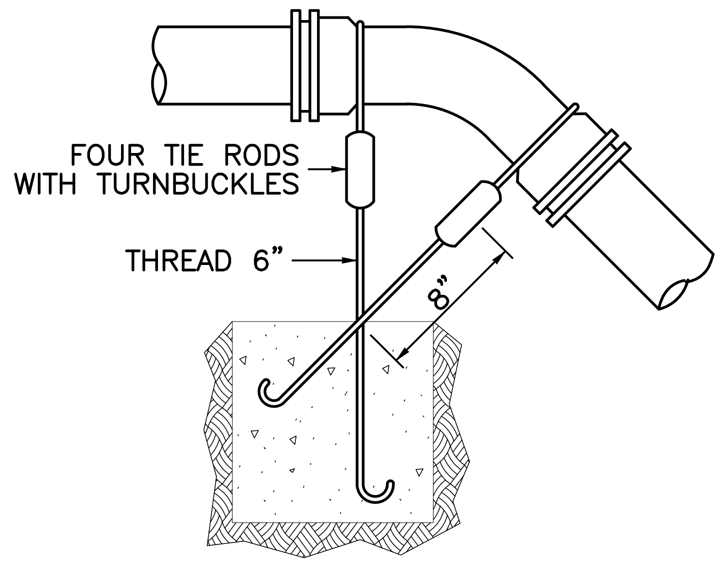
STANDARD DETAIL

W2

5/1/2014



BLOCKING FOR 11.25° OR 22.5°
VERTICAL BENDS



BLOCKING FOR 45°
VERTICAL BENDS

NOTE: STEEL TIE RODS SHALL BE HEAVILY COATED
WITH ASPHALT AFTER INSTALLATION.

DIMENSION TABLE

PIPE DIAM.	TEST PRESSURE (PSI)	BEND ANGLE	CONCRETE VOLUME (Cubic–Ft)	CUBE SIZE (Ft)	TIE ROD DIAM.	TIE ROD EMBEDMENT
4"	250	11.25°	6	1.8	5/8"	17"
		22.5°	12	2.3		
		45°	22	2.8		
6"	250	11.25°	14	2.4	5/8"	17"
		22.5°	27	3.0		
		45°	50	3.7		
8"	250	11.25°	25	2.9	5/8"	17"
		22.5°	48	3.6		
		45°	89	4.5		
10"	250	11.25°	38	3.4	5/8"	17"
		22.5°	75	4.2		
		45°	139	5.2		
12"	250	11.25°	55	3.8	5/8"	17"
		22.5°	108	4.8		
		45°	200	5.8	7/8"	24"
14"	250	11.25°	75	4.2	5/8"	17"
		22.5°	147	5.3	3/4"	20"
		45°	272	6.5	1"	27"
16"	250	11.25°	98	4.6	5/8"	17"
		22.5°	192	5.8	7/8"	24"
		45°	355	7.1	1 1/8"	30"

BASED ON WSDOT STANDARD PLAN
B–90.50–00 DATED 6/8/06.

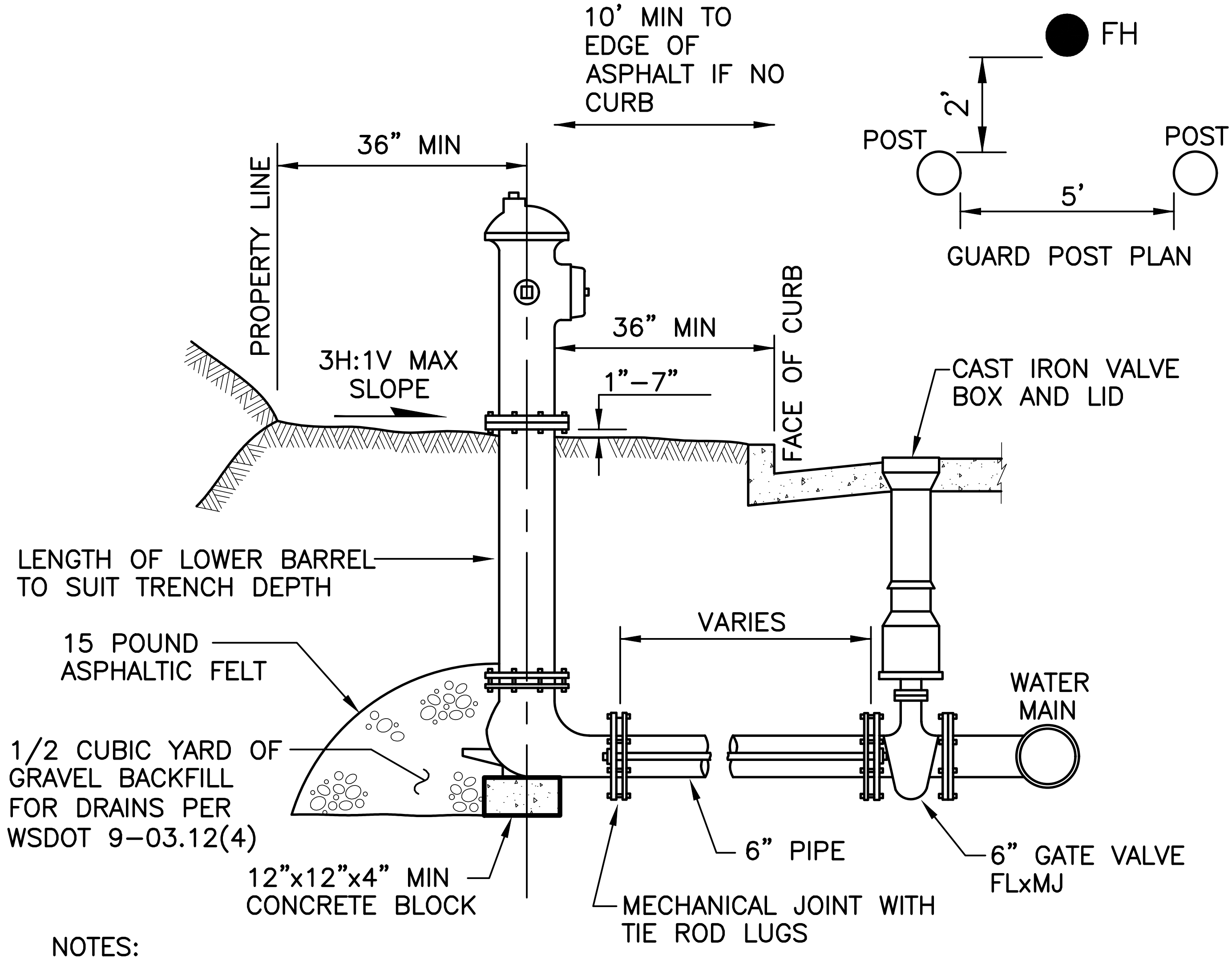
LAKE WHATCOM WATER & SEWER DISTRICT

CONCRETE THRUST BLOCK
FOR CONVEX VERTICAL BENDS

STANDARD DETAIL

W3

5/1/2014



NOTES:

1. Fire hydrants shall be 5–1/4" compression type MJ foot with National Standard Thread on 2–1/2" side ports, and 5" Stortz connection fitting on the steamer port. District standard fire hydrant manufacturers/models are: American Flow Control – Waterous Pacer 250, M&H – Style 929 Reliant, Clow – Medallion, and EJ 5CD250 3 nozzle with standard operating nut. Hydrant caps & bells shall be painted bright industrial yellow in accordance with Whatcom County Fire District #2 and #4 requirements. Hydrant barrel extensions shall be provided and installed as required.

2. Shackle rods shall be installed with Romac ductile lugs. Tie rods shall be ¾" diameter stainless steel (for up to 12" diameter main) with stainless steel hardware. Restrained joints may be substituted for tie rods with approval of District Engineer.

3. Ground surface within 36" of hydrant shall be smooth and clear of obstructions on all sides.

4. A minimum of two guard posts shall be provided. Guard posts shall be reinforced concrete having a compressive strength of 3,500 psi and shall be 6–feet in length by 9–inches in diameter. Reinforcing shall consist of a minimum of five No. 3 deformed steel bars. Guard posts shall be buried 3–feet deep and painted bright white.

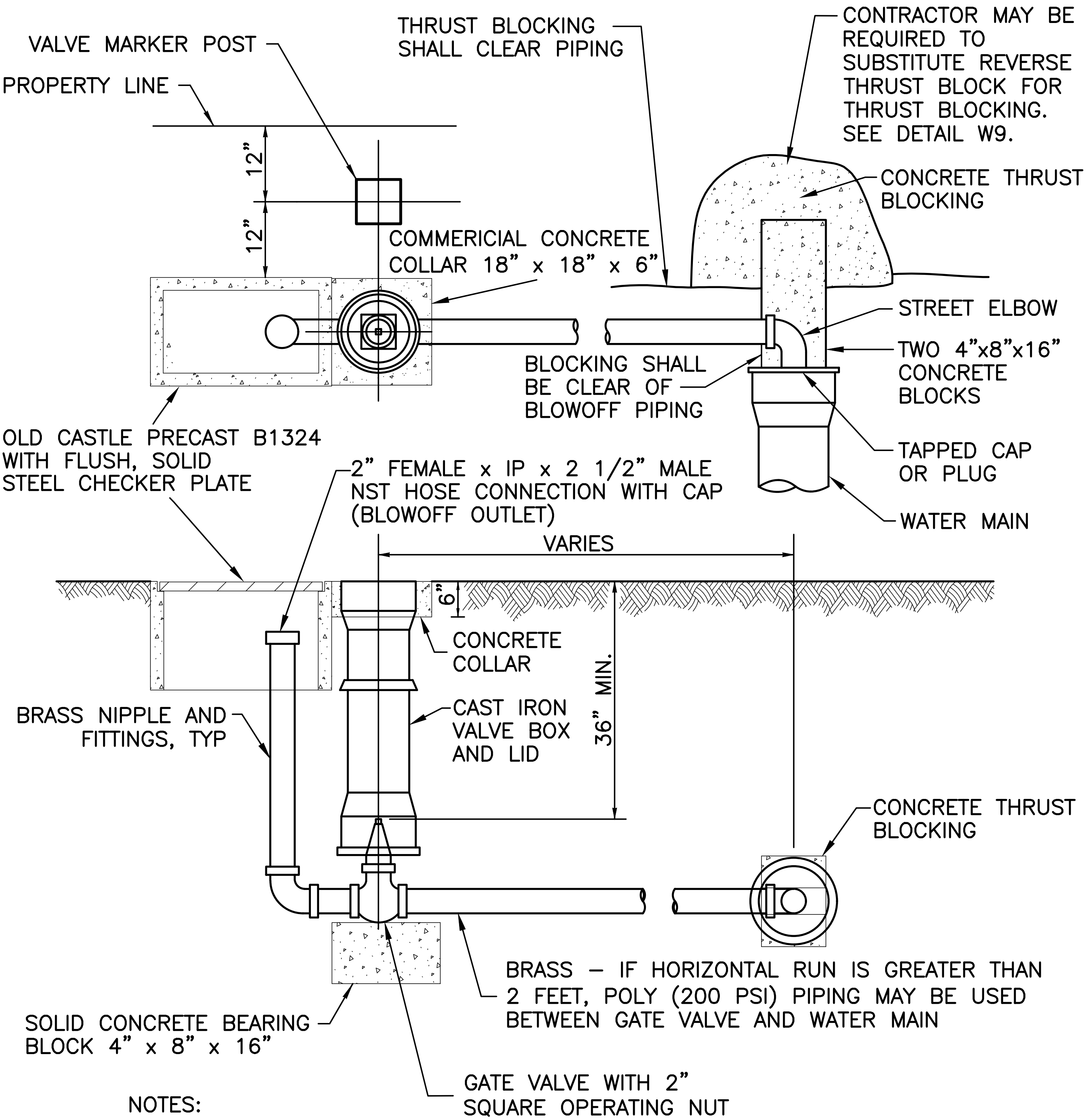
LAKE WHATCOM WATER & SEWER DISTRICT

FIRE HYDRANT ASSEMBLY

STANDARD DETAIL

W4

9/20/2017



NOTES:

1. Paint pipe threads with asphalt paint after assembly.
2. Valve and piping to valve shall be 2" unless otherwise noted on plans.
3. Locate blowoff outlet near property corner if possible.

BASED ON WSDOT STANDARD PLAN B-90.20-00 DATED 6/8/06.

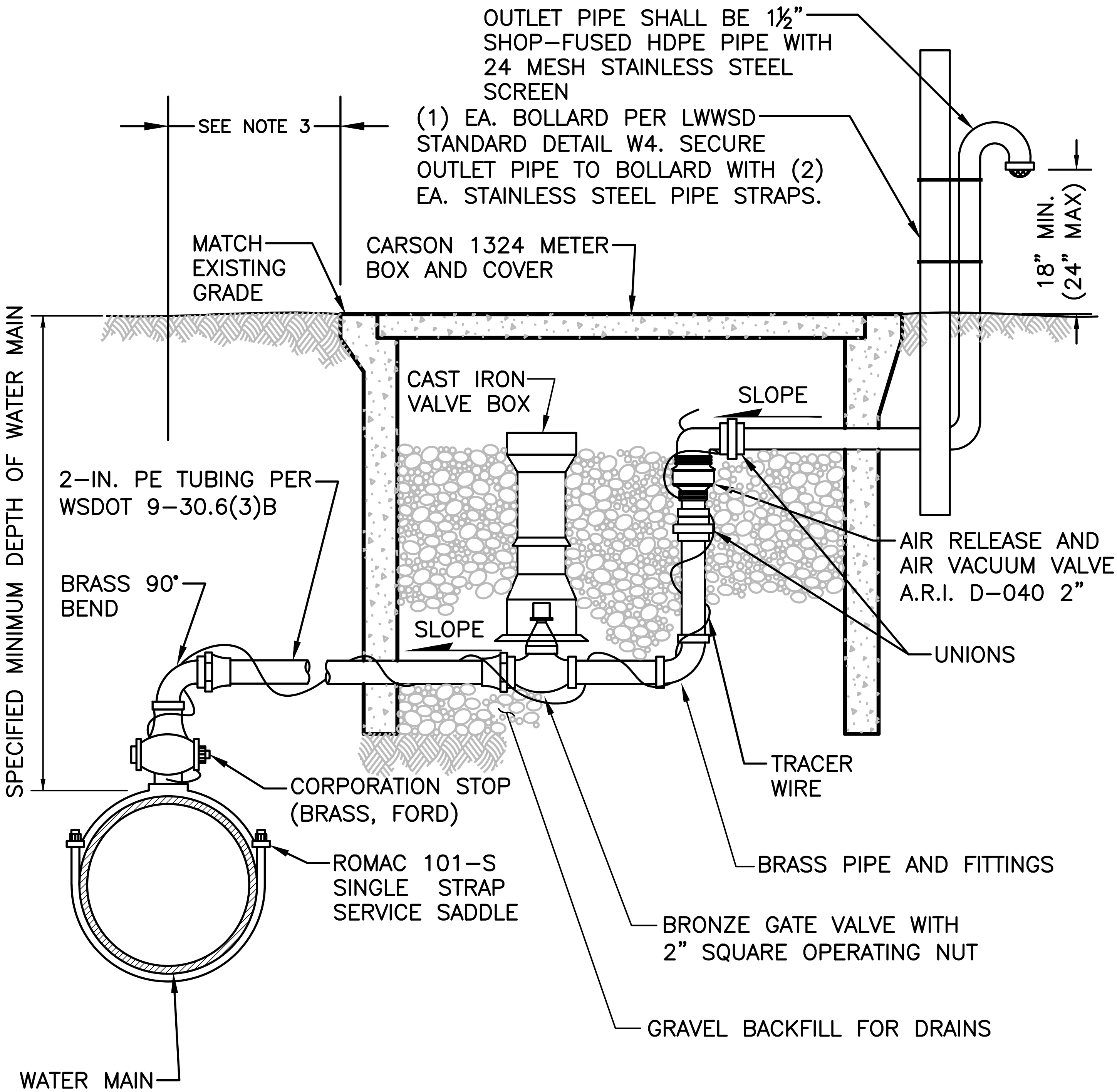
LAKE WHATCOM WATER & SEWER DISTRICT

2 INCH BLOWOFF ASSEMBLY

STANDARD DETAIL

W5

9/20/2017



NOTES:

1. The Air/Vacuum Release Valves shall be 2" A.R.I. Model D-040.
2. Locate at the high point of the main, tap top of main.
3. Air/Vacuum Release assembly shall be installed along the right-of-way at location staked by engineer.

BASED ON WSDOT STANDARD PLAN B-90.30-00 DATED 6/8/06.

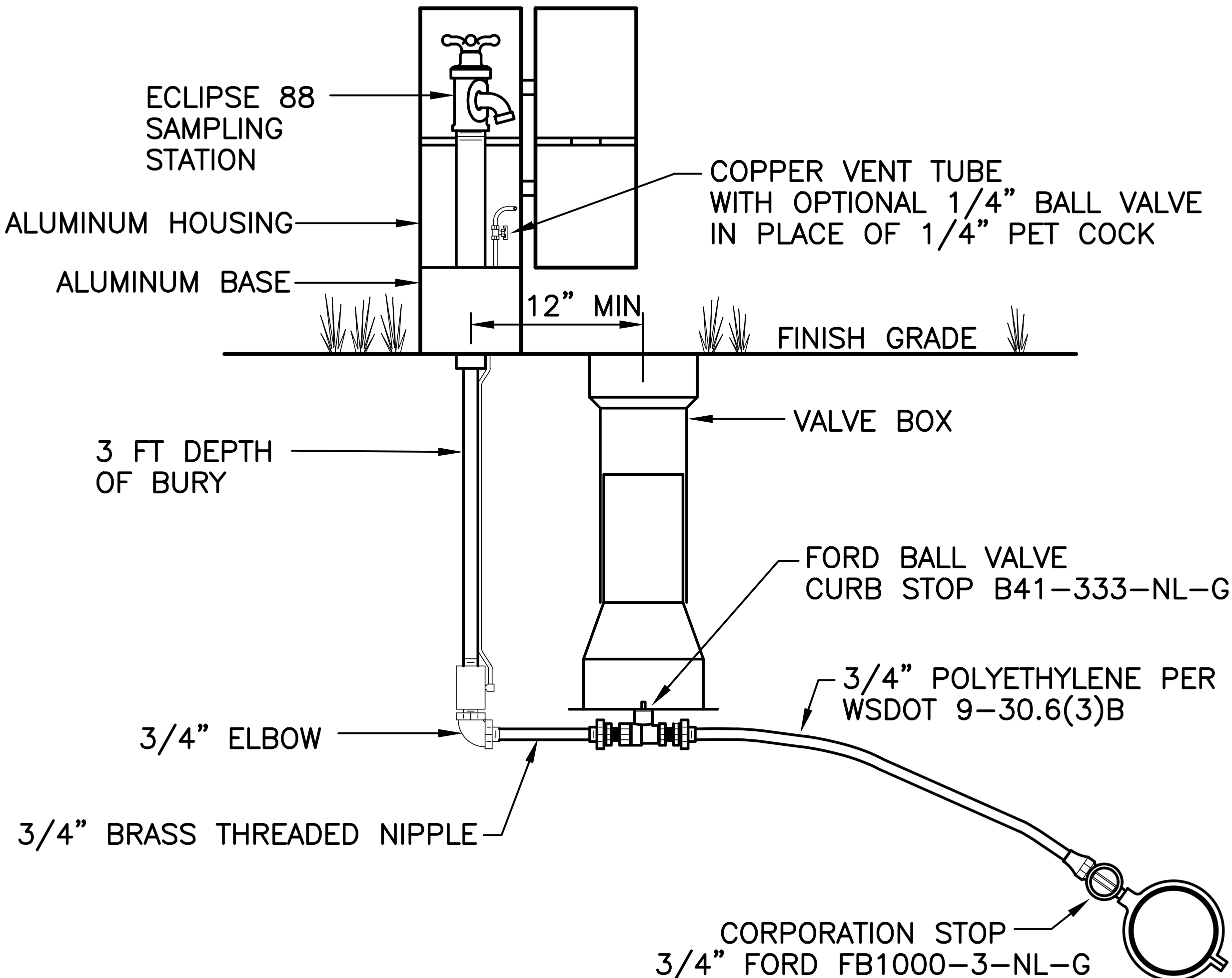
LAKE WHATCOM WATER & SEWER DISTRICT

COMBINATION
AIR RELEASE / AIR VACUUM
VALVE ASSEMBLY

STANDARD DETAIL

W6

9/20/2017



NOTES:

1. Sampling stations shall be buried 3' bury, with a 3/4-inch FIP inlet, and a (3/4-inch hose or unthreaded) nozzle.

2. All stations shall be in a lockable, nonremovable, aluminum cast housing. Housing shall be painted green.

3. When opened, the station shall require no key for operation, and the water will flow in an all brass waterway.

4. All working parts will be of brass and be removable from above ground with no digging.

5. Exterior piping shall be brass pipe.

6. A copper vent tube will enable each station to be pumped free of standing water to prevent freezing and to minimize bacteria growth.

7. Sampling station shall be Eclipse No. 88, manufactured by Kupferle Foundry, St. Louis, MO 63102.

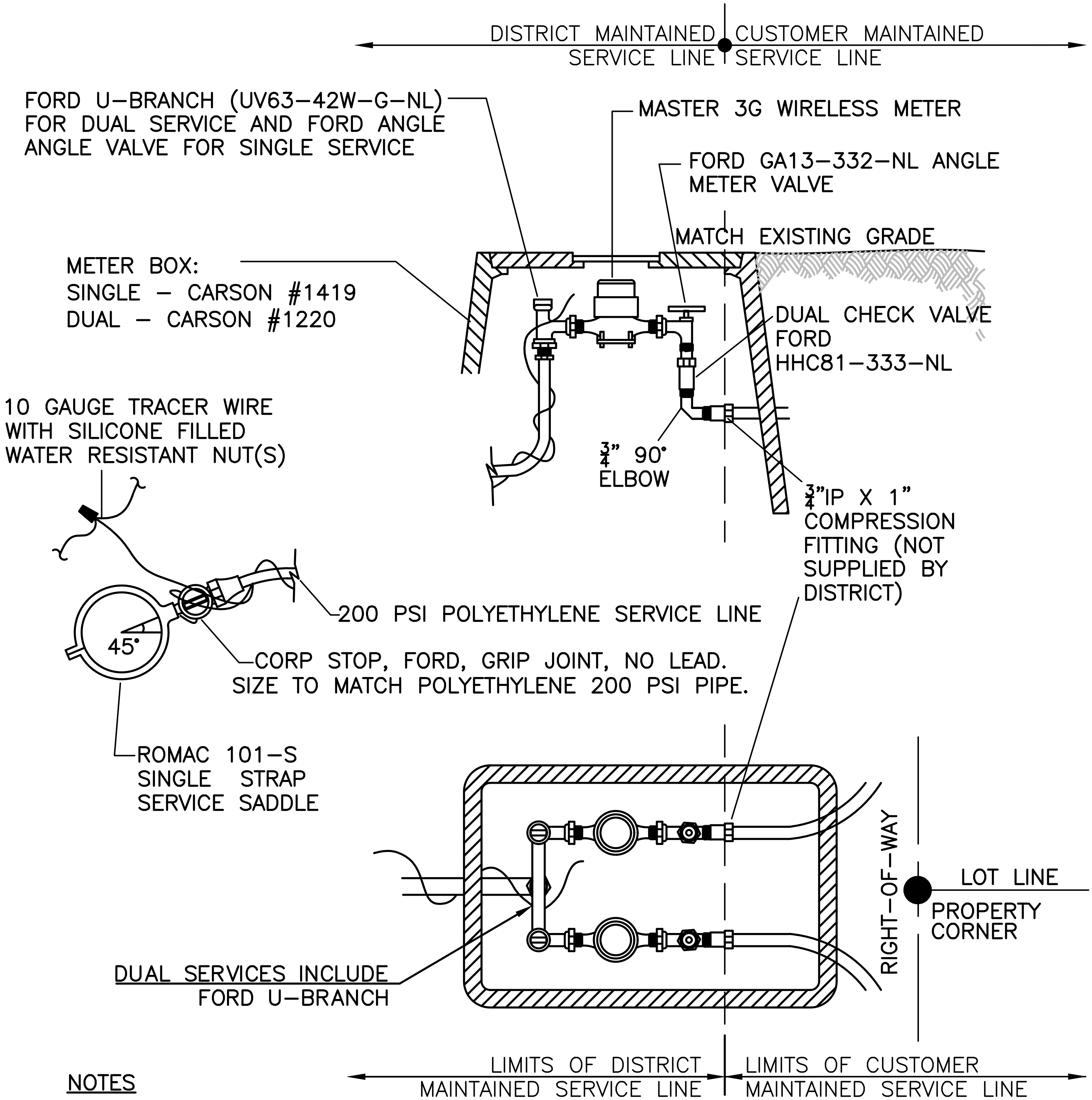
LAKE WHATCOM WATER & SEWER DISTRICT

WATER SAMPLING STATION

STANDARD DETAIL

W7

9/20/2017



NOTES

1. Service fittings shall be in accordance with WSDOT 9-30.6 except that only compression (grip joint) fittings on service lines are allowed.

2. All fittings shall be Ford brass.

3. The water service pipe shall have a minimum of 30 inches depth and a maximum of 36 inches depth, including under ditch sections.

4. Meter boxes in traffic areas shall be concrete with a reader lid.

LAKE WHATCOM WATER & SEWER DISTRICT

WATER METER ASSEMBLY

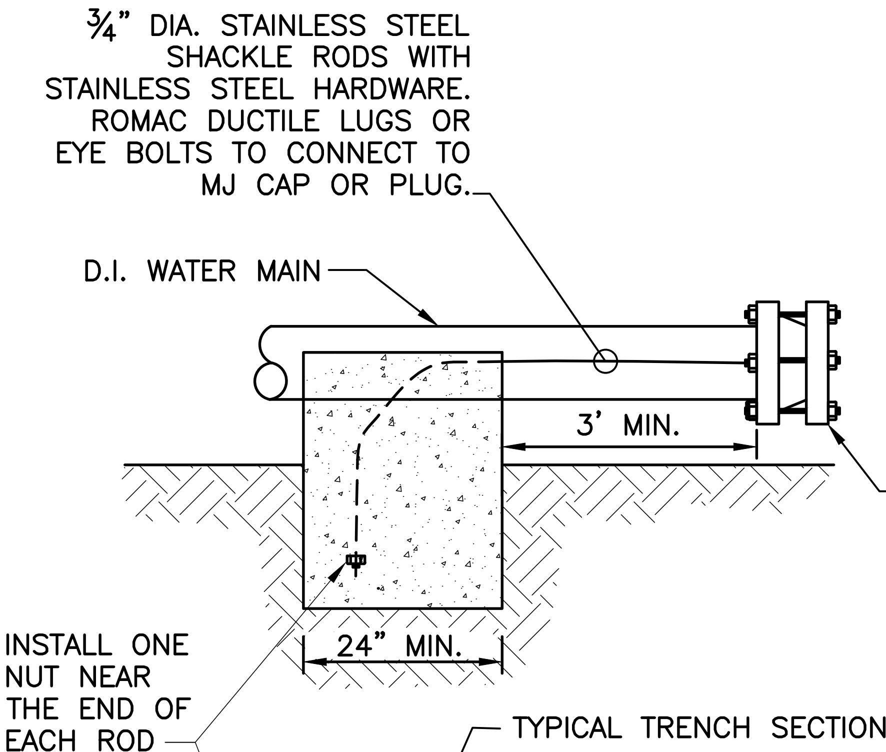
STANDARD DETAIL

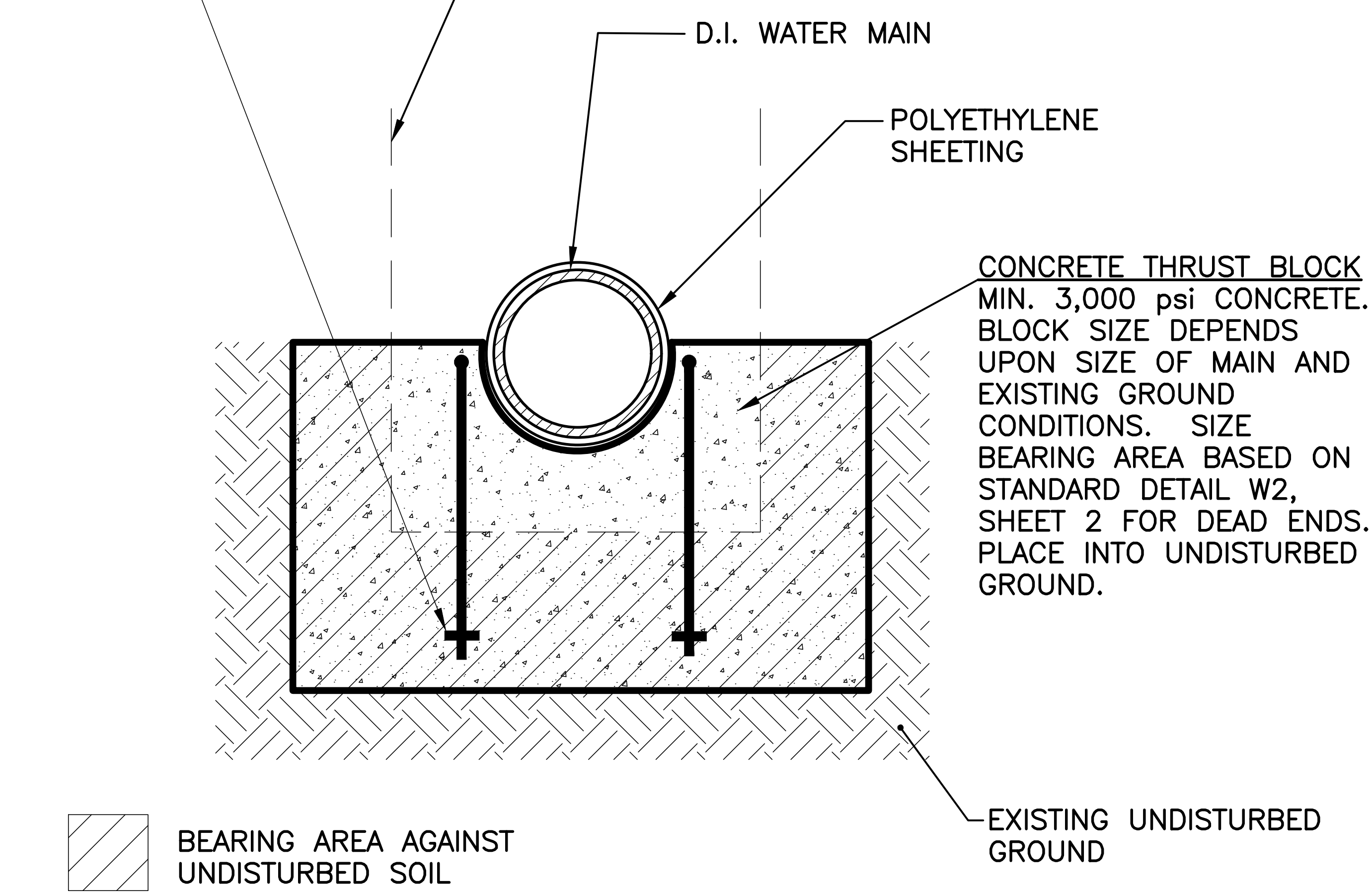
W8

9/20/2017

WATER MAIN DIAMETER (IN)	NUMBER OF SHACKLE RODS*
4	2
6	2
8	3
10	4
12	6

* BASED ON TEST PRESSURE OF 250 PSI





LAKE WHATCOM WATER & SEWER DISTRICT

REVERSE THRUST BLOCK

NOT TO SCALE

STANDARD DETAIL

W9

9/20/2017

SEWER SYSTEM NOTES

1. Sewer system materials, trenching, bedding, installation, backfilling, and testing shall conform to WSDOT 7–05 and 7–17.

2. Gravity sewer pipe shall be ASTM D3034–SDR 35 PVC per WSDOT 9–05.12(1). In certain applications, the District may require class 52 ductile iron pipe, per WSDOT 9–30.1(1) encased in polyethylene encasement per WSDOT 9–30.1(2).

3. Pressure sewer pipe shall be class 52 ductile iron pipe per WSDOT 9–30.1(1) encased in polyethylene encasement per WSDOT 9–30.1(2) or PVC C900 class 150 per WSDOT 9–30.1(5). HDPE may be substituted with the approval of the District Engineer and the pipe rating shall be based on the specific design conditions.

4. Side sewers, from main to private property line, shall be installed per WSDOT 7–18. Side sewers shall have a minimum slope of 2%. Side sewer shall maintain a minimum cover of 30 inches under ditches. Side sewers and cleanout/test tee at property line shall be minimum 6–inches in diameter. Inspection prior to backfill.

5. Sewer cleanouts shall be installed per WSDOT 7–19.

6. Grout for manholes shall be a non–shrinking cementitious grout, containing no gypsum or calcium sulfate Di–hydrate ($CaSO_4 2H_2O$), conforming to WSDOT 9–20.3(2), such as Rapid Set Cement All or approved equivalent. Grout shall be installed according to manufacturer's instructions. JET SET, BLUELINE, AND QUICKCRETE ARE NOT ALLOWED!

7. All sewer pipe and appurtenances shall be flushed and cleaned prior to being put into service. Debris shall not be allowed into the existing sewer system.

8. District Engineer or their appointed representative shall witness testing. Contractor shall provide the District Engineer 48 hours notice prior to conducting tests or sampling.

9. Pipe shall be tested after backfill by the low–pressure air test method per WSDOT 7–17.3(2)F. PVC pipe shall have a mandrel passed through it to check for any deflections in the pipe per WSDOT 7–17.3(2)G. The District at their option may require any or all sewers to be inspected by the use the District television camera before final acceptance. The costs incurred in making the inspection shall be borne by the Contractor. Connection to the existing system is not permitted until final acceptance.

10. Downspouts, foundation/crawl space sump pumps, yard drains, or any outside drains shall not be connected to sanitary sewer mains or services.

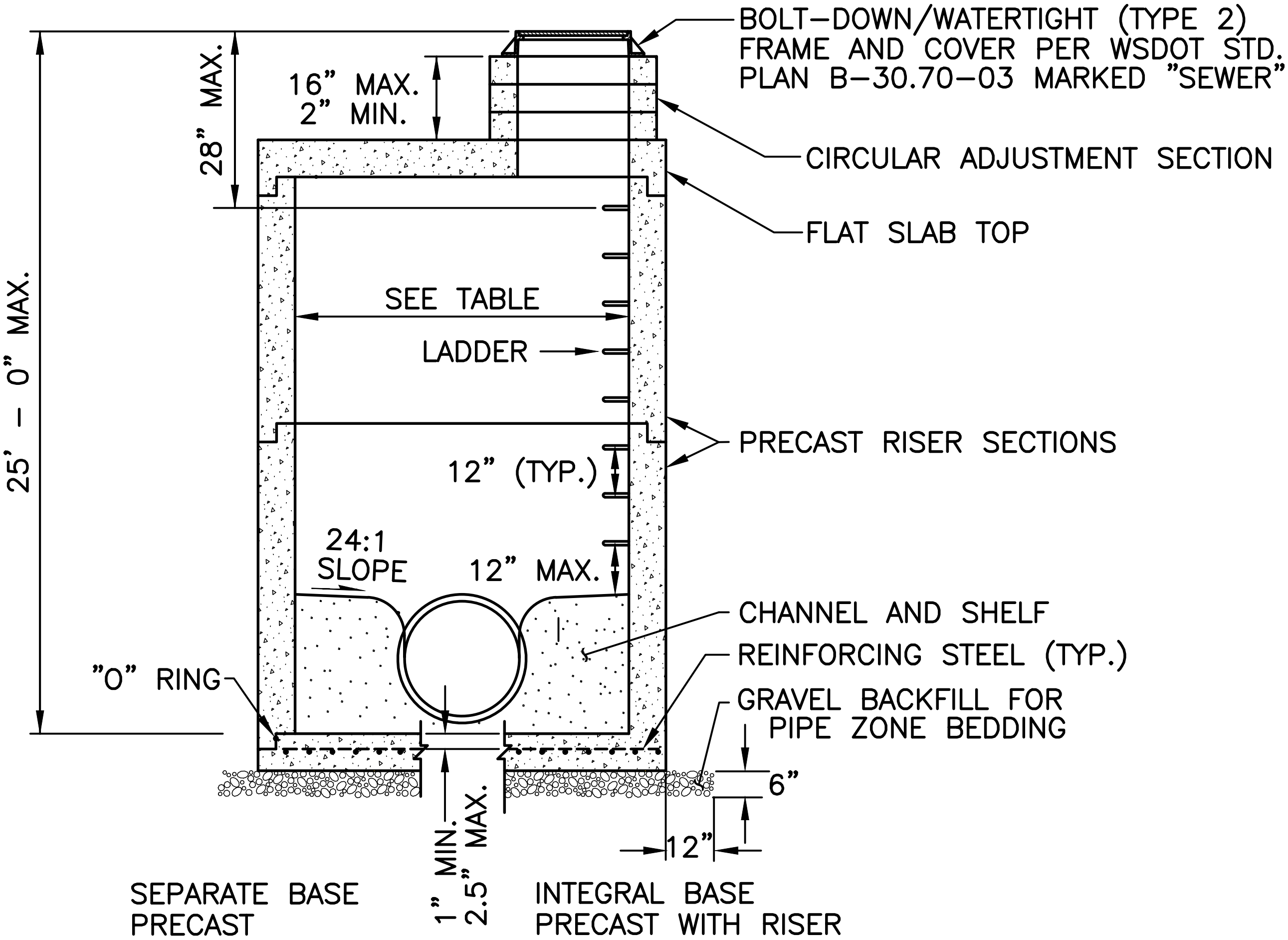
LAKE WHATCOM WATER & SEWER DISTRICT

SEWER SYSTEM NOTES

STANDARD DETAIL

S1

9/20/2017



MANHOLE DIMENSION TABLE

DIAM	MIN. WALL THICKNESS	MIN. BASE THICKNESS	MAXIMUM KNOCKOUT SIZE	MINIMUM DISTANCE BETWEEN KNOCKOUTS	PIPE ALLOWANCES PIPE MATERIAL WITH MAX. INSIDE DIAM.	
					ALL METAL	SOLID WALL PVC
48"	4"	6"	36"	8"	30"	30"
54"	4.5"	8"	42"	8"	36"	36"
60"	5"	8"	48"	8"	42"	42"
72"	6"	8"	60"	12"	54"	48"
84"	8"	12"	72"	12"	60"	48"
96"	8"	12"	84"	12"	72"	48"

NOTES:
1. Knockouts shall have a wall thickness of 2" minimum to 2.5" maximum.

2. No steps are required when height is 4' or less.

BASED ON WSDOT STANDARD PLANS B–15.60–02 AND B–10.20–01.

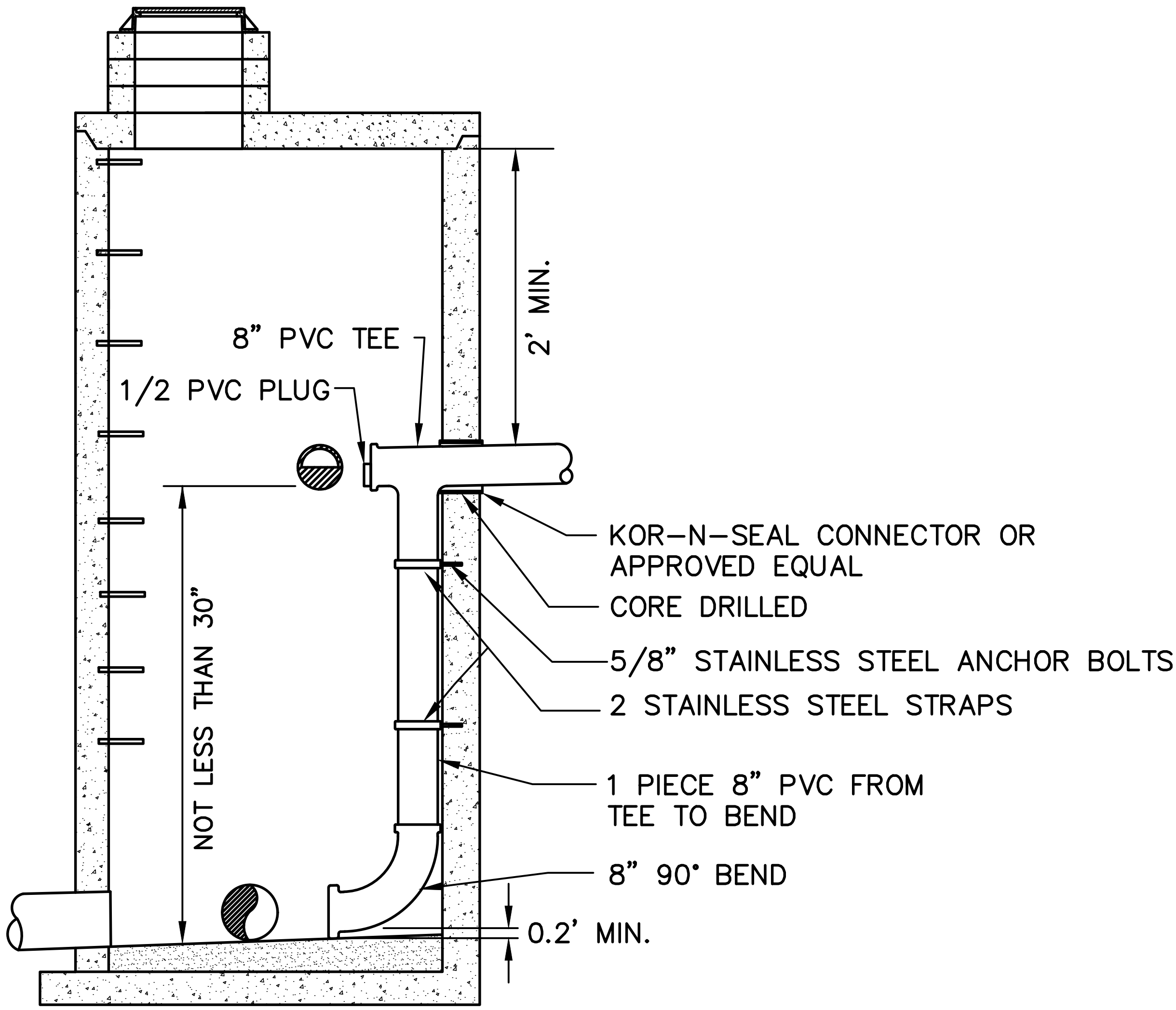
LAKE WHATCOM WATER & SEWER DISTRICT

SANITARY SEWER MANHOLE TYPE 3

STANDARD DETAIL

S2

9/20/2017



NOTES:

1. Drop tee to be installed minimum of 2' below ceiling.

2. Inside drop manhole shall be installed only where approved the District.

3. Size of manhole will increase with larger diameter pipe and shall be approved by the District Engineer.

4. Channel to outlet.

BASED ON CITY OF BELLINGHAM DRAWING SS-715 DATED 11/29/04.

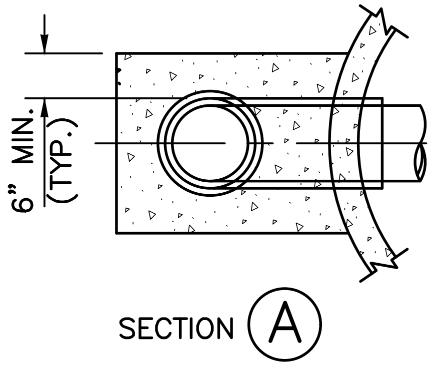
LAKE WHATCOM WATER & SEWER DISTRICT

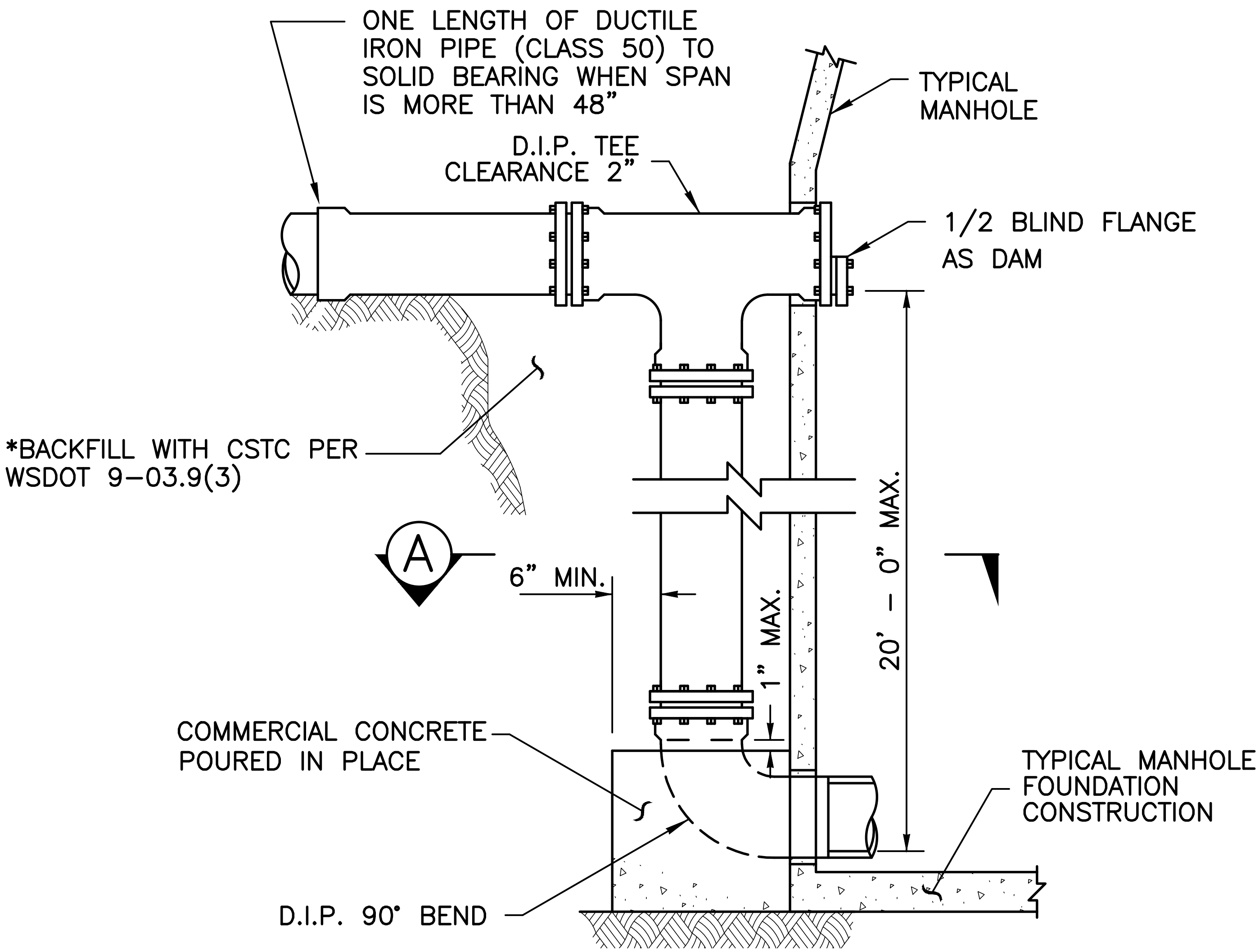
INSIDE DROP SEWER MANHOLE CONNECTION

STANDARD DETAIL

S3

9/20/2017





NOTES:

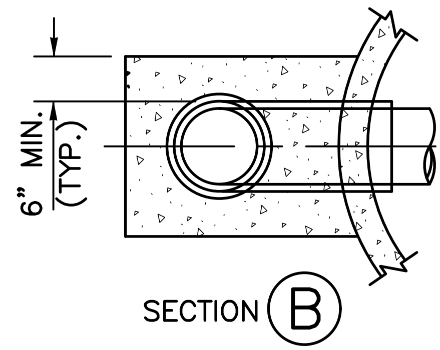
1. * Differs from WSDOT Std. Plan B-85.50-01

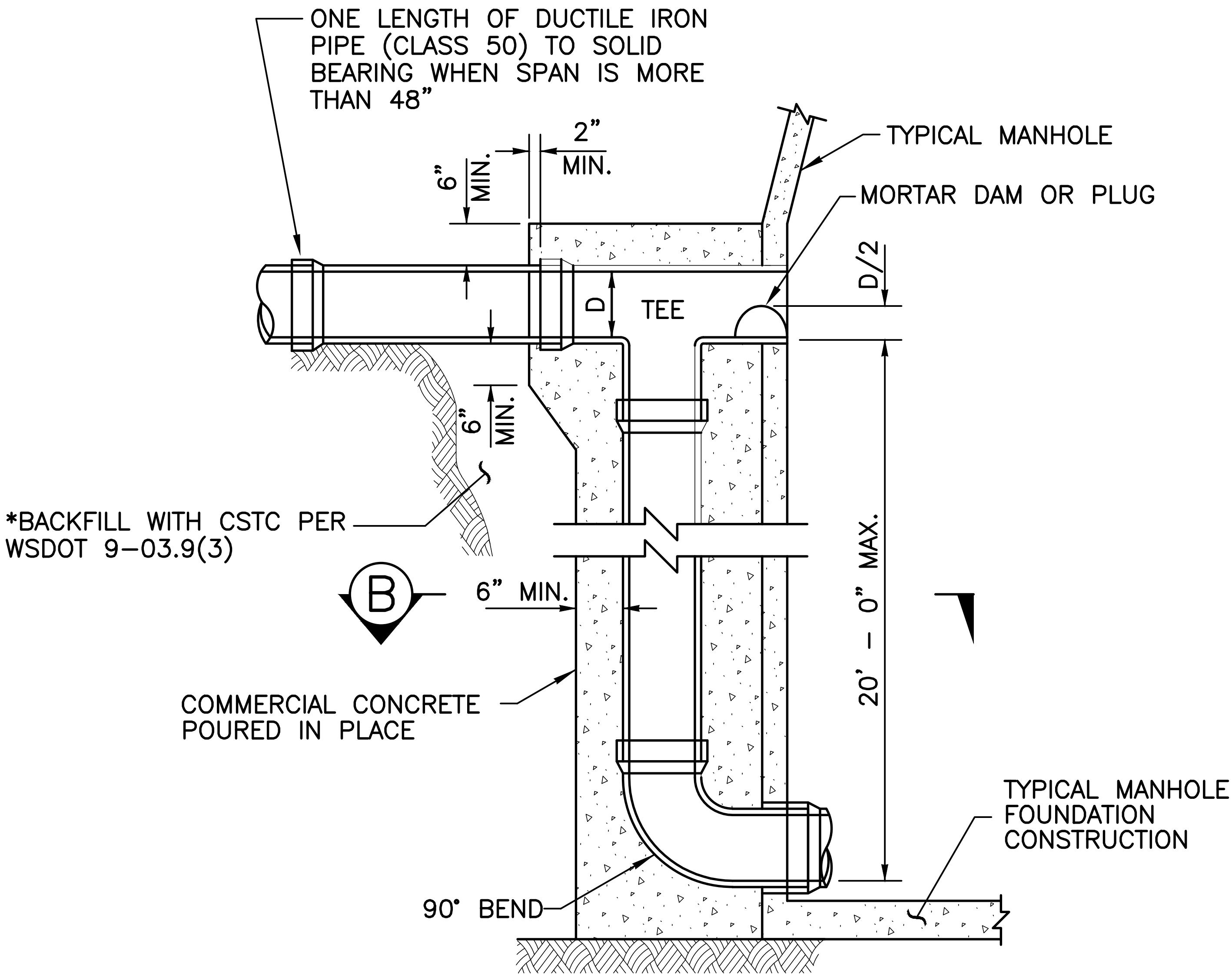
BASED ON WSDOT STANDARD PLAN B-85.50-01 DATED 6/10/08.

LAKE WHATCOM WATER & SEWER DISTRICT

OUTSIDE DROP SEWER MANHOLE CONNECTION
Sheet 1 of 2

STANDARD DETAIL
S4
9/20/2017





NOTES:

1. All pipe, except ductile iron pipe, shall be concrete encased.

2. Inside drop manhole shall be installed only where approved by the district.

3. * Differs from WSDOT Std. Plan B–85.50–01.

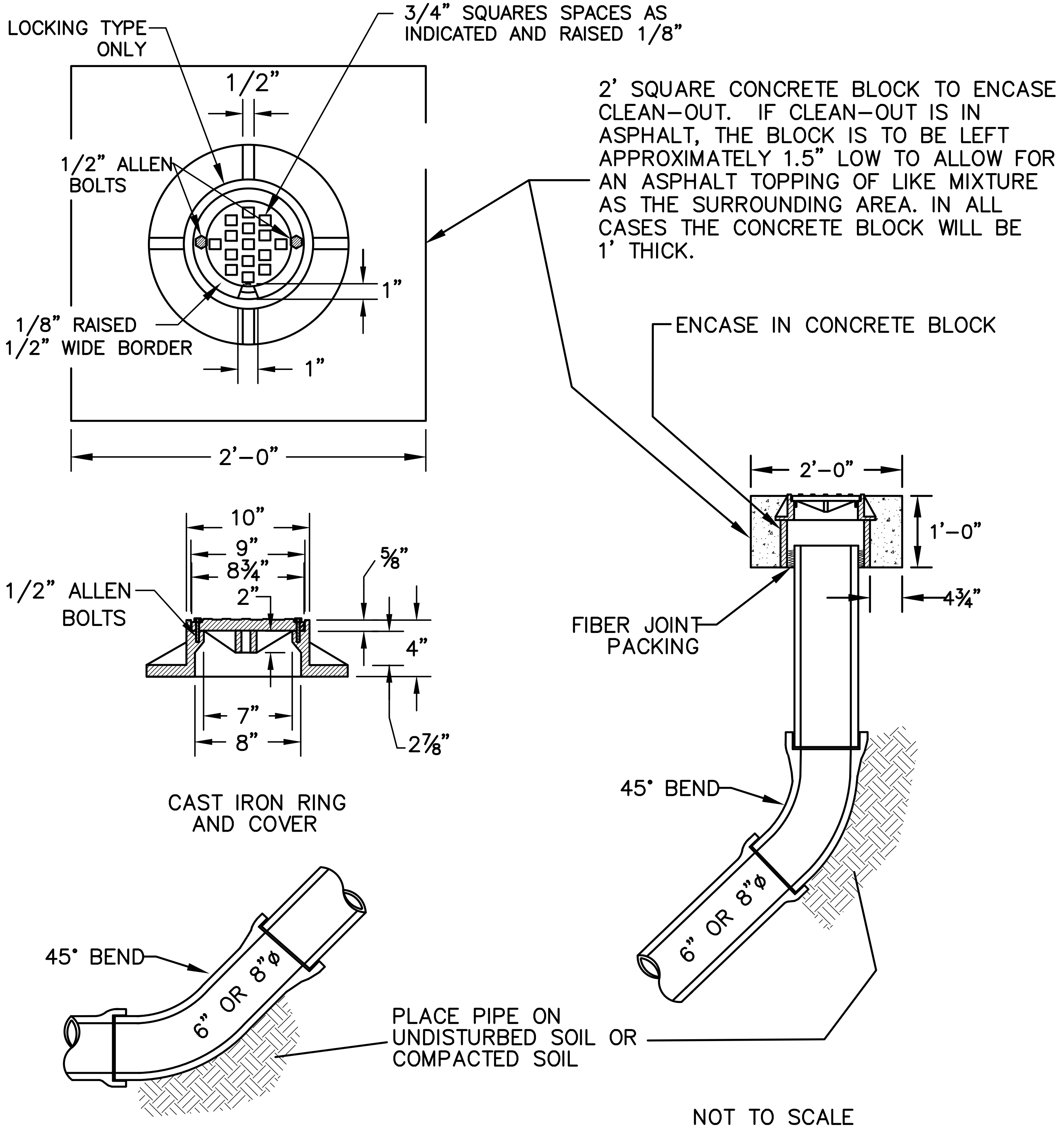
BASED ON WSDOT STANDARD PLAN B–85.50–01 DATED 6/10/08.

OUTSIDE DROP SEWER MANHOLE CONNECTION
Sheet 2 of 2

STANDARD DETAIL

S4

9/20/2017



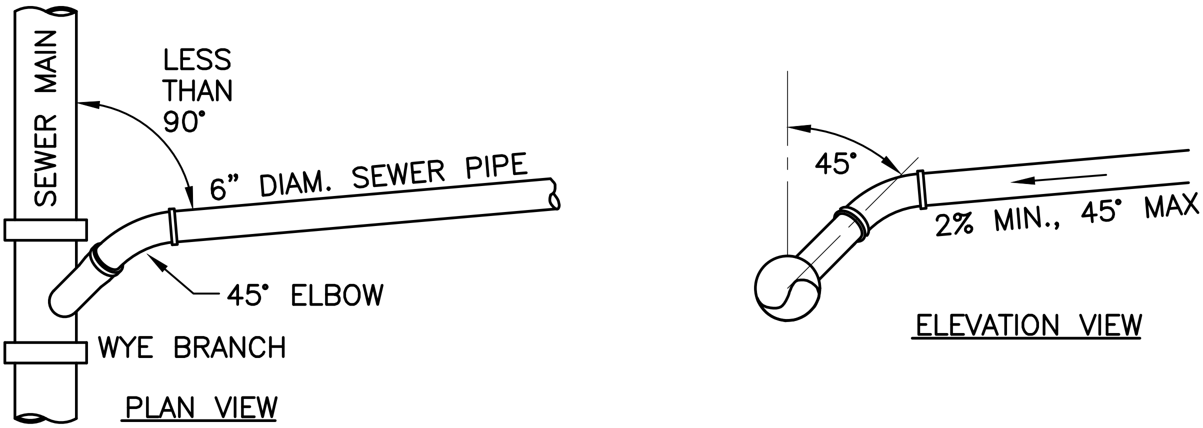
LAKE WHATCOM WATER & SEWER DISTRICT

SEWER MAIN CLEANOUT

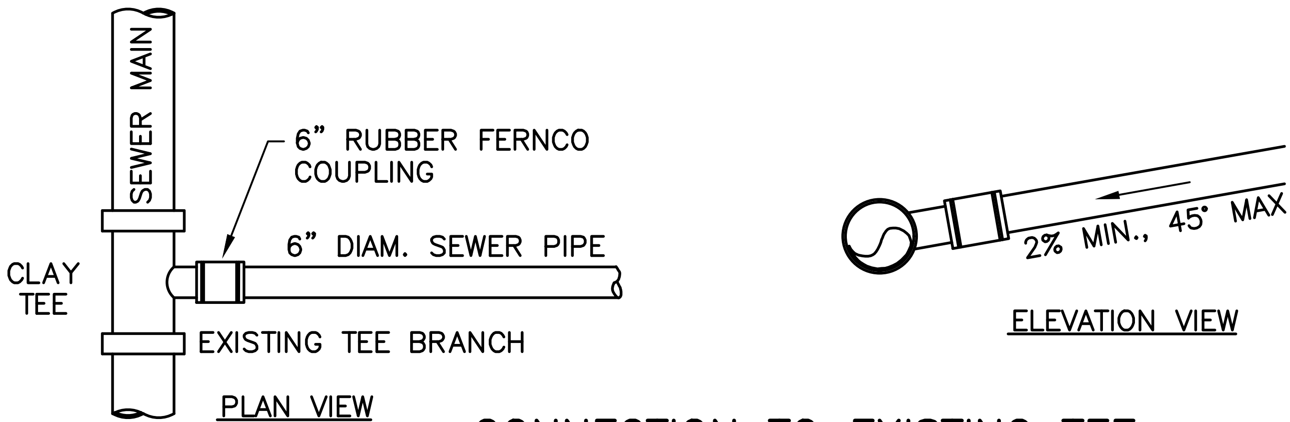
STANDARD DETAIL

S5

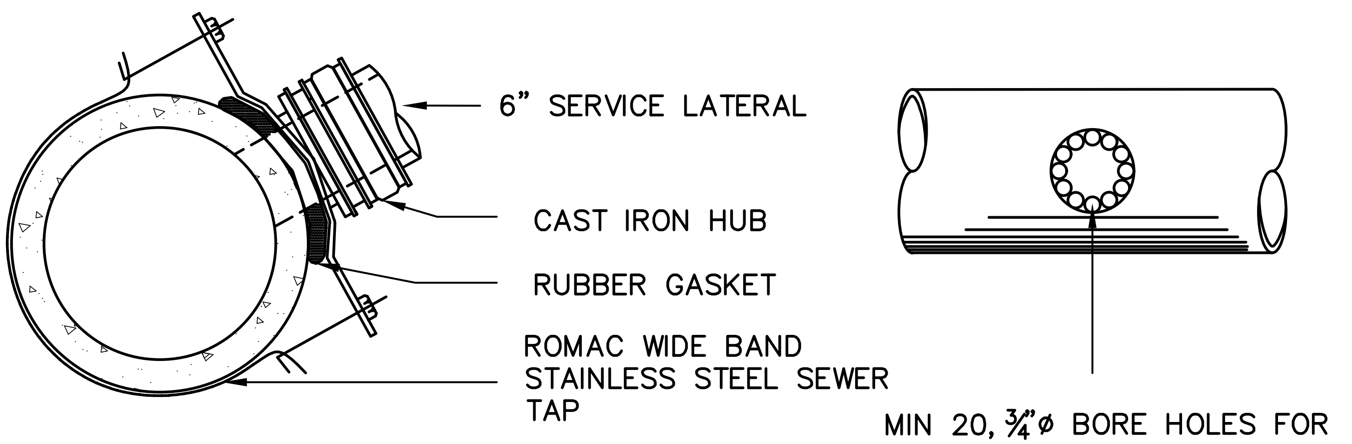
5/1/2014



SERVICE LATERAL INSTALLED WITH NEW MAINS



CONNECTION TO EXISTING TEE



NOTES;

1. Install wye fitting with gaskets for new sewer installations
2. Pipe bedding shall be sand or pea gravel 6" all around.
3. Minimum cover to finish grade is 30".
4. Drill multiple 3/4' holes (20 min for 6") then break out

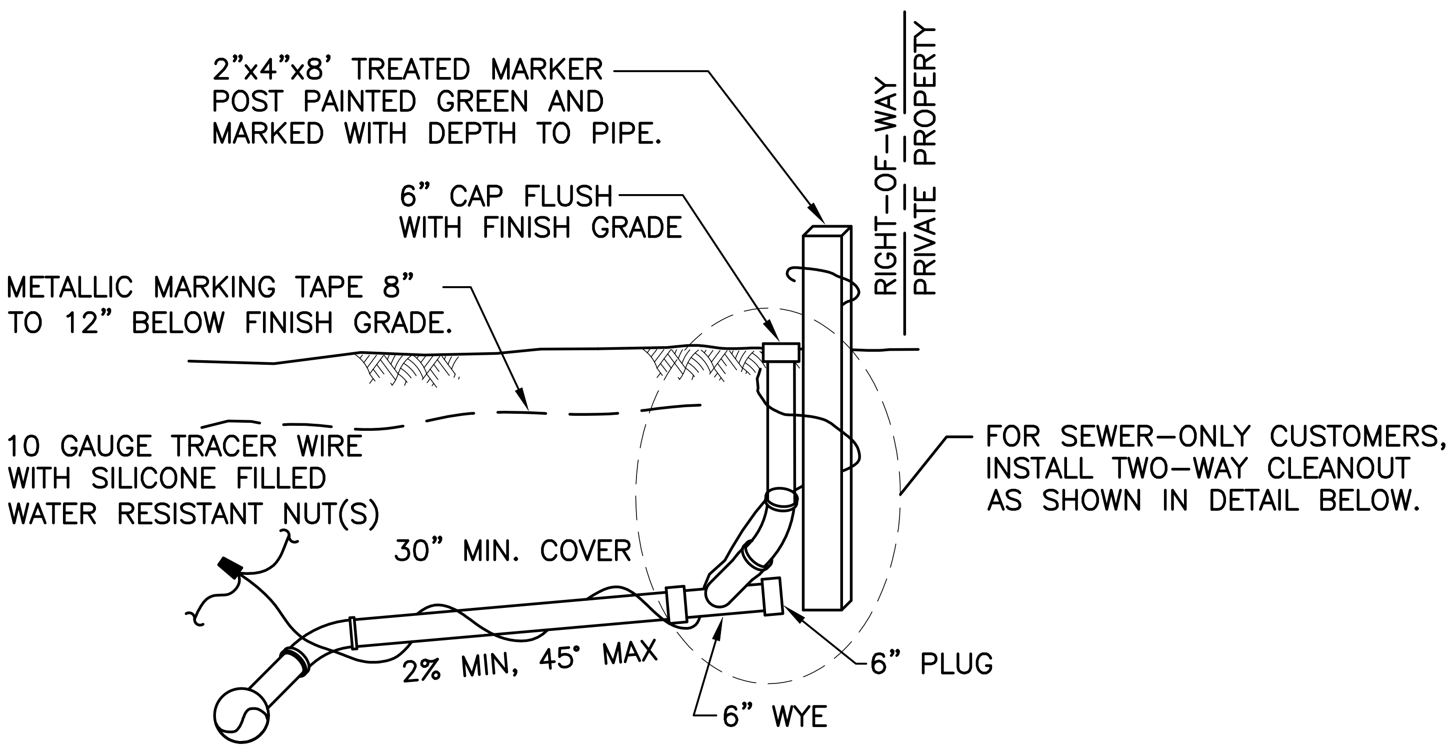
CONNECTION TO EXISTING SEWER (TAP)

SEWER LATERAL CONNECTION TO MAIN

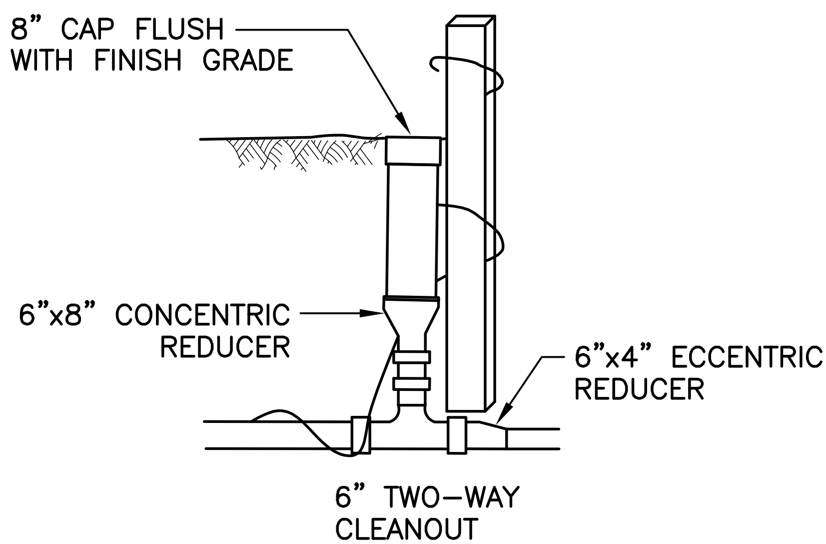
STANDARD DETAIL

S6

5/1/2014



TYPICAL SEWER LATERAL & CLEANOUT



CLEANOUT FOR SEWER-ONLY CUSTOMERS.

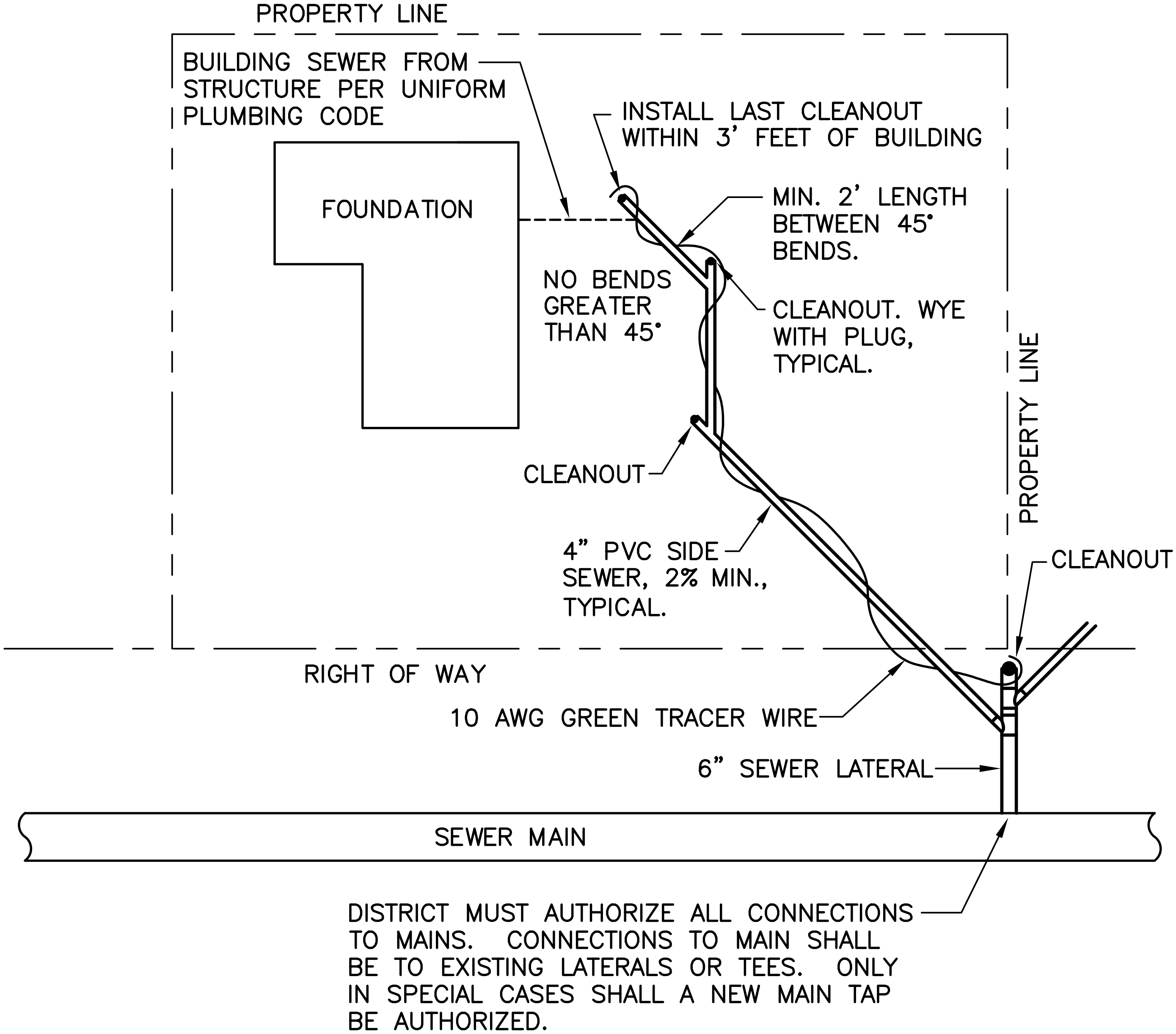
LAKE WHATCOM WATER & SEWER DISTRICT

SEWER LATERAL AND CLEANOUT

STANDARD DETAIL

S7

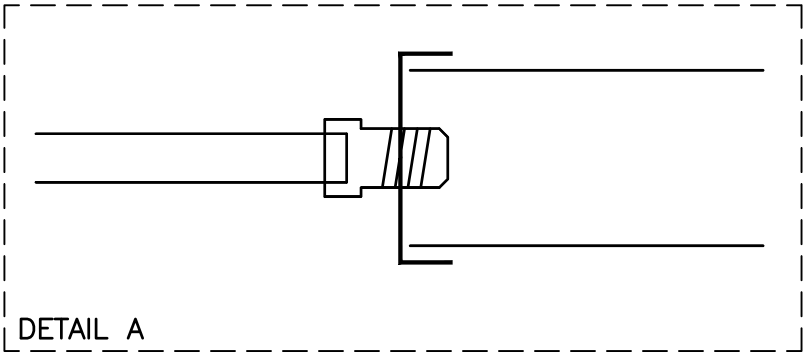
5/1/2014

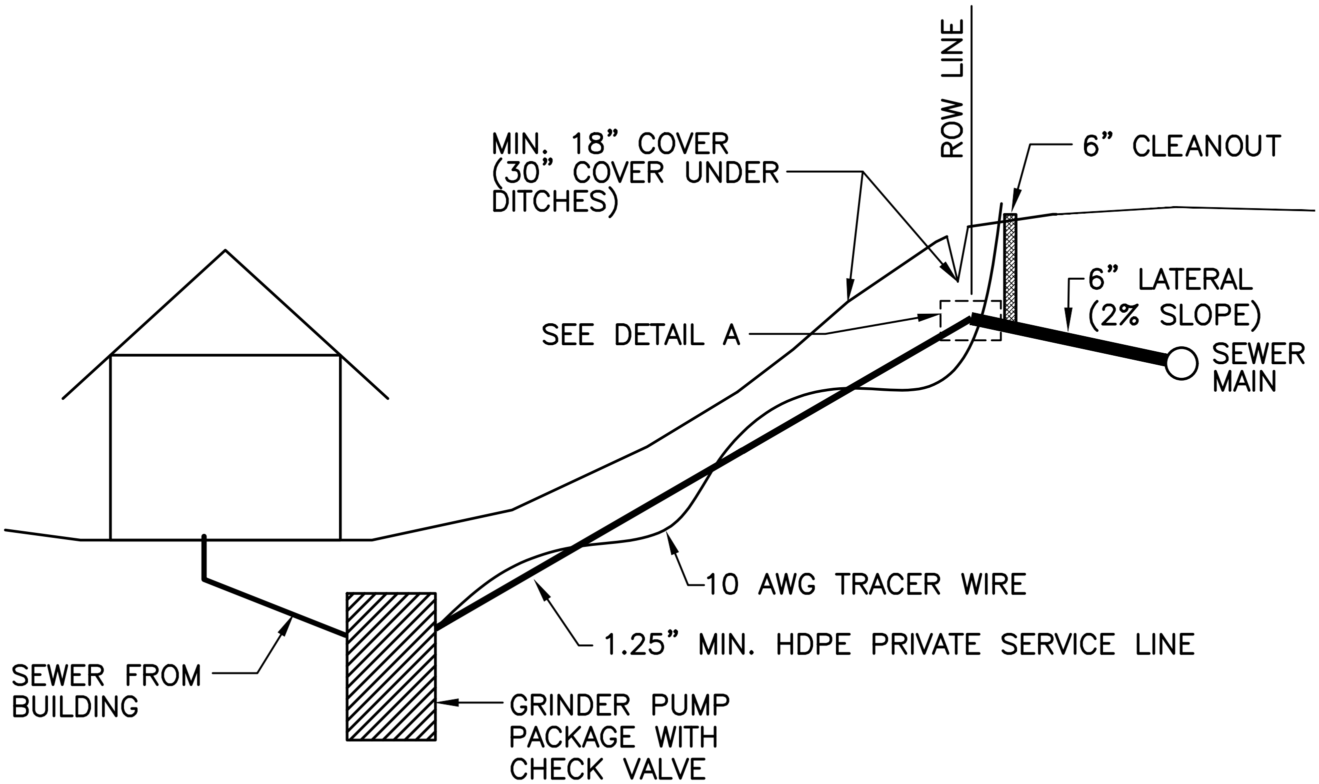


Notes:

1. All pipe from main to cleanout at foundation shall be PVC ASTM D3034 SDR 35, joints shall conform to ASTM D3212 using elastomeric gaskets conforming to ASTM F477. Fittings shall be injection molded, factory welded, or factory solvent cemented.
2. Minimum 18" of cover from property line to building.
3. Down spouts, sump pumps, and outside drains shall not be connected to the sewer line.
4. Bends greater than 45° will not be accepted.
5. Minimum size for sewer lines will be 4" for single family residence and 6" for multi–family residence up to a 4 plex.
6. Cleanouts on service lines shall be installed at every change in alignment or grade in excess of 22 1/2 degrees.
7. Cleanouts shall be spaced no greater than 100' apart.
8. A cleanout shall be installed within 3' of the building.

LAKE WHATCOM WATER & SEWER DISTRICT	GRAVITY SIDE SEWER INSTALLATION	STANDARD DETAIL S8 5/1/2014





SEE DOE'S CRITERIA FOR SEWAGE WORKS DESIGN, SECTIONS C1–10.1 & C1–10.2 FOR GRINDER PUMP DESIGN & COMPONENT INFORMATION

NOTES:

1. Pressure sewer service pipe shall be PE 3408 HDPE conforming to the requirements of ASTM D–3350. Piping shall be SDR11, IPS (OD), pressure rated at 160 PSI, conforming to the requirements of AWWA C901 and ASTM F714.

2. Brass compression fittings only – no hose clamps.

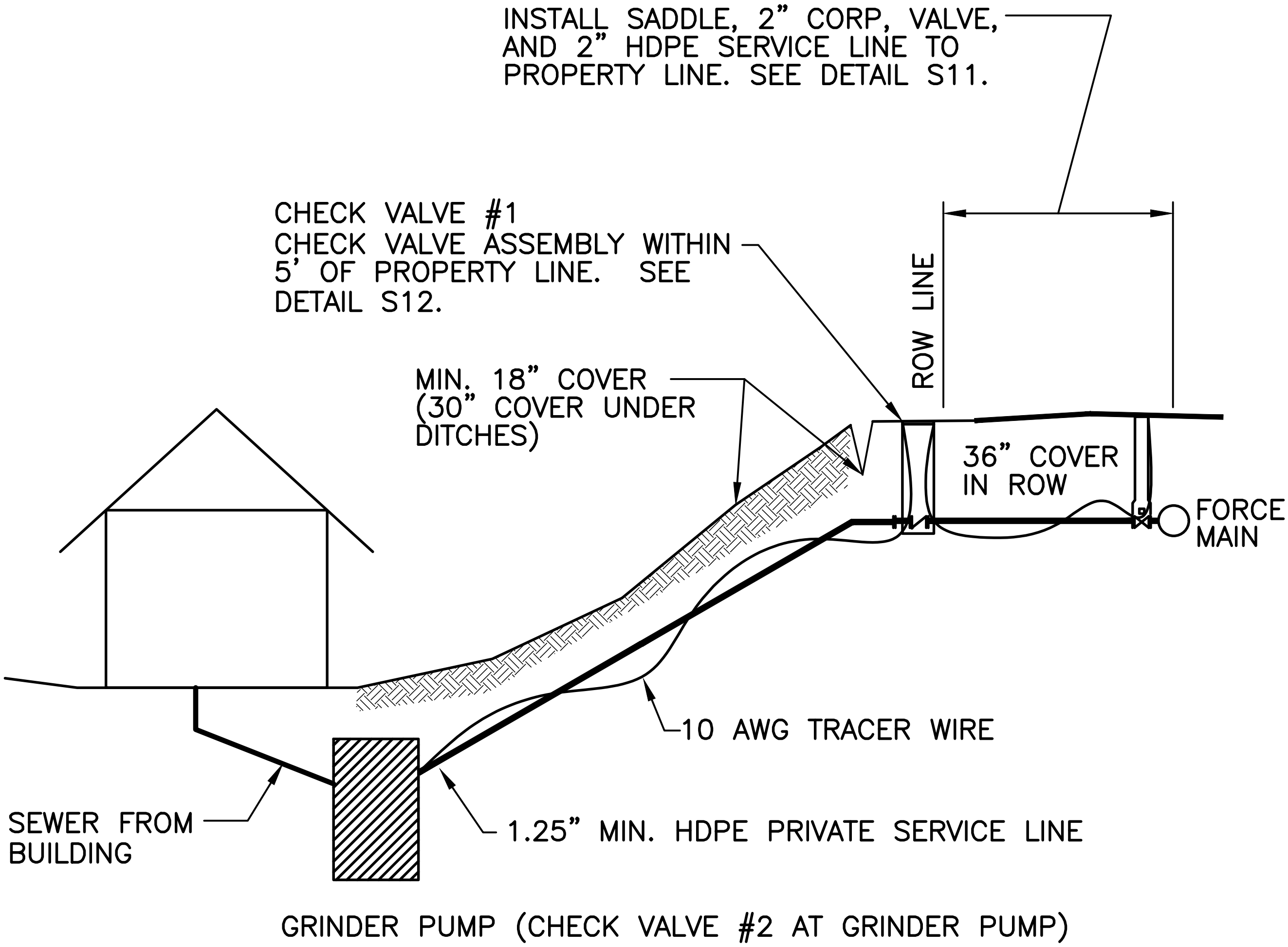
LAKE WHATCOM WATER & SEWER DISTRICT

GRINDER PUMP SERVICE TO GRAVITY MAIN INSTALLATION

STANDARD DETAIL

S9

9/20/2017



SEE DOE'S CRITERIA FOR SEWAGE WORKS DESIGN, SECTIONS C1-10.1 & C1-10.2 FOR GRINDER PUMP DESIGN & COMPONENT INFORMATION

NOTES:

1. Pressure sewer service pipe shall be PE 3408 HDPE conforming to the requirements of ASTM D-3350. Piping shall be SDR11, IPS (OD), pressure rated at 160 PSI, conforming to the requirements of AWWA C901 and ASTM F714.

2. Two check valves are required between the pump station and the force main. One check valve shall be installed within 5' of the right-of-way in the check valve vault. The second valve shall be installed at the grinder pump.

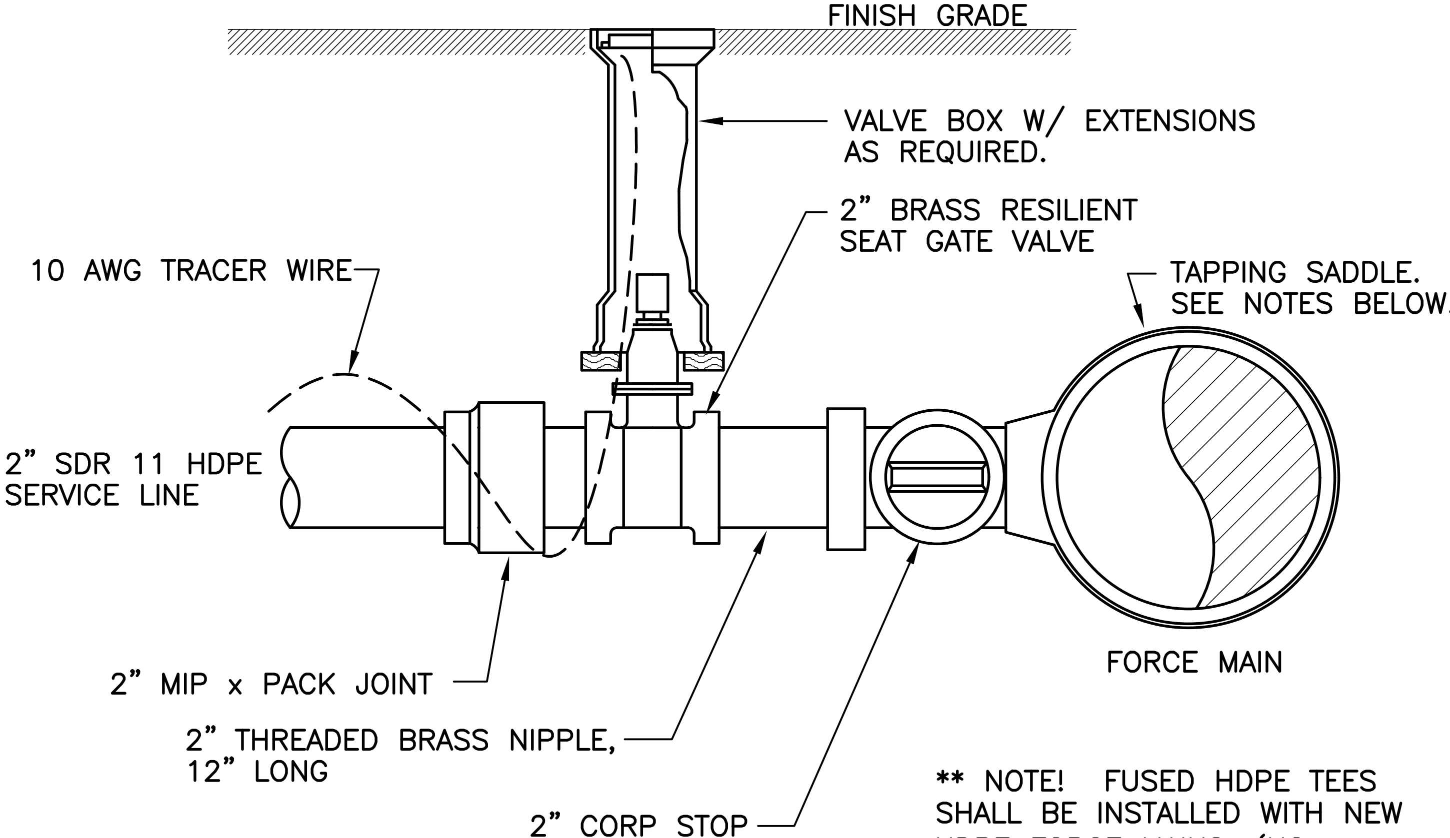
LAKE WHATCOM WATER & SEWER DISTRICT

GRINDER PUMP SERVICE TO FORCE MAIN INSTALLATION

STANDARD DETAIL

S10

5/1/2014



** NOTE! FUSED HDPE TEES SHALL BE INSTALLED WITH NEW HDPE FORCE MAINS. (NO TAPPING SADDLE OR CORP STOP.)

NOTES:

1. HDPE Service Saddles. Saddles for use on SDR 17 HDPE mains shall be epoxy or nylon coated ductile iron tapping saddles with a double stainless steel strapping mechanism specifically recommended by the manufacturer for use on HDPE piping. Saddles shall be Romac style 202N-H or approved equal.

2. PVC Service Saddles. Saddles for use on AWWA C900 PVC mains shall have epoxy or nylon coated ductile iron tapping saddles with a double strap stainless steel strapping mechanism. Service saddles shall be Romac style 202N or approved equal.

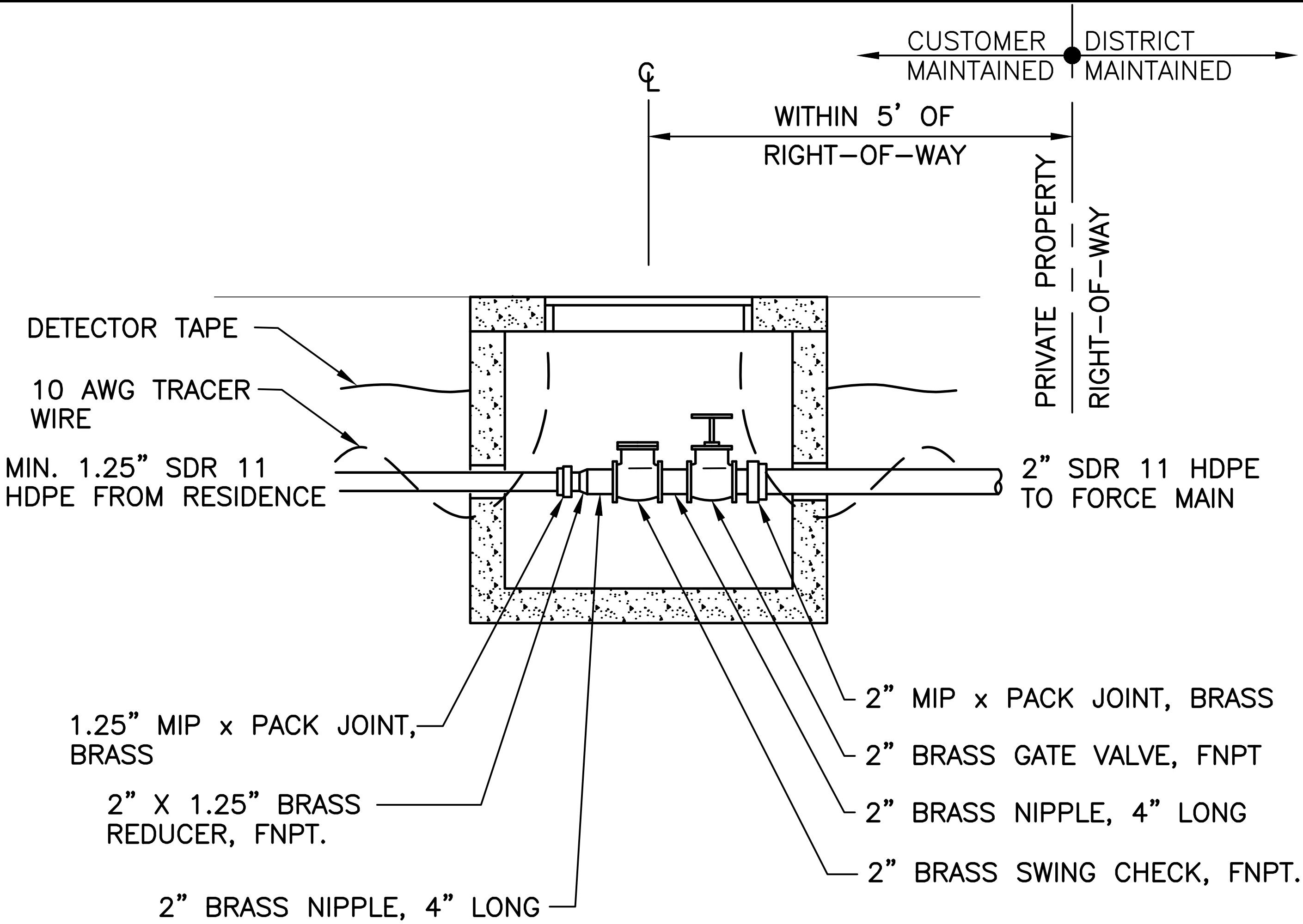
3. Ductile Iron Service Saddles. Saddles for use on ductile iron mains shall have epoxy or nylon coated ductile iron tapping saddles with stainless steel tapping mechanism. Service saddles shall be Romac style 101NS or approved equal.

4. Customer Service Shutoff Valves. Shutoff valves shall be resilient wedge type gate valves in conformance with AWWA C515. Valves shall be suitable for sewage service and be equipped with transition gaskets where needed. Gate valves shall have a non-rising stem and be fusion-bonded epoxy coated inside and out meeting AWWA C550. Gate valves shall be Clow resilient wedge gate valves or approved equal.

5. Valve boxes shall have the word "SEWER" cast into the cover.

6. Fittings. All fittings shall be brass.

LAKE WHATCOM WATER & SEWER DISTRICT	CONNECTION TO FORCE MAIN	STANDARD DETAIL S11 9/20/2017



Notes

1. Check Valve. Check valve shall be horizontal swing type manufactured out of brass and be pressure rated to 125 psi. Valve shall have metal to metal seal and threaded NPT end connections. Valve shall be a Milwaukee Valve UP509 or equal.

2. Gate Valve. Gate valve shall be manufactured out of brass and be pressure rated to 200 psi. Valve shall have threaded bonnet and non–rising stem. Valve shall be a Watts Regulator Company Series WGV–X or equal.

3. Vault. Vault shall be a pre–cast concrete hand hole with a 2'–0" by 3'–0" inside diameter and a maximum 4'–0" inside depth. Hand hole and access hatch shall be traffic rated. Access hatch shall be galvanized steel checker plate with pick holes and bolt down holes in plate. Check valve vaults shall be Utility Vault Model 2436 hand hole or approved equal.

4. Air/Vacuum Valve. Where required, air relief and combination air relief/ vacuum relief valves shall be as manufactured by Orenco, Apco, Crispin, ARI, or equivalent for sewer service. All valves shall be on private property and be fully accessible to enable customer's operation, maintenance and repair.

5. Fittings and Adapters. All fittings and adapters shall be brass.

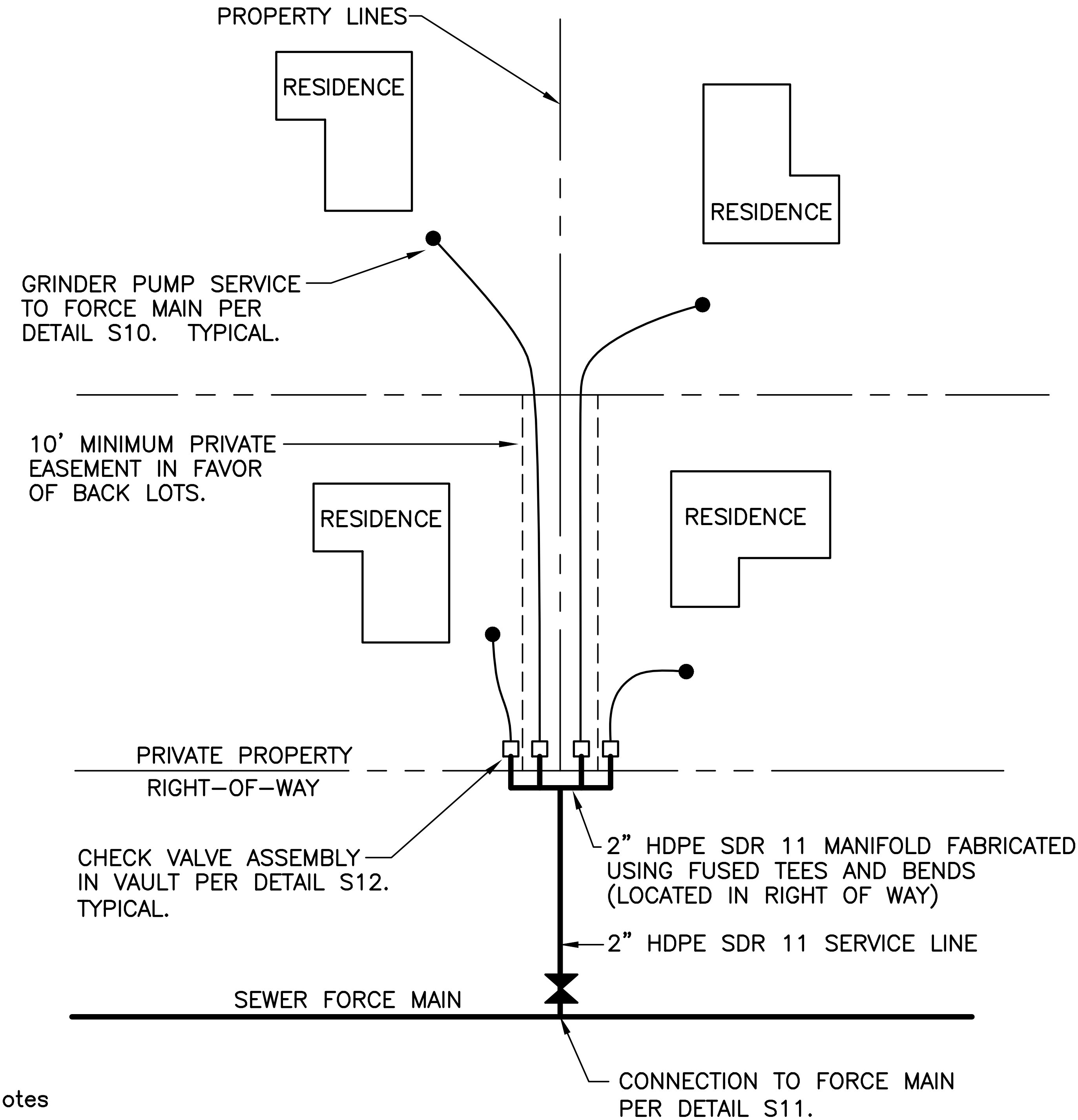
LAKE WHATCOM WATER & SEWER DISTRICT

FORCE MAIN SERVICE CHECK VALVE

STANDARD DETAIL

S12

9/20/2017

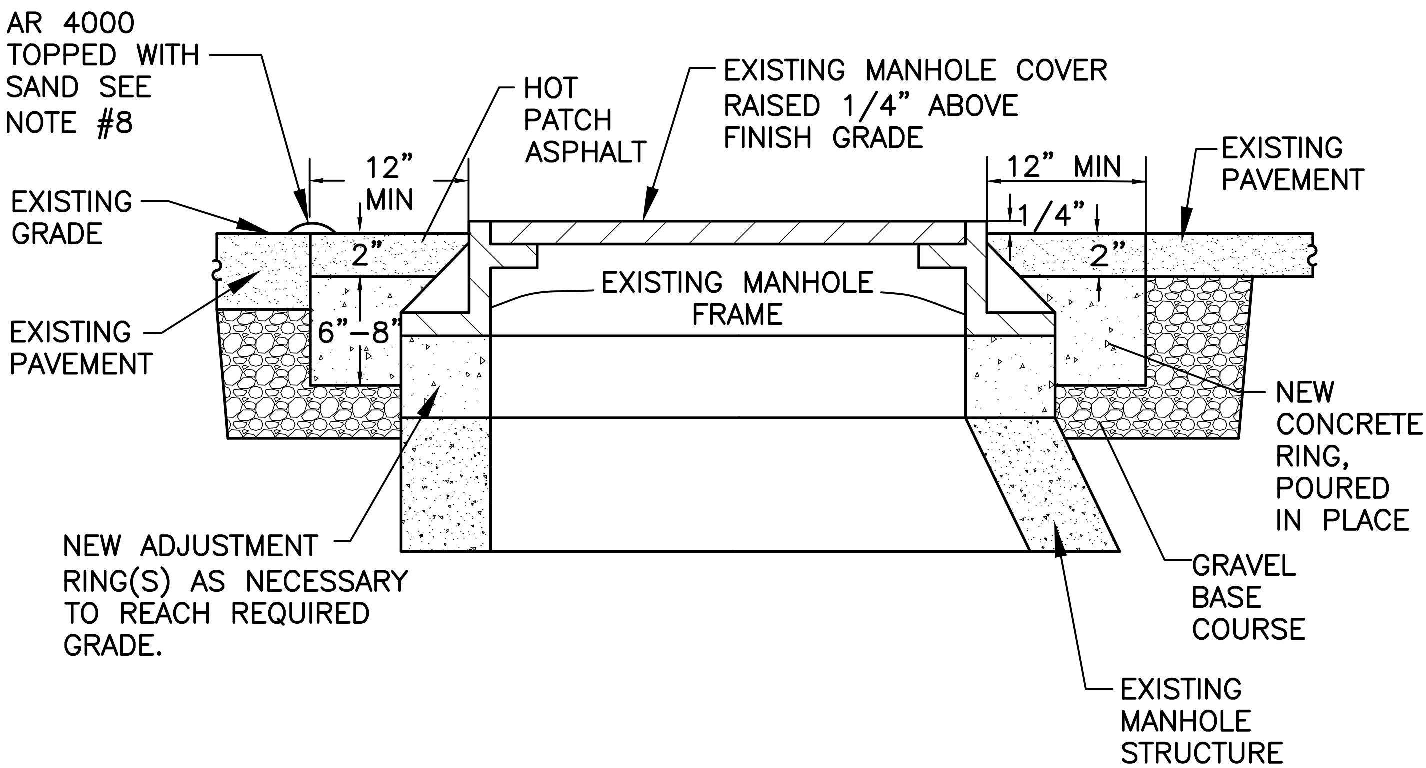


Notes

1. If approved by the District Engineer, a single 2" service tap may be shared with multiple residences. District will review requests for shared taps on a case by case basis. Property owners desiring to install a shared tap, shall individually but at the same time, submit a sewer permit application with the grinder pump check list for review by the District.

2. Manifold must be fabricated using fused HDPE tees and bends by a contractor certified by a HDPE pipe or fusion machine manufacturer.

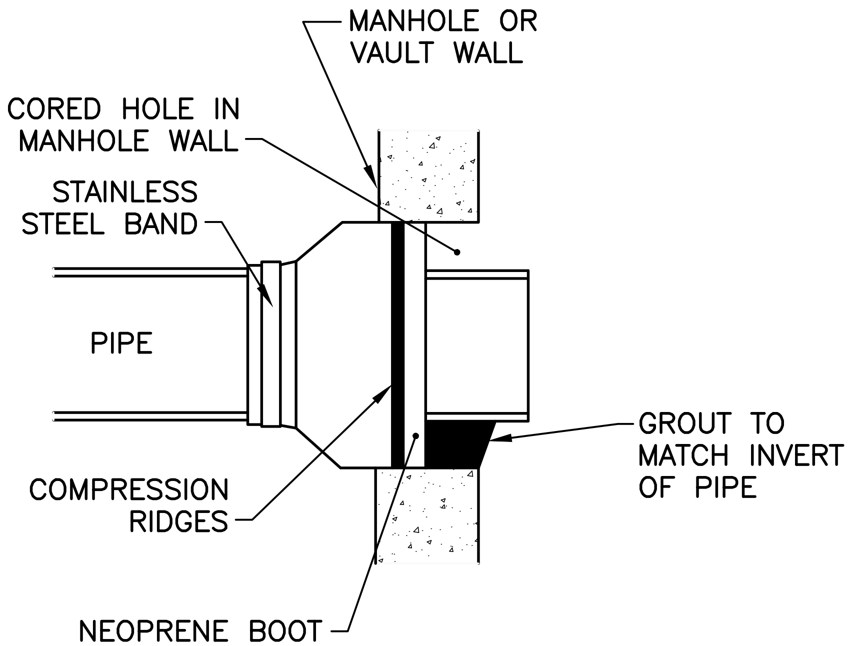
LAKE WHATCOM WATER & SEWER DISTRICT	SHARED FORCE MAIN SERVICE TAP	STANDARD DETAIL S13 5/1/2014



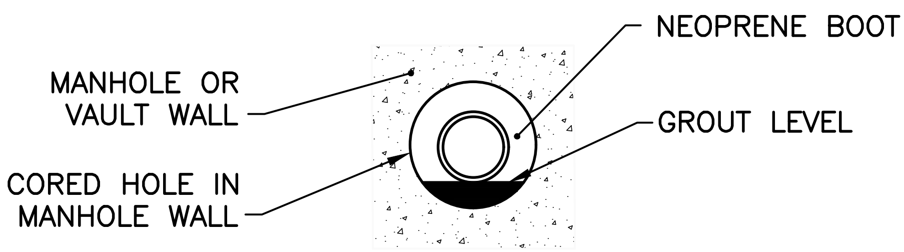
Notes

1. All manhole frames and covers shall be removed, cleaned and raised to finished grade.
2. Cut the asphalt or remove shoulder ballast in an even circle around the structure casting to be adjusted.
3. Remove the fill material within the cut pavement or shoulder area to 8 inches below finish grade, or to expose adjustment ring.
4. All joints shall be grouted with material conforming to WSDOT 9–20.3(2).
5. Place Portland Cement concrete to within the top 2 inches of finish grade.
6. Apply tack to the structure casting, cut pavement, and PC concrete.
7. Place and compact 2 inches hot mix asphalt patch to finish grade.
8. Seal pavement joints with hot AR4000 and top with sand.

LAKE WHATCOM WATER & SEWER DISTRICT	MANHOLE RIM & VALVE BOX RE-ADJUSTMENT	STANDARD DETAIL S14 9/20/2017



FLEXIBLE SEAL ADAPTER

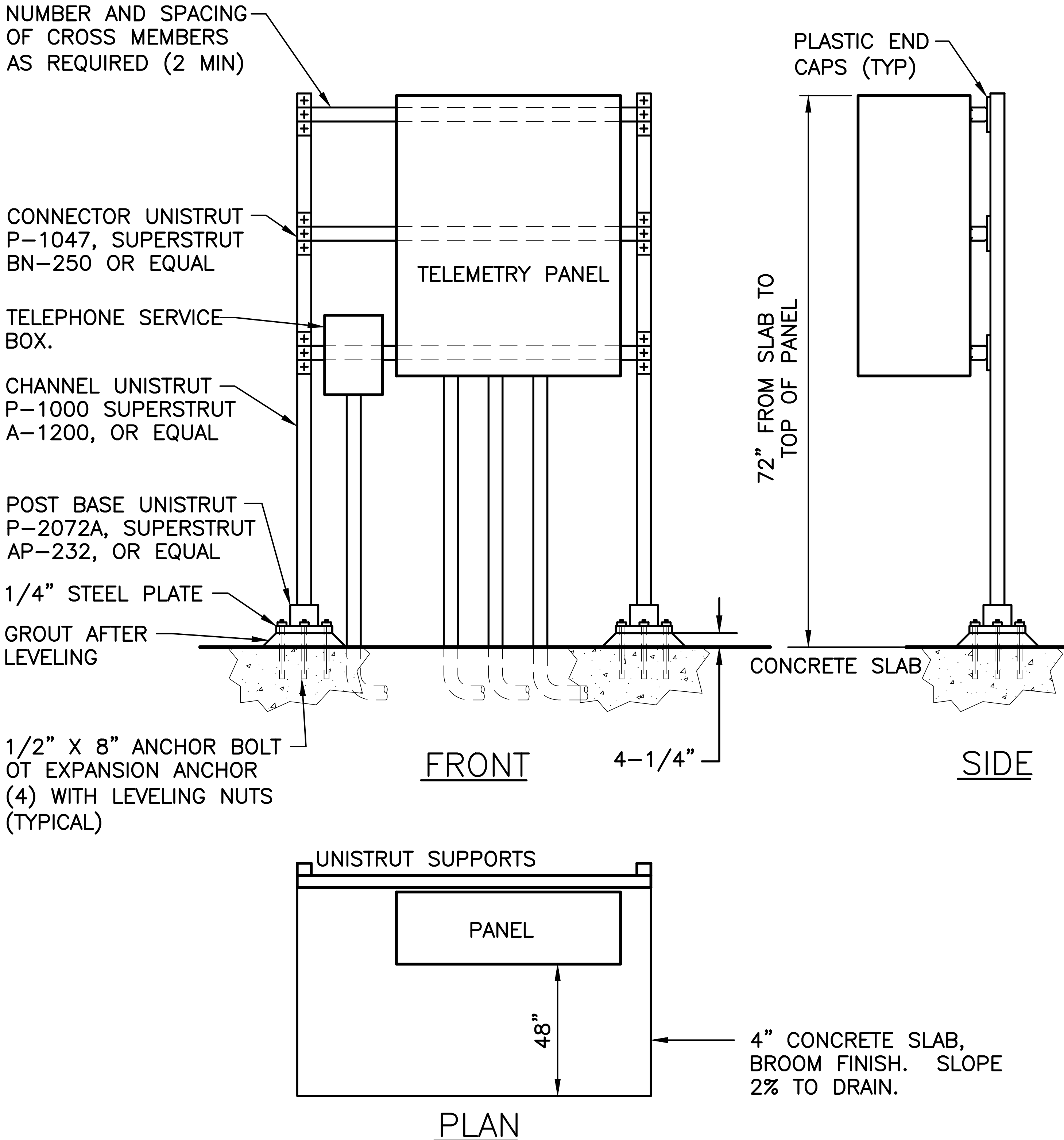


GROUT DETAIL

NOTES:

1. ALL MANHOLE CONNECTIONS SHALL BE 100% WATERTIGHT.
2. ALL PIPE SHALL EXTEND 2" INTO MANHOLE.
3. NEOPRENE BOOT ON THE FLEXIBLE SEAL ADAPTER SHALL BE A MINIMUM OF 3/8" THICK PER ASTM C-443, AND SHALL BE HELD IN PLACE WITH AN INTERNAL EXPANDING STAINLESS STEEL BAND SUCH AS "KOR-N-SEAL" OR APPROVED EQUAL.
4. DEFLECTION AT THE ADAPTER MUST NOT EXCEED MANUFACTURER'S RECOMMENDATION. IF SLOPE OF PIPE AT PENETRATION EXCEEDS RECOMMENDED DEFLECTION, CAST OR CORE HOLE AT AN ANGLE SUCH THAT DEFLECTION DOES NOT EXCEED MANUFACTURER'S RECOMMENDATION.

LAKE WHATCOM WATER & SEWER DISTRICT	MANHOLE PIPE PENETRATION DETAILS	STANDARD DETAIL S15 9/20/2017



NOTES:

1. Rack channels and fittings shall be hot dipped galvanized steel.

2. Telephone service lines shall be installed in conduit, both above and underground.

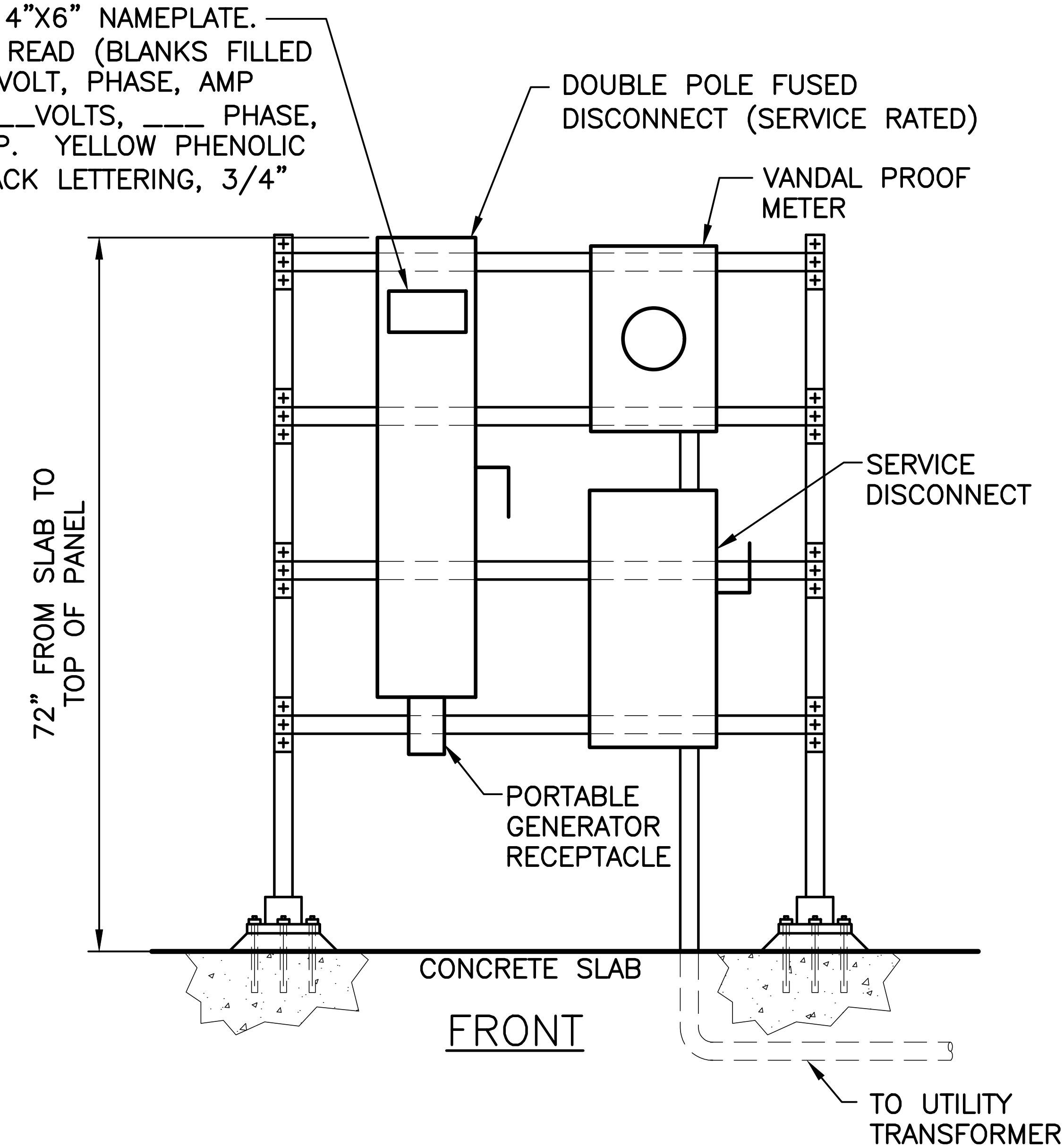
LAKE WHATCOM WATER & SEWER DISTRICT

TELEMETRY PANEL

STANDARD DETAIL

E1

5/1/2014



NOTES:

1. See LWWSD Standard Detail E1 – Telemetry Control Panel for unistrut system and concrete slab requirements. Concrete slab shall extend out 48" from face of panels.

2. Utility equipment may be mounted on back of telemetry panel rack.

3. Portable generator receptacle shall be 480 volt, 3-phase, 4 wire service, 100 amp with reversed contacts (female). Receptacle shall be provided complete with cast back box, angle adapter, gaskets, and a gasketed screw-type, weathertight cap with chain fastener. Receptacle shall be Crouse-Hinds "Arktite", Appleton "Powertite", or approved equal.

4. Manual transfer switch shall be a heavy duty (not general or light duty) double-throw MTS, fused as required to comply with NEC as manufactured by Cutler Hammer, Square D, Westinghouse, or equal.

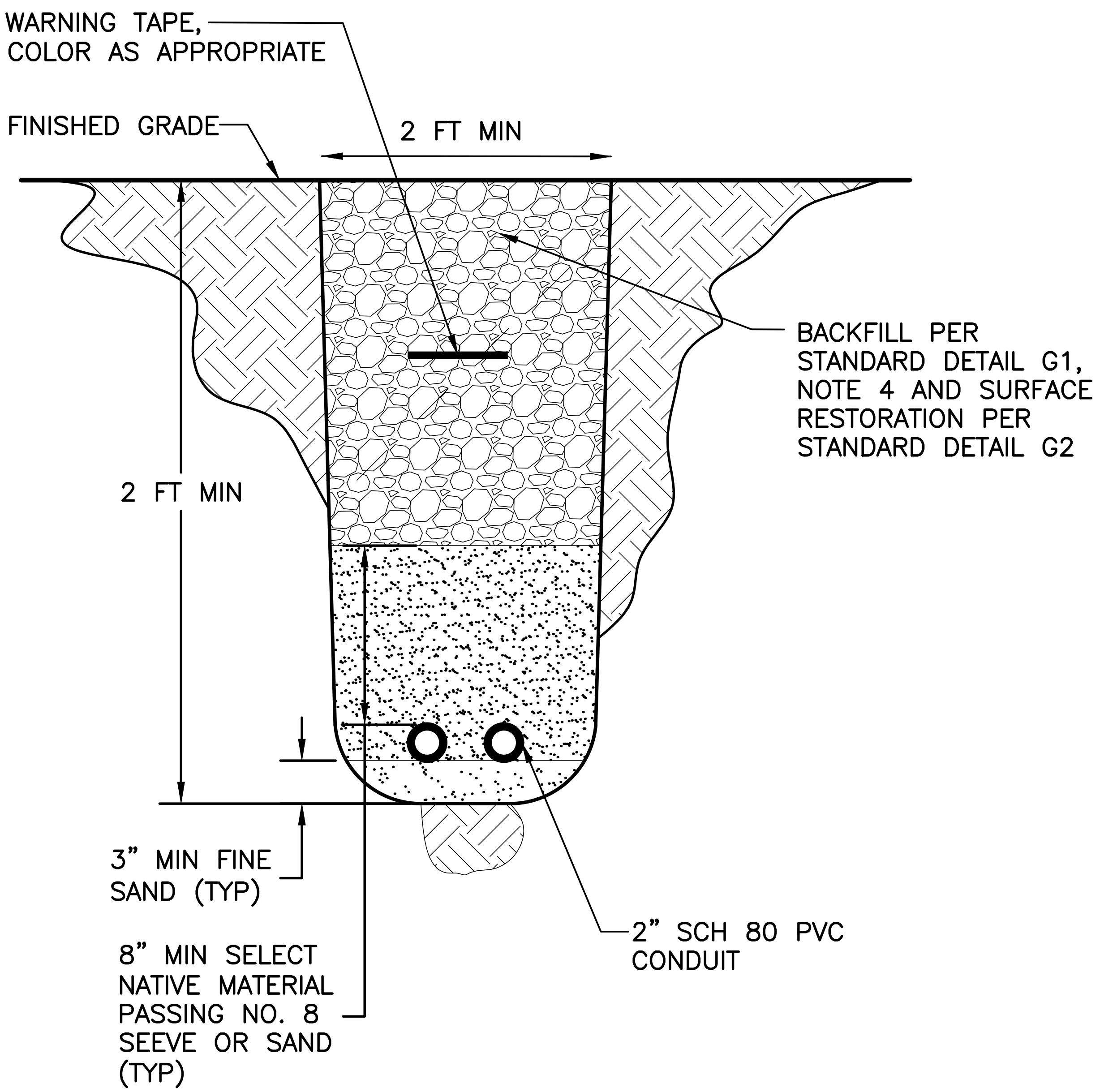
LAKE WHATCOM WATER & SEWER DISTRICT

UTILITY EQUIPMENT RACK

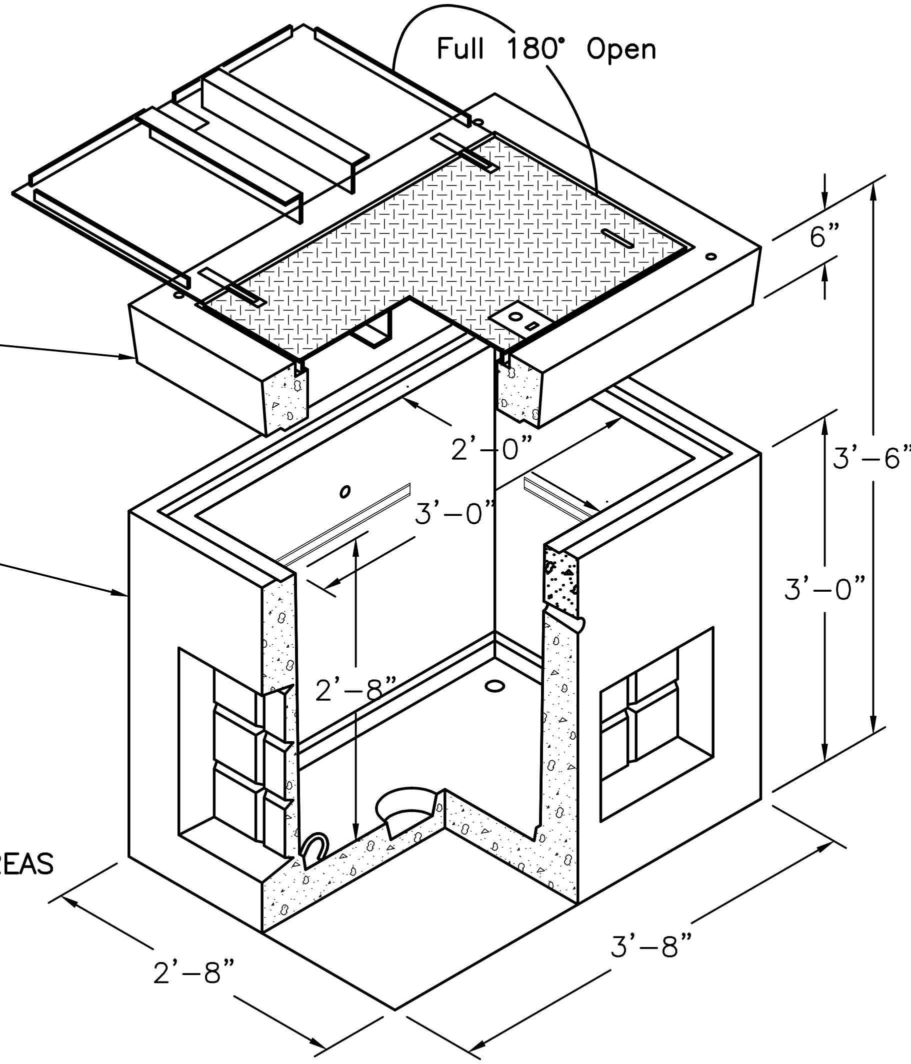
STANDARD DETAIL

E2

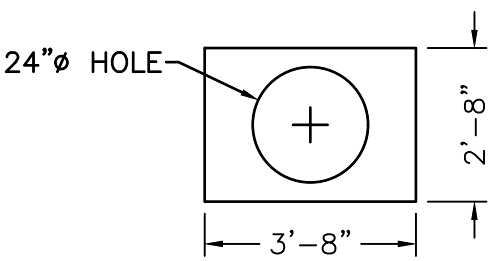
5/1/2014



LAKE WHATCOM WATER & SEWER DISTRICT	SCHEDULE 80 PVC TRENCH	STANDARD DETAIL E3 9/20/2017



COVER FOR PAVED TRAFFIC AREAS



No. 23–24C WITH 4220 DUCTILE
IRON COVER AND FRAME.

NOTES:

1. Utility Vault base No. 233–LA or approved equal. Dimensions shown as minimum.

2. Covers shall be rated for H–20 traffic loads. In non–traffic and gravel shoulder areas install hatch cover No. 23–2436P. In paved traffic areas install 4220 Ductile Iron Cover and Frame.

3. Sump knockout in floor.

4. Handholes shall be spaced every 500 to 1000 feet and installed at changes in conduit direction.

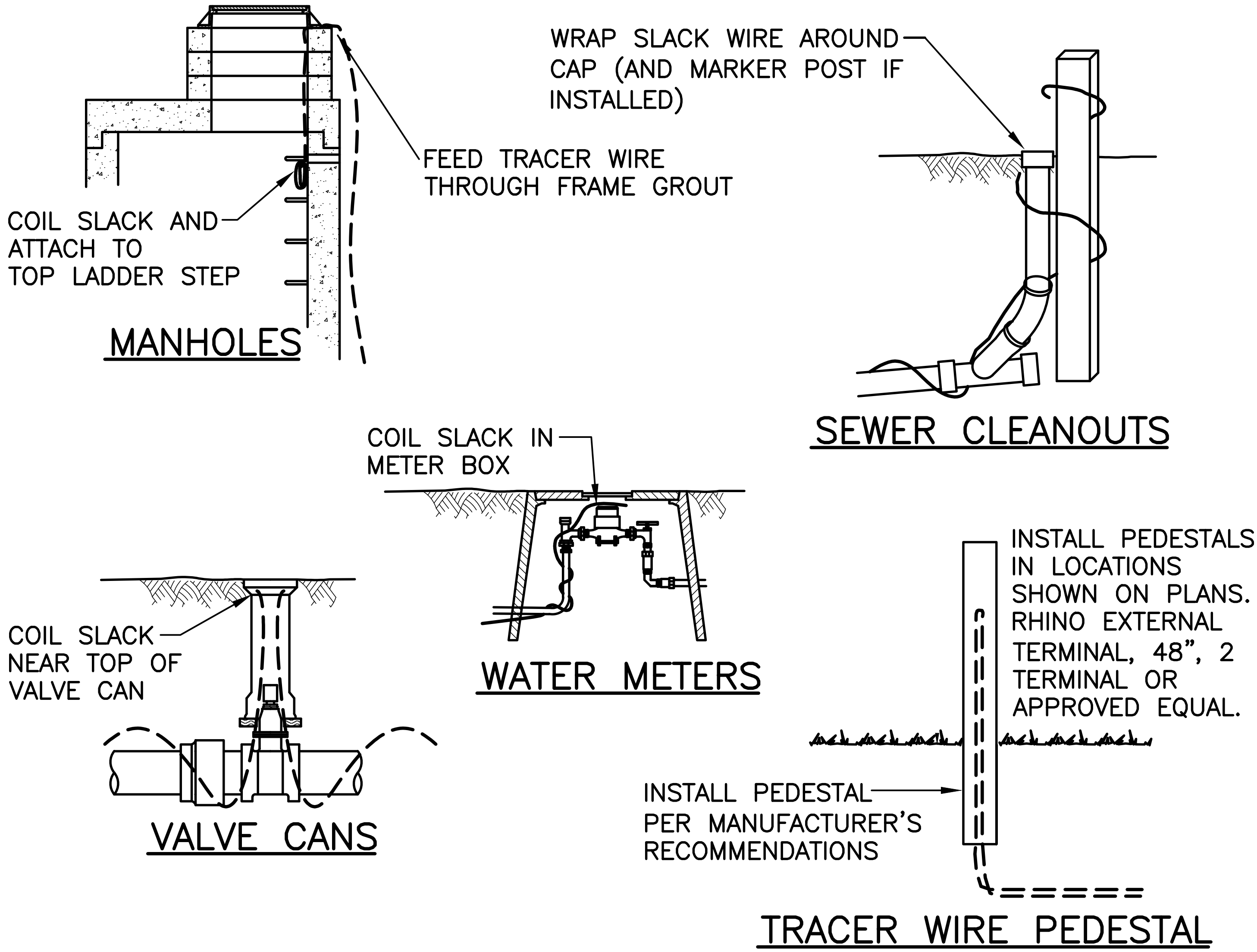
LAKE WHATCOM WATER & SEWER DISTRICT

HANDHOLE

STANDARD DETAIL

E4

9/20/2017



NOTES:

1. Tracer wire installation is required on all District owned pipe and communication lines. Tracer wire is also required on private side sewers.

2. Tracer wire shall be 10 AWG insulated copper wire rated for direct burial in wet locations. Use green insulation for sewer, blue insulation for water, and orange insulation for fiber/communication related utilities.

3. Install tracer wire in continuous lengths (no splices) between surface access points. Any direct bury splices shall be approved and inspected by the District Engineer prior to cover. Splices shall be made with silicone filled wire nuts rated for direct burial in wet locations such as "Ideal Underground Wire Connectors", "Ideal Mudbug Connectors," "Copperhead Snakebite Connectors," or "3M DBR Direct Bury Splice Kit."

4. Tape tracer wire to pipe at 10-foot intervals.

5. Provide at least 2-feet of coiled tracer wire slack at surface access points.

LAKE WHATCOM WATER & SEWER DISTRICT

TRACER WIRE

STANDARD DETAIL

E5

9/20/2017

Appendix I – Capital Improvement Plan – 2017 Update

Active Capital Improvement Projects

(values updated 11/17/2017)

Category	Project #	Project Title / Tasks	Projected Budget to Completion	Spent to Date	Amount Remaining	Notes
		Grant, Loan, and Bond Funded Projects				
Sewer	C1705	Geneva and Par Sewer Pump Stations				
		Geneva Pump Station Construction Estimate	$ 500,000.00	$ -	$ 500,000.00	RH2 estimate $493k
		Geneva Force Main Construction Estimate	$ 90,622.83	$ -	$ 90,622.83	RH2 estimate range $65k - $100k
		Assign Remaining 2016 Revenue Bond Funds	$ 590,622.83	$ -	$ 590,622.83	
		Sewer/Storm Water Contingency Fund Projects				
Sewer	C1607	Lake Whatcom North Shore Water Quality Testing				Coodination with City/County
		Herrera - Quality Assurance Project Plan	$ 18,052.00	$ 18,052.00	$ -	Original Agreement
		Herrera - Sampling, Data Analysis, Reporting	$ 69,295.00	$ 69,295.00	$ -	Amendment #1
		T&M Consultants for 2017 (Herrera, Attorney, Wilson)	$ 18,000.00	$ 15,006.95	$ 2,993.05	Misc Support
		T&M Consultants for 2018	$ 50,000.00	$ -	$ 50,000.00	Misc Support
		Grand Total for Sewer/Storm Water Contingency Projects	$ 155,347.00	$ 102,353.95	$ 52,993.05	
		Rate Funded Projects				
Sewer	C1407	Lowe Sewer PS VFD	$ 10,000.00	$ 6,548.68	$ 3,451.32	
Water	C1504	Reservoir Site Security	$ 5,000.00	$ 3,049.89	$ 1,950.11	
Water	C1605	Water System Plan Update	$ 111,813.00	$ 95,038.00	$ 16,775.00	Incl T/O Amend #1
Water	C1610	Little Strawberry Water Leak on Bridge	$ 10,000.00	$ -	$ 10,000.00	
Sewer	C1611	Country Club Sewer Pump Station				
		BHC Design, Permitting, Bidding	$ 206,222.00	$ 55,774.44	$ 150,447.56	Incl Amend #3
		BHC Services During Construction - Estimate	$ 80,000.00	$ -	$ 80,000.00	BHC estimate $75k
		Construction - Estimate	$ 450,000.00	$ -	$ 450,000.00	BHC estimate $435k
General	C1704	Replace Server Hardware and Reorganize Virtual Servers	$ 35,000.00			
Sewer	C1705	Geneva and Par Sewer Pump Stations				
		RH2 Design, Permitting, Bidding	$ 269,288.00	$ 118,069.50	$ 151,218.50	Incl Amend #2
		RH2 Services During Construction - Estimate	$ 80,000.00	$ -	$ 80,000.00	
		Par Construction Estimate	$ 400,000.00	$ -	$ 400,000.00	RH2 estimate $386k
		Geneva Pump Station Construction Estimate	$ -	$ -	$ -	See bond funded projects above
		Geneva Force Main Construction Estimate	$ -	$ -	$ -	See bond funded projects above
Sewer	C1707	Beaver, Flat Car Level Transmitter Replacement	$ 50,000.00	$ 2,538.42	$ 47,461.58	
Sewer	C1709	CMOM	$ 25,000.00		$ 25,000.00	
Water	C1710	Eagleridge Booster Station - Fire Pump Controls	$ 10,000.00		$ 10,000.00	
Water	C1713	Eagleridge Booster Station - Decommission Pumps	$ 45,000.00		$ 45,000.00	
Sewer	C1716B	Geneva Booster Station - PRV's,Backflow, Roof	$ 40,000.00	$ 5,429.43	$ 34,570.57	
		Grand Total for Rate Funded Projects	$ 1,827,323.00	$ 286,448.36	$ 1,505,874.64	

Lake Whatcom Water and Sewer District - Capital Improvement Plan 2018 thru 2027

Both Water and Sewer

Program Area / CIP Project #	CIP Project Name	Fund	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
0175	Shake Alert Pilot Program - Integrate Device into SCADA - Auto Close Exist Seismic Valve at Div 22 Res		15,000	15,000									
A0005	Accounting & Administration Server - Replace/Update Hardware, Network Security, & OS		75,000			25,000			25,000			25,000	
E0001	Replace Backhoe and Add Trailer		87,550	87,550									
E0002	Replace 5-yard Dump Truck		123,600					123,600					
E0007	Replace Mini Excavator		66,950								66,950		
E0008	Replace Flush and Vac Truck		420,000		420,000								
V0001	Replace Tool Truck (7 tool trucks in fleet)		325,000	65,000		65,000		65,000		65,000		65,000	
V0002	Replace Administrative Staff Vehicle (4 cars in fleet)		52,000				26,000				26,000		
V0003	Replace Locator / Meter Reading Van		28,000									28,000	
V0004	Replace Light-Duty Truck		35,000	35,000									
	Subtotal		**1,228,100**	**202,550**	**420,000**	**90,000**	**26,000**	**188,600**	**25,000**	**65,000**	**92,950**	**118,000**	

Sewer System

Program Area / CIP Project #	CIP Project Name	Fund	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
0032a	Agate Bay Sewer Pump Station - Predesign and Shorelines Permitting		100,000					100,000					
0032b	Agate Bay Sewer Pump Station - Design and Bidding		125,000						125,000				
0032c	Agate Bay Sewer Pump Station - Construction		525,000							525,000			
0044a	Edgewater Pump Station - Predesign and Shorelines Permitting		100,000	100,000									
0044b	Edgewater Pump Station - Design and Bidding		100,000		100,000								
0044c	Edgewater Pump Station - Construction		500,000			500,000							
0053a	Dellesta Pump Station - Predesign and Shorelines Permitting		100,000	100,000									
0053b	Dellesta Pump Station - Design and Bidding		100,000			100,000							
0053c	Dellesta Pump Station - Construction		500,000				500,000						
0055a	Rocky Ridge Pump Station - Predesign and Shorelines Permitting		100,000			100,000							
0055b	Rocky Ridge Pump Station - Design and Bidding		100,000				100,000						
0055c	Rocky Ridge Pump Station - Construction		555,000					555,000					
0056a	Lakewood Pump Station - Predesign and Shorelines Permitting		100,000				100,000						
0056b	Lakewood Pump Station - Design and Bidding		100,000					100,000					
0056c	Lakewood Pump Station - Construction		595,000						595,000				
0128c	Camp Firwood Automatic Transfer Switch and Replace Fence		20,000	20,000									
0128d	Airport Sewer Pump Station Stationary Generator		55,000	55,000									
0157	Install Ball Check Valves at Cable, Ranch House, Flat Car, Beaver		106,090				106,090						
0161	Stationary Generator Closed Loop Cooling Retrofit - North Point, SV, Flat Car, Beaver		212,180						212,180				
0163a	Euclid Sewer Pump Station - Replace Controls, Add Transfer Switch, and Stationary Generator - Permitting		31,827	31,827									
0163b	Euclid Sewer Pump Station - Replace Controls, Add Transfer Switch, and Stationary Generator - Construction		127,308		127,308								
0171	Sudden Valley Sewer Pump Station - Recondition Electrical Controls		159,135							159,135			
0172	Flat Car Sewer Pump Station - Recondition Electrical Controls		159,135								159,135		

Program Area / CIP Project # / CIP Project Name		Fund	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
0173	Beaver Sewer Pump Station- Recondition Electrical Controls		159,135									159,135	
A0010	Update Sewer Comprehensive Plan (Current Plan Dated 6-14-2014)		142,055		71,027						71,027		
E0003	Replace Sewer Camera Vehicle		77,613					77,613					
E0004	Replace Camera Equipment		39,140					39,140					
S0001a	EPA Capacity, Management, Operations, & Maintenance (CMOM) Projects - Sewer I&I		30,000	30,000									
S0001b	EPA Capacity, Management, Operations, & Maintenance (CMOM) Projects - Sewer I&I		60,000		60,000								
S0001c	EPA Capacity, Management, Operations, & Maintenance (CMOM) Projects - Sewer I&I		1,320,000			165,000	165,000	165,000	165,000	165,000	165,000	165,000	165,000
	Subtotal		**6,398,618**	**336,827**	**358,335**	**865,000**	**971,090**	**1,036,753**	**1,097,180**	**849,135**	**395,162**	**324,135**	**165,000**
Water System													
0083	South Shore Water System - SVWTP - Transfer and Transmission Pump VFD's		554,529								554,529		
0084a	Agate Heights Water System - Phase 1 WTP Upgrade 1/3 capacity (from 30gpm to 60gpm) - Prelim Design & Permitting		51,500	51,500									
0084b	Agate Heights Water System - Phase 1 WTP Upgrade 1/3 capacity (from 30gpm to 60gpm)		82,400		82,400								
0144	South Shore Water System - 1992 SVWTP 0.235MG Chlorine Contact Tank Seismic Retrofit - Priority 2		165,500							165,500			
0146	South Shore Water System - 1971 Division 22 0.5MG Reservoir Seismic Retrofit and Coatings - Priority 3		389,350									389,350	
0147	South Shore Water System - 1973 Division 30 0.15MG Reservoir Seismic Retrofit and Coatings - Priority 4		573,947										573,947
0164	Demolish Old Concrete Reservoir at 1010 Lakeview Street		35,000			35,000							
0166	South Shore Water System - SVWTP - Convert from Chlorine Gas to Liquid		106,090							106,090			
0176	SVWTP - Replace 6 Turbimeters and 2 Chlorine Analyzers		38,000	38,000									
0177	Water Meter Registers		284,000	284,000									
0187	Fire Flow Improvements - Remove Deficient Fire Hydrant ID 22-112 (Low flow and pressure) at top of Kinglet Ct		2,000		2,000								
0188	Fire Flow Improvements - Hydraulic Model Calibration of Assumed Pipe Friction Loss Factor (C-Factor) in Areas of Fire Flow Deficiencies		25,000		25,000								
0189	Fire Flow & Seismic Improvements - Replace Division 7 Reservoir (Applied for $1.5M Grant + $215k matching District Funds = $1.7M Total Project Cost)		202,658			202,658							
W0002	Water System Rehab and Replacement Projects		1,760,000			220,000	220,000	220,000	220,000	220,000	220,000	220,000	220,000
W0002b	Water System Rehab and Replacement Projects		140,000		140,000								
W0003	SVWTP Filter 3&4 Media - Replace		24,238								24,238		
W0005	Reservoirs - Inspection & Maintenance		60,000	30,000					30,000				
W0007	SVWTP Filter 1&2 Media - Replace		24,238									24,238	
	Subtotal		**4,518,450**	**403,500**	**249,400**	**457,658**	**220,000**	**220,000**	**250,000**	**491,590**	**798,767**	**633,588**	**793,947**
* Note: Cost Estimates in 2016 Dollars	**Grand Total**		**12,145,168**	**942,877**	**1,027,735**	**1,412,658**	**1,217,090**	**1,445,353**	**1,372,180**	**1,405,725**	**1,286,879**	**1,075,723**	**958,947**

Capital Improvement Project List
Unscheduled Projects

CIP #	Project Name	Cost Est in Year $		Business Risk Exposure
Both Water and Sewer				
0169	Centimeter-Grade GPS Receiver	$15,000.00	in 2015	1
0142	Upgrade Shop Security Cameras and Coverage	$15,000.00	in 2016	1
0100	Car-Port Along Fence to Cover District Vehicles/Equipment	$250,000.00	in 2012	1
0143	Public Art at Cable Street (need to develop scope/fee and see if Board is interested)	$10,000.00	in 2016	1
0134	Kubota Jack Hammer Attachment	$11,500.00	in 2017	1
	Subtotal	$301,500.00		
Sewer System				
0124	Rehabilitate Old Flat Car Sewer Pump Station - Construction	$75,000.00	in 2015	42
0151	Pigging - Lake Whatcom Boulevard Interceptor	$50,000.00	in 2016	21
0152	Pigging - Lake Louise Road Interceptor	$30,000.00	in 2016	21
0153	Pigging - Cable Street Force Main	$35,000.00	in 2016	21
0154	Pigging - Plum Basin Gravity Outlet at Lake Whatcom Boulevard Interceptor	$20,000.00	in 2016	18
0160	Sudden Valley Sewer Pump Station - Recondition Drywell Pumps and Motors	$20,000.00	in 2016	14
0170	Telemtry-SCADA Reconfiguration between Beaver and Flat Car	$25,000.00	in 2015	14
0156	Austin Sewer Pump Station - Install Ball Check Valves and Flow Meter	$15,000.00	in 2016	12
0162	Lowe Sewer Pump Station - Retrofit Overhead Power to Underground Power	$50,000.00	in 2016	12
0155	Lake Whatcom Boulevard - Replace ~200LF at Gravity Outlet	$50,000.00	in 2016	9
0159	Airport Sewer Pump Station - Increase Pump Capacity (higher head pumps)	$30,000.00	in 2016	4
	Subtotal	$400,000.00		
Water System				
0148	South Shore Water System - 1979 Geneva 0.5MG Reservoir Seismic Retrofit - and Coatings Priority 5	$505,000.00	in 2016	50
0184	South Shore Water System - SVWTP - Replace Alum Tank	$10,000.00	in 2018	18
0110	Security - Intrusion Alarms at Reserviors, Cameras as SVWTP AHWTP	$10,000.00	in 2015	18
0084c	Agate Heights Water System - Phase 3 WTP Upgrade 3/3 capacity, Tank 2 of 2, Main Ext	$7,000,000.00	in 2017	6
0084b	Agate Heights Water System - Phase 2 WTP Upgrade 2/3 capacity, Tank 1 of 2, Main Ext to Trailer Park and Forks Restaurant	$1,350,000.00	in 2017	6
0183	South Shore Water System - SVWTP - Remodel Entrance to have Roll-Up Door	$50,000.00	in 2018	5
0180	South Shore Water System - New South Geneva Reservoir	$200,000.00	in 2017	5
0179	South Shore Water System - Main Extension to Sudden Valley Campground (funded by DEA)	$1.00	in 2018	4
0178	South Shore Water System - Glen Cove System Consolidation	$600,000.00	in 2017	4
0186	Water Main Extension - Lake Whatcom Boulevard between Strawberry Pt and Sudden Valley (funded by DEA or ULID)	$1.00	in 2018	4
0181	South Shore Water System - Reduce Number of Pressure Reducing Valves	$10,000.00	in 2018	2
0182	All Water Systems - Pressure Monitoring and Alarming for Major Pressure Zone Areas	$25,000.00	in 2018	2
0185	South Shore Water System - SVWTP - Fiber Comm from SVPS to WTP (completes circuit from Shop to WTP)	$200,000.00	in 2018	2
0135	Automatic Valve Excerciser (need to get quote)	$25,000.00	in 2016	1
0165	South Shore Water System - SVWTP - Spare Transfer Pump	$10,000.00	in 2016	1
	Subtotal	$9,995,002.00		

Appendix J – Division 7 Reservoir Project

WILSON ENGINEERING
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MEMORANDUM

TO: LWWSD – Bill Hunter, PE, Rich Munson, and Kristin Hemenway, PE

FROM: Brian Smith, PE and Melanie Mankamyer, PE

SUBJECT: Division 7 Reservoir – Seismic Upgrades and Maintenance vs. Replacement

DATE: February 8, 2018

Introduction

A structural analysis of the Lake Whatcom Water and Sewer District Division 7 water reservoir has found significant deficiencies in its ability to meet existing earthquake code requirements (BHC report, December 2016). The recent Water System Plan also analyzed the capacity of the Division 7 reservoir and found it to be significantly oversized at a volume of one million gallons. The Water System Plan recommended an alternatives analysis for this reservoir to compare the cost of making seismic upgrades and replacing the interior and exterior coatings that are beyond their useful life against the alternative of replacing the Division 7 reservoir with a more appropriate (~half a million gallons) amount of storage volume. This memorandum contains a preliminary analysis of these alternatives.

Alternative 1 – Make Seismic Upgrades and Replace Coatings

Alternative 1 is to make the needed repairs to the Division 7 reservoir and continue to use it for the foreseeable future. There are four major pieces of work that are required to allow the Division 7 reservoir to continue to provide reliable service for the more than 2,000 people that depend on it for their water service:

1. Seismic retrofits as detailed in the December 2016 BHC report.
2. Structural roof support header repair as detailed in the December 13, 2012 Wilson Engineering assessment.
3. Replacement of interior and exterior steel coating systems.
4. Addition of reservoir outlet valve that can respond to earthquake event. This portion of the work would be part of the ShakeAlert Project scope and is not included in the cost estimates in this memo.

Coatings

The existing interior and exterior steel coating systems for the welded steel reservoir are original from its construction in 1971. The Division 7 reservoir had no cathodic protection system from 1971 to 2015. In 2015, a cathodic protection system was installed. In 2014, the coatings were inspected by a qualified professional. The coatings were overall found to be in reasonable condition, although the interior ceiling and roof supports showed visible corrosion and the coatings in that area need to be removed and replaced to prevent further steel corrosion.
It is uncertain if the existing coatings contain lead-based primers. Based on the time of construction (1971), it is possible that they may have lead-based primers. Samples would need to be taken to know for sure, but that has not yet occurred.

The opinion of steel coatings professionals is that the entire interior coating should be removed and replaced. The exterior coating is likely a vinyl coating and is in reasonable condition. With some coatings in reasonable condition, they could be pressure washed and a new coating applied on top of the existing. But vinyl coatings do not work well with standard epoxy overcoats because of the solvent in the epoxy. There are new technologies that may work well with overcoating on top of the vinyl coating, but they are not necessarily time-tested to demonstrate longevity. The District could choose to try a system like this, and there would be substantial initial cost savings, especially if the exterior existing coating was found to contain lead. But because these new technologies have not been time-proven yet and there would be some risk associated with using it, a cost estimate for this option was not included.

Temporary Water Storage

In order to perform the coating work, structural roof repair, and addition of reservoir outlet valve that can respond to an earthquake, the tank would need to be taken out of service and drained. Because there is no alternate storage that could serve this area, temporary storage would need to be installed for the duration of the work. There is no feasible way to temporarily provide the full storage volume. Even to provide a fraction of the full storage volume will be very challenging and expensive. In order to perform the work, the reservoir will likely need to be out of service for a number of months, and this will need to occur in the summer months in order to achieve desirable coating outcomes (hot and dry surfaces). The summer months are also the highest water demand months, which adds to the operational challenge.

One temporary storage solution can be rented from a company called ModuTank. It consists of steel support walls and a water tight, NSF approved liner (with a cover) to contain the water. Based on the design, it is limited to a maximum water height of 4.5 ft. Because of the limited flat space adjacent to the reservoir, the maximum estimated footprint of a temporary storage tank would be approximately 46 ft by 46 ft. Considering that the tank needs 4 ft of framing around the perimeter, this leaves the water tank size at 38 ft by 38 ft for a water volume of 48,600 gallons. Any storage solution to provide more volume than this would likely require a permanent storage solution and would cost significantly more than the temporary tank.

It would be quite challenging to operate the water system with such little water storage at Division 7 (48,600 gallons). An average day demand for the area served by Division 7 (which includes serving Division 30) is approximately 200,000 gallons. If half of the 48,600 gallons was saved for fire suppression / standby storage, this means that there would be 24,000 gallons of operating storage, and it would need to be refilled, on average, every 3 hours. At a fill rate of 700 gpm and with average demand, it would take about 43 minutes to fill the tank. Because the transmission pump is only operated when the treatment plant is running, it makes operation of the whole system challenging, although theoretically possible. Moving forward with this project would require coordination with and approval of the fire department and the Department of Health. It is uncertain if this kind of solution would be acceptable to either of these entities. If it was not, a permanent storage tank would need to be installed next to the Division 7 reservoir that had a more reasonable storage volume, perhaps 100,000 to 200,000 gallons to be able to serve the system temporarily while the Division 7 reservoir is out of service. A permanent storage solution would be significantly more expensive than the temporary tank. A cost estimate for this option was not prepared but may be necessary based on input from the water treatment plant operator, the fire department, and the Department of Health.

Cost Estimate

A cost estimate is shown below for Alternative 1 based on the conservative approach of removing and replacing the exterior as well as the interior coating. As shown, there is an item for containment if the exterior coating is found to contain lead. If it is not, then this item would not be needed. The Alternative 1 cost estimate is shown for the temporary storage of 48,600 gallons. As described above, this may not be adequate. If it is not adequate, the temporary storage item would be much more expensive.

LAKE WHATCOM WATER AND SEWER DISTRICT **2/8/2018**
Division 7 Reservoir Rehabilitation (Alternative 1)
Preliminary Cost Estimates

Prepared by: **Brian Smith, PE and Melanie Mankamyer, PE, Wilson Engineering LLC**

Wilson Job No.: **2018-001**

Preliminary Cost Estimates - Rehabilitate Div 7 (Seismic Retrofits, Re-coatings, Repairs)

Item Description	Quantity	Unit	Unit Price	Amount
CONSTRUCTION				
a. Mobilization (10%)	1	LS	$ 63,210	**$ 63,300**
b. Coating work				
If lead is present on exterior coating, need containment for abrasive blasting	1	LS	$ 90,000	$ 90,000
Remove existing coating from interior and exterior and replace coating	29,385	SF	$ 15	$ 440,800
Subtotal				**$ 530,800**
c. Structural repair of roof support header as detailed in December 13, 2012 assessment	1	LS	$ 15,000	**$ 15,000**
d. Provisions for providing temporary water storage while tank is out of service				
Rental of temporary potable water storage tank assembly (48,600 gallons) for 5 months with freight	1	LS	$ 24,255	$ 24,300
Temporary Erosion and Sediment Control	1	LS	$ 5,000	$ 5,000
Tree removal, clearing and grubbing, and earthwork to provide 46 ft by 46 ft level pad for temporary tank	1	LS	$ 35,000	$ 35,000
Labor to assemble temporary tank, fill, disinfect, and disassemble temporary tank	1	LS	$ 12,000	$ 12,000
Temporary piping to temporary tank (install, test, disinfect appprox 100 ft, 8 inch)	1	LS	$ 10,000	$ 10,000
Subtotal				**$ 86,300**
SUMMARY				
Subtotal				$ 695,400
Contingencies	15%			$ 104,310
Sales Tax	8.5%			$ 67,975
Preliminary Estimated Construction Costs				**$ 868,000**
Complete Estimated Project Costs of Seismic Retrofits from BHC (includes construction, tax, engineering)				$ 721,000
Engineering Design	5%			$ 43,400
Construction Phase Engineering/Inspection	10%			$ 86,800
GRAND TOTAL				**$ 1,720,000**

As described previously, this cost estimate does not include the necessary addition of a reservoir outlet valve that can respond to earthquake event. This portion of the work would be part of the ShakeAlert Project scope.

One piece of information to keep in mind is that the current NSF61 approved interior coating systems have a shorter expected life than previous coating systems because of more stringent requirements for materials in contact with potable water. Current interior coating systems have an expected life of roughly 15 years, at which point they would either need to be coated over or replaced again.

Alternative 2 – Replace Division 7 Reservoir

Alternative 2 entails replacing the existing Division 7 reservoir. The 2016 BHC report performed a quick alternatives analysis of replacing the reservoir instead of retrofitting the existing, but their analysis was based on replacing it with a reservoir of the same size. That analysis also did not account for the need for coatings replacement, structural work, and installation of a new seismic outlet valve, all of which will require the reservoir to be taken out of service and temporary storage put in place.

As the recent Water System Plan points out, the 1,000,000 gallons of storage is roughly twice the storage that is required for build-out. Replacing the Division 7 reservoir with new storage with half the volume is more likely to be a realistic alternative and is analyzed here.

A downside to having an oversupply of treated water storage is that it increases water age and can negatively impact water quality. The American Water Works Association (AWWA) recommends that the hydraulic residence time of water storage reservoirs should not exceed 2.5 days under average demand to maintain water quality. The hydraulic residence time in the existing 1 million gallon Division 7 reservoir under average day demand in a build-out scenario is 4.6 days. Appropriately sized replacement storage for Division 7 would have an average hydraulic residence time within the AWWA recommendation of less than 2.5 days. This lower residence time would help improve water quality in terms of less formation of disinfection by-products and better maintenance of chlorine residual in the distribution system.

One Vs. Two Reservoirs

The Division 7 reservoir could be replaced with one storage reservoir of the appropriate size, or could be replaced with two storage reservoirs that contain an appropriate total volume. Having two reservoirs instead of one offers three major advantages:

1. One reservoir can be taken out of service for maintenance or repairs at any time and the other reservoir is capable of providing sufficient storage for these temporary periods.
2. If one tank happens to have an unexpected leak or failure, the other can be used. If there was only one tank and there was a failure, it would cause a public health emergency until temporary storage was able to be put in place.
3. In a major earthquake, there will likely be both water main breaks that cause major leaks and fires that need fire suppression water. This leads to a situation where if there is only one storage tank it will either be drained quickly by the leaks and fire suppression activities or the outlet valve will be closed to maintain water for the longer-term response but water will not be available for initial fire suppression. With two reservoirs in place, the system can have the best of both because one tank outlet can be left open for immediate fire suppression needs and the other can be closed to maintain a supply of treated water for the days and weeks of response to the emergency.

At the volume being considered (~half a million gallons), the cost of a single reservoir vs two smaller reservoirs will be similar. Because of this and the advantages listed above, this analysis continues with the two reservoir option.

Storage Volume Analysis

The needed storage volume for the Division 7 service area was analyzed in detail. A first step of this was to refine the ERU distribution shown in the Water System Plan to reflect the current status of restricted lots in Sudden Valley and the impact this has on the distribution of ERUs (and subsequent storage needs) throughout the system.

In order to assess ERU distribution throughout the system's water reservoirs, two maps were analyzed. Figure A-1 from the Water System Plan was analyzed to determine the geographic distribution of the service areas of each reservoir. This was cross-referenced with the Sudden Valley Land Use Map (updated August 2015) to determine the number of developed and vacant single-family lots in each of the Division 30 and Division 7 reservoir service areas.

Division 30 serves only single-family lots, so the number of build-out ERUs served by it was easily determined to be 364 ERUs. This is lower than the number of build-out ERUs shown in the Water System Plan (474) because many lots in the Division 30 service area have been converted to SVCA common area and restricted from development.

With the decreased number of ERUs in the Division 30 service area, the Division 30 reservoir can now provide its own standby storage (in the Water System Plan, Div 30 standby storage was provided by Div 7). This change is reflected in Table 1.

The number of ERUs served by Division 7 was determined by counting the number of single-family lots in the service area and adding the numbers of ERUs of the condominiums and commercial areas in the service area from the District's database. The total number of ERUs in the Division 7 service area as defined by Figure A-1 from the Water System plan is 1076 ERUs. This is higher than the number shown in the Water System plan. The total number of build-out ERUs for the water system remains what was shown in the Water System Plan, so the Division 22 ERUs was updated appropriately. An analysis of this distribution of ERUs yielded a required storage volume for the Division 7 service area of 423,000 gallons.

But the service areas shown in Figure A-1 of the water system plan do not fully utilize the existing available storage from Division 22 and Geneva reservoirs. In order to more fully utilize the existing storage of those reservoirs, The Division 22 reservoir could serve a portion (about half) of the lowest pressure zone between Division 22 and Division 7. This would lower the number of ERUs served by Division 7 from 1076 to 654 ERUs. In order for Division 22 to be able to serve this area of the system, the system operation would need to shift so that Geneva reservoir served a portion of the lower pressure zone in Geneva. These shifts in ERU distribution are represented in Table 1 as well as their impact to required storage in each service area. This more efficiently utilizes existing resources and minimizes the required storage volume for the replacement Division 7 reservoirs to about 317,000 gallons.

Note that the Supply Capacity to Division 7 shown in Table 1 is 196 gpm. This is based on the methodology described in the Water System Plan, Appendix A, in that the needed transmission flow rate to Division 7 should be based on the proportional service area and the total needed supply flow. In the Water System Plan, Appendix A, this was 246 gpm, but this was adjusted to 196 based on the updated ERU distribution determined as described above. This means that the new Division 7 reservoirs are sized based on a supply capacity of 196 gpm so that a future project to replace the transmission pumps can use this design flow rate.

Table 1 shows a reservoir height for the Proposed Division 7 reservoirs of 35 feet, but the intent at this early stage in design is that the top 5 ft will be maintained as freeboard to allow for sloshing in an earthquake event. The amount of freeboard needed will be further refined in a detailed design, but 5 ft should be conservative at this point.

Table 1: Reservoir sizing requirements to meet anticipated build-out based on treatment/pumping capacity appropriate for anticipated build-out - sizing new Div 7 reservoirs - if close valve and have Div 22 serve some of lowest zone instead of Div 7 plus shift some demand from Div 22 to Geneva

					Operating Storage		MDD (gpd/ERU)		ERUs		PHD for Reservoir (gpm)					Equalizing Storage		ADD (gpd/ERU)		Standby Storage		Fire Suppression Storage		Dead Storage	
Reservoir	Base Elevation (ft NAVD88)	Reservoir Height (ft)	Reservoir Diameter (ft)	Reservoir storage per foot (gal/ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Geneva	Sudden Valley	Geneva Contribution	Sudden Valley Contribution	Flow out to other reservoirs (gpm)	Total PHD for Reservoir (gpm)	Supply Capacities (gpm)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Geneva	Sudden Valley	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)	Storage Volume (gallons)	Level with Storage Depleted (ft)
Proposed Division 7A	697	35	30	5,287	42,298	22		250		654		239	165	404	196	31,101	19.06		150	196,200	0.50	45,000	14.80	2,644	0.00
Proposed Division 7B	697	35	30	5,287	42,298	22											19.06				0.50		14.80	2,644	0.00
Division 22	804.65	35	50	14,687	117,496	27	370	250	250	2249	166	682	250	1098	788	46,487	25.60	175	150	762,200	2.58	45,000	24.24	7,343	2.08
Division 22 New	805	35	56	18,423	147,386	27											25.60				2.58		24.24	9,212	2.08
Division 30	1027.98	40	25	3,672	18,359	35		250		364		153	0	153	165	0	35.00		150	109,200	5.26	30,000	26.83	1,836	4.76
Geneva	661.12	32	52	15,885	31,771	30	370		989		482		0	482	250	34,860	27.81	175		346,150	6.02	45,000	24.97	7,943	5.52

Summary:

		Build-out ERUs		
Reservoir	Existing capacity (gallons)	Geneva	Sudden Valley	Sum of required storage (gallons)
Proposed Division 7A	1,000,000		654	317,186
Proposed Division 7B				
Division 22	1,158,859	250	2249	1,090,124
Division 22 New				
Division 30	146,869		364	129,395
Geneva	508,333	989		420,724

Two reservoirs, each 30 ft diameter and 35 ft tall, provides this storage with 5 ft freeboard for sloshing

Note: Fire Suppression Storage is nested within Standby Storage for all reservoirs

New Reservoir Layout and Elevation

In addition to the existing Division 7 reservoir being vastly oversized for build-out, its base elevation and water elevation do not provide the current required minimum pressure to the residences nearest to the reservoir. The replacement reservoirs can be located at a higher elevation to improve water pressure for these highest residences.

Based on the nearby topography, there is a “bench” further up the ridge to the north with an elevation approximately 25 feet higher than the existing Division 7 reservoir base. Locating the new reservoirs on this bench will provide more pressure to the system served directly from the reservoir but will not increase the pressure so much that there are negative impacts. Increasing the pressure by 25 feet will provide the minimum required pressure to all houses in the service area except for the two highest houses that are adjacent to the existing reservoir. But installing the new reservoirs at a higher location that would provide sufficient pressure to these two houses would increase the maximum pressure in the zone to 130 psi, which is higher than desirable. We propose that installing the new reservoirs on the “bench” with a base elevation of approximately 25 ft higher than the existing Division 7 reservoir is a good balance between improving the pressure for houses at the higher points in the system but not increasing the zone pressure so much that there are detrimental effects. This is a needed balance when modifying an existing system that was not originally designed with this in mind.

Raising the base elevation by about 25 feet will increase the maximum head by about 11 psi. The highest pressure in the area served by the reservoir is at the upstream side of PRV 17-20, which is currently approximately 111 psi. This would increase this pressure to 122 psi. This pressure is slightly higher than desirable, but there are many locations in the water system that have higher pressure because of the topography of the area. The other impact the pressure increase has is on the operating point of the transmission pumps. Based on the existing pump curve and operating pressure, the current transmission pump flow rate is approximately 830 gpm at 405 ft head gain. The increase in system pressure would shift the operating point to approximately 430 ft head gain at a flow rate of 780 gpm. This will not negatively impact operation of the system, as a flow rate of 780 gpm is still well more than what is required. In fact, this flow rate may help ease operation of the system because it is closer to the current treatment plant flow rate of 700 gpm, so it may make it easier to balance the flows.

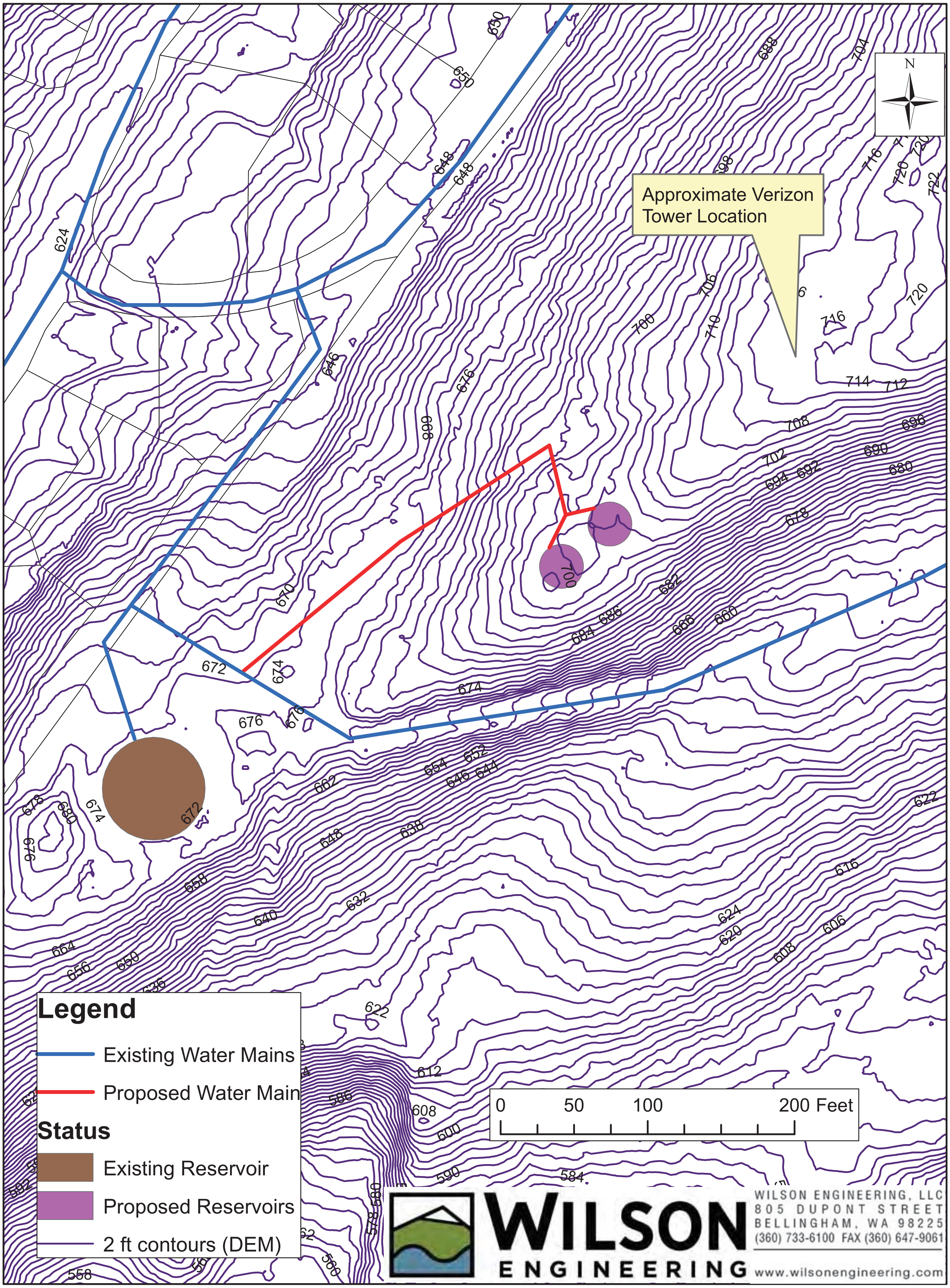
The layout of the proposed location of the new reservoirs is shown in Figure 1. The District has received plans from Verizon for a new cell phone tower in the vicinity of this project. We have confirmed that the proposed reservoir location does not interfere with the Verizon tower.

Cost Estimate

A preliminary cost estimate for Alternative 2 is shown on page 13. Note that demolition of the existing Division 7 reservoir is shown at the bottom. This work could be postponed until a later date depending on funding availability.

As described previously, this cost estimate does not include the necessary addition of a reservoir outlet valve that can respond to earthquake event. This portion of the work would be part of the ShakeAlert Project scope.

Figure 1 - Division 7 Reservoir - Proposed Replacement with 2 Reservoirs



LAKE WHATCOM WATER AND SEWER DISTRICT **2/8/2018**

Division 7 Reservoir Replacement (Alternative 2)

Preliminary Cost Estimates

Prepared by: **Brian Smith, PE and Melanie Mankamyer, PE, Wilson Engineering LLC**

Wilson Job No.: **2018-001**

Preliminary Cost Estimates - Replace Div 7 Reservoir with Two Concrete Reservoirs

Item Description	Quantity	Unit	Unit Price	Amount
CONSTRUCTION				
a. Mobilization (10%)	1	LS	$ 72,200	**$ 73,000**
b. Temporary Erosion and Sediment Control (1%)	1	LS	$ 7,220	**$ 7,300**
c. Storage Improvements				
Concrete storage tank 185,000 Gallon 30 ft dia x 35 ft height (installed by supplier, prevailing wages)	2	EA	$ 171,000	$ 342,000
Reservoir railing	2	EA	$ 10,000	$ 20,000
Tree removal	1	LS	$ 30,000	$ 30,000
Clearing and grubbing	1	LS	$ 10,000	$ 10,000
Site earthwork	1	LS	$ 90,000	$ 90,000
Overflow piping	500	LF	$ 100	$ 50,000
Piping from new tank to existing, 12" diameter	500	LF	$ 100	$ 50,000
Manual valve on one tank outlet (other tank to have seismic valve installed as separate scope of work)	1	EA	$ 2,000	$ 2,000
Surface restoration	1	LS	$ 20,000	$ 20,000
Stormwater management	1	LS	$ 8,000	$ 8,000
Electrical, telemetry and instrumentation	1	LS	$ 100,000	$ 100,000
Subtotal				**$ 722,000**
SUMMARY				
Subtotal				$ 802,300
Contingencies	15%			$ 120,300
Sales Tax	8.5%			$ 78,421
Preliminary Estimated Construction Costs				**$ 1,002,000**
Permit Fees	2.2%			$ 22,000
Easement Acquisition				$ 5,000
Topographic Survey	2%			$ 20,040
Engineering Design	10%			$ 100,200
Construction Phase Engineering/Inspection	10%			$ 100,200
Construction Phase Surveying	1%			$ 10,020
NEW CONSTRUCTION TOTAL PROJECT ESTIMATED COST				**$ 1,260,000**
Demolition of Existing Division 7 Steel Reservoir (including permit fee and sales tax)				$ 167,000
NEW CONSTRUCTION PLUS DEMO TOTAL PROJECT ESTIMATED COST				**$ 1,427,000**

Alternative 3 – Do Nothing

The "do nothing" alternative in this case would be to leave the Division 7 reservoir as-is and in operation and not perform the seismic retrofits. This would leave the water system quite vulnerable to significant and perhaps catastrophic damage if/when a large earthquake occurs. The expected failure modes are described in the BHC December 2016 report.

A "do nothing" alternative in terms of maintenance would mean that the coatings and structural roof support header that needs repair are left as-is. Leaving the roof support unrepaired will lead to further corrosion of the structural steel and eventual roof failure under a snow load, as detailed in the December 2012 assessment. This would leave the system very vulnerable to contamination until repairs were able to be made. This would likely require the tank to be taken out of service, which would put the entire area served by the Division 7 and Division 30 reservoirs out of water until either repairs were made or temporary water storage was put in place.

Leaving the coatings as-is leaves the reservoir vulnerable to corrosion. The frequency of needed inspections and potentially spot repairs would increase. If corrosion was not caught early, it could lead to damage to the structural steel and the need to replace portions of the reservoir. This would require the reservoir to be taken out of service and a temporary tank installed. At this point, it would be an emergency situation and the costs for the expedited delivery and assembly of a temporary tank would increase significantly. More importantly, depending on the severity of the damage/failure, the portion of the water system served by the Division 7 reservoir may not have any storage and would therefore not be able to operate until storage was in-place. This would be a major public health emergency.

Summary and Conclusions

The Do Nothing, Alternative 3 is not recommended because it leaves the entire portion of the water system served by the Division 7 reservoir very vulnerable to both seismic risks as well as the inevitable damage caused by corrosion of structural steel. The Division 7 reservoir is an essential piece of the water system, and it cannot function without the reservoir in service.

There are many advantages Alternative 2 (replace reservoir) has over Alternative 1 (rehabilitate reservoir):

1. Capital Cost – the estimated capital cost of Alternative 2 is significantly lower than Alternative 1.
2. Water Quality – The existing Division 7 reservoir is significantly oversized and results in an excessive average water age of 4.6 days. The hydraulic residence time in the reservoirs proposed in Alternative 2 would be 2.1 days under average day demand in a build-out scenario. This would be within the AWWA recommendation of less than 2.5 days average hydraulic residence time and would help improve water quality in terms of less formation of disinfection by-products and better maintenance of chlorine residual in the distribution system.
3. Improved Water Pressure – Installing new storage 25 feet higher than the existing reservoir will improve water pressure for those houses immediately adjacent to the reservoir. The increased pressure will not negatively impact the system in terms of over pressurizing or decreasing pumped flow excessively.
4. Resiliency – Having two parallel water storage reservoirs provides substantially improved system resiliency in case of emergency (earthquake or unexpected failure of one tank) or typical maintenance. Having the ability to keep one reservoir in service while taking the other out of service will improve the District's ability to serve their customers efficiently.
5. Maintenance – Replacing a steel reservoir with concrete reservoirs decreases maintenance efforts and costs. The corrosion protection systems (interior and exterior coatings, cathodic protection) that are required for steel reservoirs are not needed for concrete reservoirs. Current interior coatings for a steel reservoir need to be replaced/refurbished at least every 15 years. This requires the tank to be taken out of service for the work, and this is significantly challenging with only one tank.
6. Construction/Operation Feasibility – Alternative 1 would require temporary storage during construction that would either be prohibitively expensive or would make operation of the system during construction very challenging. It is unknown if the limited temporary storage proposed as part of this alternative would be acceptable to the water system operator, the fire department, or the Department of Health. Alternative 2 allows the existing tank to remain in service during construction and does not impose the operational challenges of Alternative 1.

Alternative 2 has these six significant advantages over Alternative 1. There are no meaningful advantages Alternative 1 has over Alternative 2. Based on this, we recommend Alternative 2 (replacing Division 7 reservoir with two reservoirs) as the preferred alternative.

Appendix L – Water Quality Monitoring Schedules

Generated on: 10/27/2017

Washington State Department of Health
Environmental Public Health
Office of Drinking Water

Water Quality Monitoring Schedule

System: LWWSD - SOUTH SHORE WATER SYSTEM **PWS ID: 95910 1** **Region: NORTHWEST**
Contact: Kevin Cook **Group: A - Comm** **County: WHATCOM**

NOTE: To receive credit for compliance samples, you must fill out laboratory and sample paperwork completely, send your samples to a laboratory accredited by Washington State to conduct the analyses, AND ensure the results are submitted to DOH Office of Drinking Water. There is often a lag time between when you collect your sample, when we credit your system with meeting the monitoring requirement, and when we generate the new monitoring requirement.

Coliform Monitoring Requirements

	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
Coliform Monitoring Population	9948	9948	9948	9948	9948	9948	9948	9948	9948	9948	9948	9948
Number of Routine Samples Required	10	10	10	10	10	10	10	10	10	10	10	10

- Collect samples from representative points throughout the distribution system.
- Collect required repeat samples following an unsatisfactory sample. In addition, collect a sample from each operating groundwater source.
- For systems that chlorinate, record chlorine residual (measured when the coliform sample is collected) on the coliform lab slip.

Chemical Monitoring Requirements

Distribution Monitoring

Test Panel/Analyte	*# Samples Required*	*Compliance Period*	*Frequency*	*Last Sample Date*	*Next Sample Due*	
Lead and Copper	20	Jan 2017 - Dec 2019	standard - 3 year	07/25/2016	Jul 2019	
Asbestos	1	Jan 2011 - Dec 2019	standard - 9 year	10/17/2013		
Total Trihalomethane (THM)	2	Jan 2017 - Dec 2017	reduced - 1 year	07/24/2017		
Halo-Acetic Acids (HAA5)	2	Jan 2017 - Dec 2017	reduced - 1 year	07/24/2017		

Washington State Department of Health
Environmental Public Health
Office of Drinking Water

Water Quality Monitoring Schedule

Notes on Distribution System Chemical Monitoring

For *Lead and Copper*:
- Collect samples from the COLD WATER side of a KITCHEN or BATHROOM faucet that is used daily.
- Before sampling, make sure the water has sat unused in the pipes for at least 6 hours, but no more than 12 hours (e.g. overnight).
- If you are sampling from a faucet that has hot water, make sure cold water is the last water to run through the faucet before it sits overnight.
- If your sampling frequency is annual or every 3 years, collect samples between June 1 and September 30.

For *Asbestos:* Collect the sample from one of your routine coliform sampling sites in an area of your distribution system that has asbestos concrete pipe.

For *Disinfection Byproducts (HAA5 and THM):* Collect the samples at the locations identified in your Disinfection Byproducts (DBP) monitoring plan.

Source Monitoring

- Collect 'source' chemical monitoring samples from a tap after all treatment (if any), but before entering the distribution system.
- Washington State grants monitoring waivers for various test panels /analytes. Please note that we may require some monitoring as a condition of some waivers. We have granted complete waivers for dioxin, endothal, glyphosate, diquat, and insecticides.
- Nitrate, arsenic, iron, and other individual inorganics are included as part of a Complete Inorganic (IOC) analysis when it is collected.

Source S01 LAKE WHATCOM South Shore Surface Use - Permanent Susceptility - High

Test Panel/Analyte	# Samples Required	Compliance Period	Frequency	Last Sample Date	Next Sample Due
Nitrate	1	Jan 2017 - Dec 2017	standard - 1 year	05/25/2017	
Complete Inorganic (IOC)	1	Jan 2011 - Dec 2019	waiver - 9 year	04/26/2011	
Volatile Organics (VOC)	1	Jan 2017 - Dec 2022	waiver - 6 year	05/20/2014	May 2020
Herbicides	1	Jan 2014 - Dec 2022	waiver - 9 year	03/19/2015	
Pesticides	1	Jan 2014 - Dec 2022	waiver - 9 year	03/19/2015	
Soil Fumigants	0	Jan 2017 - Dec 2019	waiver - 3 year		
Gross Alpha	1	Jan 2014 - Dec 2019	standard - 6 year	06/10/2015	
Radium 228	1	Jan 2014 - Dec 2019	standard - 6 year	06/10/2015	

Washington State Department of Health
Environmental Public Health
Office of Drinking Water

Water Quality Monitoring Schedule

Other Information

Other Reporting Schedules	*Due Date*
Measure chlorine residuals and submit monthly reports if your system uses continuous chlorination:	monthly
Submit Consumer Confidence Report (CCR) to customers and ODW (Community systems only):	07/01/2017
Submit CCR certification form to ODW (Community systems only):	10/01/2017
Submit Water Use Efficiency report online to ODW and to customers (Community and other municipal water systems only):	07/01/2017
Send notices of lead and copper sample results to the customers sampled:	30 days after you receive the laboratory results
Submit Certification of customer notification of lead and copper results to ODW:	90 days after you notify customers

Special Notes

None

Northwest Regional Water Quality Monitoring Contacts

For questions regarding chemical monitoring:	Steve Hulsman: (253) 395-6777 or Steve.Hulsman@doh.wa.gov
For questions regarding DBPs:	Steve Hulsman: (253) 395-6777 or Steve.Hulsman@doh.wa.gov
For questions regarding coliform bacteria and microbial issues:	Carol Stuckey or Ingrid Salmon: (253) 395-6775: or carol.stuckey@doh.wa.gov or ingrid.salmon@doh.wa.gov

Additional Notes

The information on this monitoring schedule is valid as of the date in the upper left corner on the first page. However, the information may change with subsequent updates in our water quality monitoring database as we receive new data or revise monitoring schedules. There is often a lag time between when you collect your sample and when we credit your system with meeting the monitoring requirement.

We have not designed this monitoring schedule to display all compliance requirements. The purpose of this schedule is to assist water systems with planning for most water quality monitoring, and to allow systems to compare their records with DOH ODW records. Please be aware that this monitoring schedule does not include constituents that require a special monitoring frequency, such as monitoring affiliated with treatment.

Any inaccuracies on this schedule will not relieve the water system owner and operator of the requirement to comply with applicable regulations.

If you have any questions about your monitoring requirements, please contact the regional office staff listed above.

Water Quality Monitoring Schedule

System: LWWSD - EAGLERIDGE
Contact: Bill A Hunter

PWS ID: 08118 1
Group: A - Comm

Region: NORTHWEST
County: WHATCOM

NOTE: To receive credit for compliance samples, you must fill out laboratory and sample paperwork completely, send your samples to a laboratory accredited by Washington State to conduct the analyses, AND ensure the results are submitted to DOH Office of Drinking Water. There is often a lag time between when you collect your sample, when we credit your system with meeting the monitoring requirement, and when we generate the new monitoring requirement.

Coliform Monitoring Requirements

	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
Coliform Monitoring Population	174	174	174	174	174	174	174	174	174	174	174	174
Number of Routine Samples Required	1	1	1	1	1	1	1	1	1	1	1	1

- Collect samples from representative points throughout the distribution system.
- Collect required repeat samples following an unsatisfactory sample. In addition, collect a sample from each operating groundwater source.
- For systems that chlorinate, record chlorine residual (measured when the coliform sample is collected) on the coliform lab slip.

Chemical Monitoring Requirements

Distribution Monitoring

Test Panel/Analyte	*# Samples Required*	*Compliance Period*	*Frequency*	*Last Sample Date*	*Next Sample Due*	
Lead and Copper	5	Jan 2017 - Dec 2019	standard - 3 year	06/02/2016	Jun 2019	
Asbestos	0	Jan 2011 - Dec 2019	waiver - 9 year			
Total Trihalomethane (THM)	1	Jan 2017 - Dec 2017	standard - 1 year	07/24/2017		
Halo-Acetic Acids (HAA5)	1	Jan 2017 - Dec 2017	standard - 1 year	07/24/2017		

Water Quality Monitoring Schedule

Notes on Distribution System Chemical Monitoring

For *Lead and Copper*:
- Collect samples from the COLD WATER side of a KITCHEN or BATHROOM faucet that is used daily.
- Before sampling, make sure the water has sat unused in the pipes for at least 6 hours, but no more than 12 hours (e.g. overnight).
- If you are sampling from a faucet that has hot water, make sure cold water is the last water to run through the faucet before it sits overnight.
- If your sampling frequency is annual or every 3 years, collect samples between June 1 and September 30.

For *Asbestos:* Collect the sample from one of your routine coliform sampling sites in an area of your distribution system that has asbestos concrete pipe.

For *Disinfection Byproducts (HAA5 and THM):* Collect the samples at the locations identified in your Disinfection Byproducts (DBP) monitoring plan.

Water Quality Monitoring Schedule

Other Information

Other Reporting Schedules	*Due Date*
Measure chlorine residuals and submit monthly reports if your system uses continuous chlorination:	monthly
Submit Consumer Confidence Report (CCR) to customers and ODW (Community systems only):	07/01/2017
Submit CCR certification form to ODW (Community systems only):	10/01/2017
Submit Water Use Efficiency report online to ODW and to customers (Community and other municipal water systems only):	07/01/2017
Send notices of lead and copper sample results to the customers sampled:	30 days after you receive the laboratory results
Submit Certification of customer notification of lead and copper results to ODW:	90 days after you notify customers

Special Notes

None

Northwest Regional Water Quality Monitoring Contacts

For questions regarding chemical monitoring:	Steve Hulsman: (253) 395-6777 or Steve.Hulsman@doh.wa.gov
For questions regarding DBPs:	Steve Hulsman: (253) 395-6777 or Steve.Hulsman@doh.wa.gov
For questions regarding coliform bacteria and microbial issues:	Carol Stuckey or Ingrid Salmon: (253) 395-6775: or carol.stuckey@doh.wa.gov or ingrid.salmon@doh.wa.gov

Additional Notes

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If you have any questions about your monitoring requirements, please contact the regional office staff listed above.

Water Quality Monitoring Schedule

System: LWWSD - AGATE HEIGHTS
Contact: Bill A Hunter

PWS ID: 52957 B
Group: A - Comm

Region: NORTHWEST
County: WHATCOM

NOTE: To receive credit for compliance samples, you must fill out laboratory and sample paperwork completely, send your samples to a laboratory accredited by Washington State to conduct the analyses, AND ensure the results are submitted to DOH Office of Drinking Water. There is often a lag time between when you collect your sample, when we credit your system with meeting the monitoring requirement, and when we generate the new monitoring requirement.

Coliform Monitoring Requirements

	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
Coliform Monitoring Population	192	192	192	192	192	192	192	192	192	192	192	192
Number of Routine Samples Required	1	1	1	1	1	1	1	1	1	1	1	1

- Collect samples from representative points throughout the distribution system.
- Collect required repeat samples following an unsatisfactory sample. In addition, collect a sample from each operating groundwater source.
- For systems that chlorinate, record chlorine residual (measured when the coliform sample is collected) on the coliform lab slip.

Chemical Monitoring Requirements

Distribution Monitoring

Test Panel/Analyte	*# Samples Required*	*Compliance Period*	*Frequency*	*Last Sample Date*	*Next Sample Due*	
Lead and Copper	5	Jan 2017 - Dec 2019	standard - 3 year	06/06/2016	Jun 2019	
Asbestos	0	Jan 2011 - Dec 2019	waiver - 9 year			
Total Trihalomethane (THM)	1	Jan 2015 - Dec 2017	standard - 3 year	06/21/2017		
Halo-Acetic Acids (HAA5)	1	Jan 2015 - Dec 2017	standard - 3 year	06/21/2017		

Water Quality Monitoring Schedule

Notes on Distribution System Chemical Monitoring

For *Lead and Copper*:
- Collect samples from the COLD WATER side of a KITCHEN or BATHROOM faucet that is used daily.
- Before sampling, make sure the water has sat unused in the pipes for at least 6 hours, but no more than 12 hours (e.g. overnight).
- If you are sampling from a faucet that has hot water, make sure cold water is the last water to run through the faucet before it sits overnight.
- If your sampling frequency is annual or every 3 years, collect samples between June 1 and September 30.

For *Asbestos:* Collect the sample from one of your routine coliform sampling sites in an area of your distribution system that has asbestos concrete pipe.

For *Disinfection Byproducts (HAA5 and THM):* Collect the samples at the locations identified in your Disinfection Byproducts (DBP) monitoring plan.

Source Monitoring

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- Washington State grants monitoring waivers for various test panels /analytes. Please note that we may require some monitoring as a condition of some waivers. We have granted complete waivers for dioxin, endothal, glyphosate, diquat, and insecticides.
- Nitrate, arsenic, iron, and other individual inorganics are included as part of a Complete Inorganic (IOC) analysis when it is collected.

Source S03 GIESBRECHT 10 Well Use - Permanent Susceptility - Moderate

Test Panel/Analyte	# Samples Required	Compliance Period	Frequency	Last Sample Date	Next Sample Due
Nitrate	1	Jan 2017 - Dec 2017	standard - 1 year	07/24/2017	
Complete Inorganic (IOC)	1	Jan 2011 - Dec 2019	waiver - 9 year	07/19/2016	
Manganese	1	Jan 2017 - Dec 2019	standard - 3 year	07/19/2016	Sep 2019
Volatile Organics (VOC)	1	Jan 2014 - Dec 2019	waiver - 6 year	07/19/2016	
Herbicides	1	Jan 2014 - Dec 2022	waiver - 9 year	07/25/2016	
Pesticides	1	Jan 2014 - Dec 2022	waiver - 9 year	08/05/2015	
Soil Fumigants	0	Jan 2017 - Dec 2019	waiver - 3 year		
Gross Alpha	1	Jan 2014 - Dec 2019	standard - 6 year	07/21/2015	
Radium 228	1	Jan 2014 - Dec 2019	standard - 6 year	07/21/2015	

Water Quality Monitoring Schedule

Other Information

Other Reporting Schedules	*Due Date*
Measure chlorine residuals and submit monthly reports if your system uses continuous chlorination:	monthly
Submit Consumer Confidence Report (CCR) to customers and ODW (Community systems only):	07/01/2017
Submit CCR certification form to ODW (Community systems only):	10/01/2017
Submit Water Use Efficiency report online to ODW and to customers (Community and other municipal water systems only):	07/01/2017
Send notices of lead and copper sample results to the customers sampled:	30 days after you receive the laboratory results
Submit Certification of customer notification of lead and copper results to ODW:	90 days after you notify customers

Special Notes

None

Northwest Regional Water Quality Monitoring Contacts

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For questions regarding coliform bacteria and microbial issues:	Carol Stuckey or Ingrid Salmon: (253) 395-6775: or carol.stuckey@doh.wa.gov or ingrid.salmon@doh.wa.gov

Additional Notes

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Any inaccuracies on this schedule will not relieve the water system owner and operator of the requirement to comply with applicable regulations.

If you have any questions about your monitoring requirements, please contact the regional office staff listed above.

Appendix N – Service Area Characteristics

SERVICE AREA CHARACTERISTICS

A. Sudden Valley

Sudden Valley is a planned community of 1,576 acres, nearly 3,000 single family lots, condominium areas, and recreational/open areas located on the west shore of Lake Whatcom. Development of the planned, residential resort began in 1968. The developers included access to all utilities, including water and sewer. Typically, the lot sizes were approximately 6,000 square feet.

The development of lots and utilities in Sudden Valley was unusual. The developers conceived the project as a single, large development with all platting and construction of utilities occurring at one time (as opposed to a phased development). The local economy experienced a down-turn in the late 1970s and early 1980s. All costs for the operation and maintenance of an extensive infrastructure had to be borne by a small base of customers. By the end of the 1970s, developers and home owners had built improvements on less than one-quarter of the lots.

1. Boundaries

For the purposes of this comprehensive plan, the Sudden Valley future service area is an area slightly larger than the original Sudden Valley development. The boundaries of the future service area follow the limits of the original development from the northwest corner of the development south and west to Lake Louise Road.

Upon reaching the District Boundaries at the boundary of Sections 7 and 18 the boundary continues east toward the lake. Beyond this point, the Sudden Valley future service area boundary deviates from the original Sudden Valley Development Boundary. The future service area boundary includes additional areas that have the *potential* for utility service (Camp Firwood, Morrison property, Lane Older, Byron Tract, Airstrip, etc.).

The Sudden Valley *Development* Boundary skirts north of an area zoned for R5A to Lake Whatcom northwest of Reveille Island. This area was down-zoned from UR3 and includes both Camp Firwood and an area of undeveloped land. This area was outside the original Sudden Valley Development. Therefore, the original developers did not design the Sudden Valley utilities, storage and treatment facilities to serve the entire area. An exception to this is the Camp Firwood area. When the Sudden Valley Development was designed, the developers negotiated with *the Firs Bible and Missionary Conference* to allow easements and a reservoir site on Camp property. As part of this negotiation, the *Sanwick Corporation* (Sudden Valley's developer) agreed to reserve service capacity for Camp Firwood. The District accepted these obligations when they accepted the Sudden Valley System in 1977, and Camp Firwood now has water and sewer service.

We have included the area within the future service area because of the proximity to the Sudden Valley Area rather than with South Lake future service area. Therefore, the Sudden Valley *future service area* Boundary includes Camp Firwood and the area potentially served by the Camp Firwood pump station.

2. Topography

The topography of the Sudden Valley Area is characterized by five topographic sub-areas. Each sub-area has its own slope orientation, height, and development and service challenges. The first area is characterized by a series of steep rides, Beaver Creek, Lake Louise Road and Lookout Mountain. The development on these ridges represents much of the Sudden Valley residential development. Further to the south, the Sudden Valley Development abuts Austin Creek and extends up the slopes of Lookout Mountain. At the extreme southeastern portion of the Area (immediately east of Lake Louise) a steep hill rises from Lake Whatcom. Sudden Valley Division 7 occupies the north side of this hill while Camp Firwood occupies the south. The remaining portion of the area is the valley floor and Lake Louise. This area is typically recreational. A topographic map of the District is included in Figure N-1.

3. Geology

The entire Lake Whatcom area forms part of the western foothills of the Cascade Range. Bedrock conditions are important considerations of the suitability of the land for different uses; the cost of development, and the production of ground water.

The predominant rock type in the Sudden Valley area consists of Tertiary sandstone, conglomerate, and shale of the Chuckanut Formation (TKc). This rock type also can be found to the north and east of Lake Whatcom.

Cross-bedding in both the sandstone and conglomerate formations are common. The relationship between the inclined bedding and fractures in the Chuckanut Formation is important to determine slope stability. Potential landslide hazards exist where either bedding or fracture planes intersect the land surface. Chuckanut Sandstone is generally a poor producer of ground water. However, wells that intercept a fracture zone can produce small yields.

4. Soils

Stream and runoff sediments (Qal) have accumulated in the delta of Beaver Creek/Austin Creek in Sudden Valley. These alluvial deposits can produce limited quantities of ground water. However, there has been no significant development of ground water within Sudden Valley.

5. Hydrology

The entire Lake Whatcom Watershed is 35,800 acres, of which approximately 5,003 acres are lake surface. The Lake itself is divided into three major basins. The deepest sections (to 100+ meters or 330 feet) are in the most southern basin north of South Bay. The large central basin has depths of over 85 meters or 280+ feet and is separated from the southern basin by the *Sunnyside Sill.* The northern basin is separated from the central basin by the *Strawberry Sill.* This is the smallest and shallowest of the basins with depths to 25 meters or 85 feet. The northern basin is separated into two minor basins by the *Geneva Sill.*

Austin Creek (and a large tributary Beaver Creek) is the major drainage course in the Sudden Valley area.

Lake Whatcom Water and Sewer District started recording daily rainfall in June 1983. The District maintains three rain gauges: one at the District shop at 1010 Lakeview Street; one at the District's Airport Pump Station on Lake Whatcom Boulevard, and one at the Division 30 water reservoir at the south end of Sudden Valley. The City of Bellingham records their rainfall at the Post Point Sewage Treatment Plant (200 McKenzie Avenue). During some periods, there is significantly more rainfall at the Lake Whatcom Water and Sewer District rain gauge stations than at the City of Bellingham Station. The LWWSD shop recorded rainfall for the twelve months ending 1984-1985 with 60.45 inches. For the same year, the City of Bellingham recorded 36.81 inches.

On January 9-10 1983, heavy continuous rains caused major slumping of unstable soils and the failure of large debris dams on major streams. Several days of rain (January 2-8) preceded the major storm event. When rainfall occurs, part of the water runs off directly into streams or over land into the Lake within a short period. Due to the combination of shallow soils in the area, bedrock and the heavy rains, the ground was not able to absorb the water. This resulted in the accretion and subsequent failure of large debris dams.

This flooding caused major changes in Lake chemistry, turbidity, phytoplankton, and loading rates of phosphorus, sediment, and other nutrients in streams. Because of the volume and shape of Lake Whatcom, the Lake took several years to return to an equilibrium state.[1]

Future similar flooding events have the potential for similar results. During these events, the Sudden Valley Water Treatment Plant will require careful monitoring. If the changes in water character are significant enough the Water Treatment Plant may require temporary changes in operations to handle the changes in raw water quality.

Records do not show the recurrences interval or the relative magnitude of the 1983 storm event. However, in the 1983 storm five inches of rain fell within the six day period. This combined with the presence of the debris dams made it difficult to evaluate on a relative scale. The Washington State Department of Emergency Services offered long-term mitigation recommendations for their *Flood Mitigation Implementation Measure Report for Whatcom County* in November 1983 (available from Whatcom County Department of Public Works).

These recommendations included suggestions on land use planning, zoning, the installation of rain gauges in higher altitudes, and debris collectors and surge dams.

B. Geneva

1. Boundaries

The Geneva future service area represents the area between the City of Bellingham and the Sudden Valley area described above. The boundary extends west along the City of Bellingham City Limits (at Lake Whatcom) to the boundary between Township 38-North and Range 4-East Sections 33 and 34. This north-south section line represents the City of Bellingham/ Lake Whatcom Water and Sewer District boundary lines and the approximate watershed boundaries.

The limits of the Geneva future service area continue along the southern edge of potential development in this area. The area south of the future service area has been purchased by the City of Bellingham and will not be developed. The future service area boundary continues roughly east along the south edge of areas down-zoned to R5A (from RR2 and R2A) to Lake

[1] The relatively rapid return of the lake to equilibrium was to some degree a result of increased diversion by the City of Bellingham from the Middle Fork of the Nooksack into the Lake through the City's Mirror Lake Inter-basin Water diversion.

Whatcom (approximately 1/2-mile northwest of Dutch Harbor) and continuing along Lake Whatcom to the Sudden Valley boundary.

2. Topography

The topography of the Geneva area is considerably less complex than the Sudden Valley Area. Most of the area forms moderately steep, north facing slopes leading down to Lake Whatcom. A series of broad north-south ravines and ridges traverse the western portions of this area. Further to the south and east, the topography forms the broad, steep, northeast facing slopes of Lookout Mountain. A topographic map of the District is included in Figure N-1.

3. Geology

The Geneva area also forms part of the western foothills of the Cascade Range. The bedrock conditions are similar to Sudden Valley. The existence of bed rock conditions is an important determinant of the suitability of the land for different uses, costs of development, and the production of ground water.

The predominant rock type in the area consists of Tertiary sandstone, conglomerate, and shale of the Chuckanut Formation (Tkc). Cross-bedding in both sandstone and conglomerate formations are also common in the Geneva Area. Likewise, the relationship between the inclined bedding and fractures in the Chuckanut Formation is important to determine slope stability. Potential landslide hazards exist where ever either bedding or fracture planes intersect the land surface. As above, Chuckanut Sandstone is a poor producer of ground water, although wells that intercept fracture zones can produce small yields.

4. Soils

Soils in the Geneva Area are typically shallow over bedrock. There are no significant ground water sources known in the Geneva Area.

5. Hydrology

No major creeks enter Lake Whatcom in the Geneva Area. However, Whatcom Creek flows from Lake Whatcom immediately north of the future service area. Although this out-fall is outside District Boundaries, the creek is important to all water uses in the area as the natural outlet from Lake Whatcom.

C. North Shore

1. Boundaries

The eastern boundary of the North Shore future service area starts at Lake Whatcom and heads north following the City of Bellingham / Lake Whatcom Water and Sewer District boundary. It then follows the District boundary to the east. It encompasses the areas adjacent to the North Shore interceptor, pump station service areas, and gravity service areas. Much of the potential development in this service area has been eliminated through density reduction programs where the property is purchased and restricted from development.

2. Topography

The topography of the North Shore future service area can be divided into five separate sub areas. The areas furthest to the west form moderate slopes. These lead down to North Shore Road and form a portion of the southern flank of Squalicum Mountain. Several shallow ravines with associated small creeks cross this section of the area to Lake Whatcom. The area then levels to form a gently sloped area that is over 1-mile wide.

Immediately west of Agate Bay, a steep north-south escarpment marks the western boundary of the second topographic area of North Shore. As with the area described above, this second area ends with a moderately sloped area approximately 1/8 of a mile wide.

The North Shore future service area enters a third topographic area of mild slopes that form Squalicum Valley between Squalicum Mountain and Stewart Mountain. Carpenter Creek flows from Stewart Mountain through Squalicum Valley into Lake Whatcom. Further to the east, the larger Olsen Creek flows from a deep ravine on the flanks of Stewart Mountain. Close to the lake, mild slopes continue approximately 1/2 mile east along the shore before running into the steep southwest-facing slopes of Stewart Mountain.

Steep slopes beginning at Olsen Creek form the boundary of the fourth area. Steep slopes lead up to the 2,800 MSL (feet above mean sea level) peak of Stewart Mountain. More moderate slopes exist close to the lake and southwest of the BPA power line. The steeper areas northeast of the power line are zoned for Forestry.

The fifth topographic area is the small area known as Sunnyside. The areas of steep ravines and slopes are zoned ROS (Rural Open Space) and Forestry.

Beyond this last portion of the North Shore future service area, Stewart Mountain continues as a steep ridge rising from the more southern portions of Lake Whatcom. The steep west facing slopes of this area preclude development. Zoning in this area is forestry. A topographic map of the District is included in Figure N-1.

3. Geology

The predominant rock type in the North Shore Area consists of Tertiary sandstone, conglomerate, and shale of the Chuckanut Formation (Tkc). Cross-bedding in both sandstone and conglomerate formations are common. The same factors we discussed above for this rock type apply in this area.

4. Soils

Along Agate Bay, construction would find out-wash sand and gravel (Qso), and undifferentiated glacial drift (Qf) deposits. Bellingham drift (Qb), and inter-glacial sandy silt occurs north of Agate Bay. Stream and runoff sediments (Qal) have accumulated in deltas at Sunnyside. The ground water developments are typically on the glacial outwash sands and gravels mapped at Agate Bay. The alluvial deposits at Sunnyside produce limited quantities of ground water.

5. Hydrology

Several major creeks enter Lake Whatcom in the North Shore area. Olsen, Carpenter, and Smith Creeks all enter the lake from the mountains to the east and provide significant recharge to the lake.

Other, smaller creeks also add significantly to the Lake recharge. The high and steep wet-facing slopes intercept much of the summer rains and winter snows that recharge the Lake. The sparsely developed residential areas and forested slopes combine to form the conditions for high quality surface recharge. In addition to the surface creeks, recharge on these high peaks provides artesian conditions in the Squalicum Aquifer. This aquifer eventually flows into the lake and also provides a significant source of lake water.

D. South Lake

1. Boundaries

The South Lake future service area begins at the northwest corner where it connects with the southeast corner of the Sudden Valley Area. From this point, the South Lake future service area boundary continues south and east along the Lake. This includes all residentially zoned areas south of the Sudden Valley area and the North Shore area.

2. Topography

There are three major topographic regions of the South Lake future service area. From the Sudden Valley Area south to South Lake, the area is steep with east facing slopes cut by small mountain streams. Areas closer to Lake Whatcom have progressively milder slopes. Lake Whatcom Boulevard crosses close to the lake to take advantage of the milder slopes within this first topographic sub-area. The flanks of Lookout Mountain continue to rise to the west beyond the District Boundaries.

South Bay is a narrow bay extending from Lake Whatcom to the southwest. The area including South Bay and the areas from South Bay to Blue Canyon form the second topographic sub-region of the South Lake future service area. Slopes to the northwest of South Bay are steep. However, slopes to the southeast are considerably milder.

The valley southwest of the Bay broadens as it extends to the Lake watershed / District boundaries. The topography in these areas is potentially well suited for development. The zoning in these areas is R5A for rural development. The lack of utilities and roads, the rural zoning, and the physical distance to either Bellingham or the Skagit Valley has limited growth in this area. [2]

Between South Bay and Blue Canyon, the flanks of a knoll form another area potentially suited to development. The eastern slopes of the knoll are gentle and lead to the broad valley of Brannian Creek. However, the zoning is R5A so any new development will be rural in nature. The higher slopes are zoned for Forestry.

[2] The broadest and most developed sections of this entire area are actually beyond both the watershed and the District Boundaries. This developed area includes *Glenhaven Lakes* and *Whatcom Meadows* and surrounds Reed (394 MSL) and Cain Lakes (391 MSL). However, both of these lakes drain away from Lake Whatcom south past the town of Alger into Friday Creek and eventually into the Samish River.

The State Fish Hatchery occupies a portion of the area zoned ROS (Recreation Open Space) south of the Creek. East of Brannian Creek (and immediately west of Blue Canyon) mild slopes lead up to Anderson Mountain.

Blue Canyon also forms a steep walled canyon. The flanks of Anderson Mountain bound one side of the canyon while the northeast side of the Canyon forms slopes leading up to Stewart Mountain. The floor of Blue Canyon is narrow and contains the small Mirror Lake. The outlet to this lake flows into Lake Whatcom. The City of Bellingham uses Mirror Lake and Anderson Creek as part of the inter-basin diversion from the Middle Fork of the Nooksack River. [3]

Areas immediately to the east of Mirror Lake flow the opposite direction. The water enters the South Fork of the Nooksack River close to the town of Acme. The County has zoned almost all of the floor of Blue Canyon as R5A. The surrounding slopes are zoned for Forestry. A topographic map of the District is included in Figure N-1.

3. Geology

Near Blue Canyon, pre-Jurassic phyllite (metamorphic slate, pJm) occurs in limited quantity. The ground water characteristics are similar to those of the Chuckanut Formation near South Bay, Sudden Valley and Geneva. Water in some locations in the phyllite yield sufficient quantities for single family residential use.

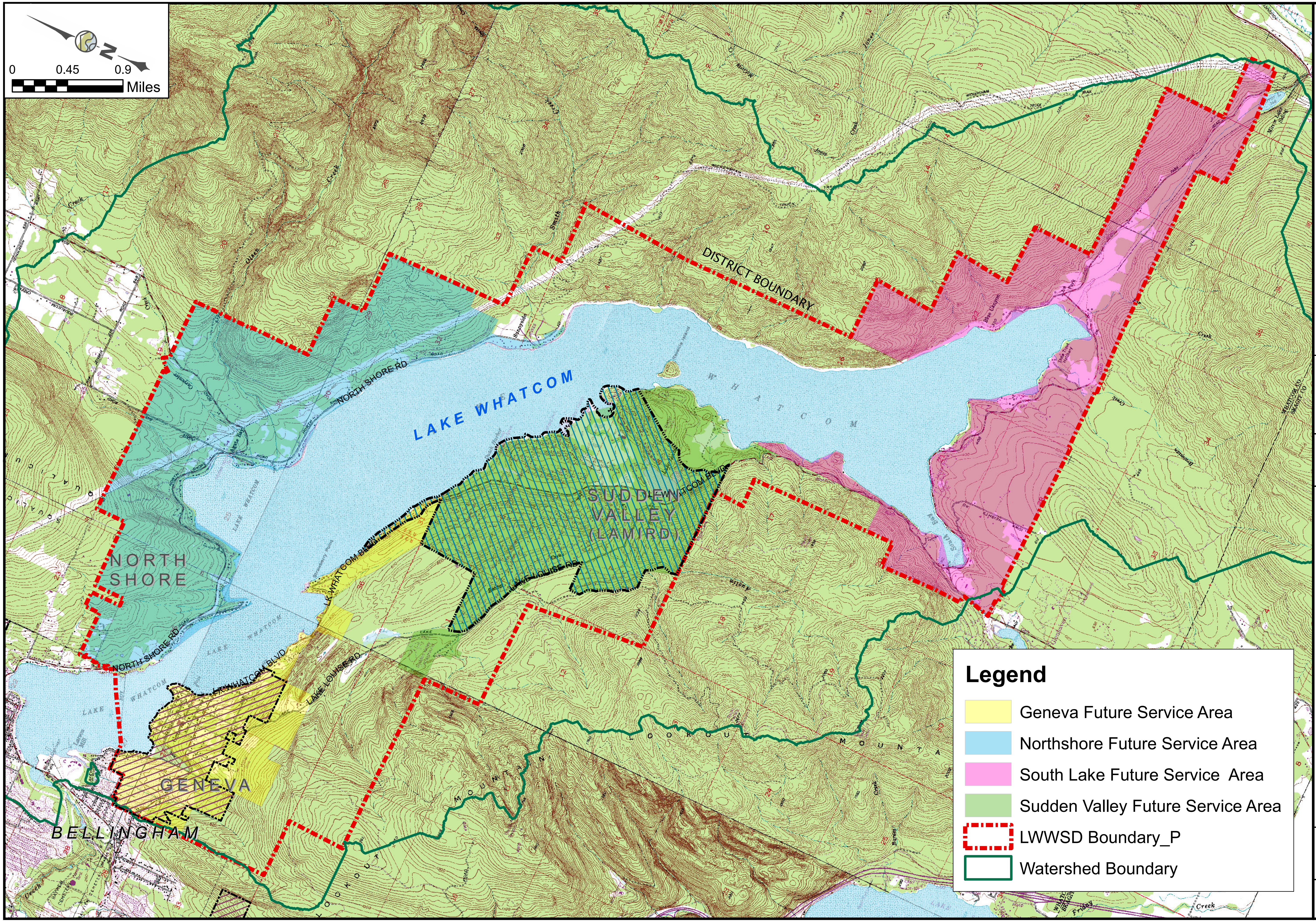
4. Soils

Along South Bay, there are areas of out-wash sand and gravel (Qso), and undifferentiated glacial drift (Qf) deposits. Stream and runoff sediments (Qal) have accumulated in deltas at the Lake Whatcom outlet of Anderson Creek. In some areas on the glacial out-wash sands wells have developed limited ground water. Limited quantities of ground water may also be available from the alluvial deposits at Anderson Creek.

5. Hydrology

Both Anderson Creek and Brannian Creek flow into Lake Whatcom in the South Lake area. While Anderson Creek is larger, Brannian Creek is important as a source of water for the State Fish Hatchery. Anderson Mountain, Anderson Creek, Brannian Creek and the sparse density and forestry zoning make this sub-area another valuable watershed area.

[3] The City of Bellingham diverts water from the Middle Fork of the Nooksack because that fork provides a better source than the closer South Fork. Waters from the Middle Fork are piped under the South Fork before entering Mirror Lake.



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DESIGNED BY	DRAWN BY	CHECKED BY
MMM	BMS	MMM

LAKE WHATCOM WATER & SEWER DISTRICT
WHATCOM COUNTY
WASHINGTON

FIGURE N-1
DISTRICT BOUNDARY

DATE	SCALE	JOB NO.
Nov 2017	AS SHOWN	2016-096

SHEET 1 OF 1