CHAPTER 3 - SYSTEM ANALYSIS

3.1 SYSTEM DESIGN STANDARDS

Standardized performance and design criteria are essential for the efficient evaluation, construction and operation of a water utility. Establishing minimum criteria assures a base level of system reliability and enhances the utility's ability to assess system deficiencies and to plan for future improvements.

The City of Selah has established the following performance and design criteria for their water system:

1. Water Quality – The quality of water supplied to the system shall meet or exceed the requirements of the latest edition of the Department of Health publication entitled *State Board of Health - Drinking Water Regulations*.

2. Average Daily Demand (ADD) – This demand shall be equivalent to the daily consumption per service in a user category averaged for the period 2007-2012, except as otherwise adjusted to account for recent changes in demand trends as discussed in CHAPTER 2 of this Plan. The ADD values for Selah are presented in Table 2-11.

3. Maximum Daily Demand (MDD) – This demand shall be the equivalent to the maximum day of consumption per service in a user category, as calculated using the volume of water from the maximum day of production as described in CHAPTER 2. The MDD values are presented in Table 2-13.

4. Peak Hour Demand (PHD) – This demand shall be equivalent to the peak hour consumption per service in a user category, as calculated using a conservative estimate of 1.8 times the MDD as shown in Table 2-13.

5. Storage Requirements – Storage requirements shall be based on providing minimum operational, equalizing, standby, and fire suppression storage for the entire water system as calculated using the *DOH Water System Design Manual* equations. The specific storage requirements for the City of Selah are presented later in this chapter.

6. Flow Rates and Velocities – Pipelines shall be sized for a maximum allowable water flow velocity of seven feet per second (FPS) for system demands, which equals the maximum instantaneous demand (PHD). Pipeline velocities of 14 FPS shall be permitted for fire flow conditions up to 3,000 GPM. Where fire flow requirements exceed 3,000 GPM, maximum allowable pipe velocities of 20 FPS will be allowed. The basis for pipe size design shall be per computer model analysis.

7. Multiple Sources – The City of Selah currently has six primary source wells in service. The City will apply for new water rights and develop new sources as demand requires.

8. Fire Suppression Storage Requirements – Storage requirements for fire flow shall be based on providing 6,000 GPM for a 4-hour duration (the minimum flow recommended by the Selah Fire Department for the largest Tree Top facility), which equals 1,440,000 gallons. Additional fire suppression storage and fire flow capacity requirements are discussed later in this chapter.

9. System Pressures – The City of Selah water system currently has seven pressure zones. The minimum service pressure under maximum instantaneous domestic demand conditions shall be 30 pounds per square inch (psi), as specified in WAC 246-290-230(5). Under fire flow conditions, the minimum fire hydrant flow pressure shall be 20 psi. Additional information regarding system pressure requirements under specific hydraulic analysis scenarios is presented later in this chapter.

10. Minimum Pipe Sizes - The minimum pipe size allowed within the system shall be eight-inch diameter. Where fire flow requirements exceed 1,000 GPM, the minimum pipeline size shall be determined by hydraulic analysis.

Standards for water main construction in the City of Selah are included in CHAPTER 10 of this Plan.

3.2 WATER QUALITY

A public water utility must supply safe and aesthetically pleasing water to its customers. However, source waters of most water utilities vary in the types and amounts of impurities which have been acquired during their passage through atmosphere, ground surfaces, or underground strata. To assure that all drinking waters maintain a standard level of quality, acceptable limits of contaminants have been established in WAC Chapter 246-290, *Group A Public Water Supplies*, March 30, 2012, specifically WAC 246-290-310 effective January 4, 2010.

These standards of acceptability establish "maximum contaminant levels" (MCLs) and "Maximum Residual Disinfectant Levels" (MRDLs) for bacteriological, inorganic chemical and physical, and other elements. The Regulations also set forth procedures to be followed if the MCL limits are exceeded.

The City of Selah monitors its system's water quality in accordance with the requirements of WAC 246-290-300, and 246-290-310. Follow-up action, if required, is completed in accordance with the requirements of WAC 246-290-320 and the Groundwater Rule (GWR). Bacteriological monitoring is performed at ten (10) locations within the water system in accordance with the City's *Coliform Monitoring Plan*. Included in the City's *Coliform Monitoring Plan* is a follow-up procedure when a sample is coliform positive, meeting the Triggered Source Water Monitoring requirements. Lead and copper distribution system monitoring is completed in accordance with the City's lead and copper monitoring program. Inorganic chemical (IOC), volatile organic chemical (VOC), synthetic organic chemical (SOC), and radionuclide testing are performed on the City's source wells.

3.2.1 Water Source Sampling and Testing

Inorganic Chemical (IOC) Monitoring: Water quality monitoring for primary IOCs, secondary IOCs and physical parameters is required from each source generally once every compliance cycle. Compliance cycles are nine years, per 40 CFR 141.23. Selah collects water samples for IOCs and physical parameters prior to introduction into the distribution system chlorination at each well.

Certain chemical characteristics must be monitored more frequently than the general monitoring requirements. For example, Nitrate and Nitrite must be monitored annually. Other chemical characteristics monitoring requirements may be waived by the Department of Health. For example, asbestos monitoring requirements have been waived for the City of Selah through December 2019 as reflected in Table 3-1.

Results of Selah's latest source IOC and physical analysis, summarized in Table 3-1 and Table 3-2, show the City to be in compliance with State standards. Copies of the most recent test results for the source wells are provided in the CHAPTER 10 of this Plan. Additional inorganic testing of wells occurred in 2007, 2004, 1997, and 1994. Copies of these test results are furnished in CHAPTER 10 of this Plan, and are shown in Table 3-3 through Table 3-7. The results indicate that water quality in each of the wells has not significantly changed over time.

TABLE 3-1 INORGANIC (PRIMARY SUBSTANCES) CHEMICAL ANALYSIS SUMMARY						
Chemical Characteristics	MCL (mg/l)	Well Nos. 3 & 4 (SO5) 08/02/2007	Well No. 5 (SO3) 08/02/2007	Well No. 6 (SO4) 09/06/2006	Well No. 7 (SO6) 08/02/2007	Well No. 8 (SO7) 09/25/2012
Antimony (Sb)	0.006	<0.0050	<0.0050	<0.0050	<0.0050	0.0030
Arsenic (As)	0.010	<0.0020	0.0037	<0.0020	<0.0020	0.0040
Asbestos	7 million fibers/liter	Waiver	Waiver	Waiver	Waiver	Waiver
Barium (Ba)	2.0	0.5700	0.0580	0.1120	0.0160	0.0430
Beryllium (Be)	0.004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Cadmium (Cd)	0.005	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Chromium (Cr)	0.1	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047
Copper (Cu)*	1.3	<0.0020	0.0059	<0.0020	<0.0020	<0.0020
Cyanide (HCN)	0.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
Fluoride (F)	4.0	0.2000	0.3000	0.1800	0.9500	0.3300
Lead (Pb)*	0.015	<0.0005	0.0006	<0.0020	<0.0005	0.0008
Mercury (Hg)	0.0020	<0.0003	<0.0003	<0.0003	<0.0003	0.0002
Nickel (Ni)	0.10	<0.0100	<0.0100	<0.0100	<0.0100	0.0050
Nitrate (as N)	10.0	1.47	1.63	1.48	<0.0500	0.4600
Nitrite (as N)	1.0	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Selenium (Se)	0.05	<0.0050	<0.0050	<0.0050	<0.0050	0.0020
Sodium (Na)*	20	14.5000	24.4000	25.4000	29.4000	19.8000
Thallium (Tl)	0.002	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010

* No DOH established MCL. Represents EPA established "action levels" for lead and copper, and recommended level for sodium.

TABLE 3-2 INORGANIC (SECONDARY SUBSTANCES) CHEMICAL ANALYSIS SUMMARY						
Chemical Characteristics	MCL (mg/l)	Well Nos. 3 & 4 (SO5) 08/02/2007	Well No. 5 (SO3) 08/02/2007	Well No. 6 (SO4) 09/06/2006	Well No. 7 (SO6) 08/02/2007	Well No. 8 (SO7) 09/25/2012
Chloride (Cl)	250.0	8.8000	9.6900	10.7000	5.0200	7.2300
Fluoride (F)	2.0	0.2000	0.3000	0.1800	0.9500	0.3300
Iron (Fe)	0.3	0.0198	0.0158	<0.1000	0.0321	0.1000
Manganese (Mn)	0.05	<0.0020	0.0054	<0.0100	0.0178	0.0112
Silver (Ag)	0.1	<0.0047	<0.0047	<0.1000	<0.0047	<0.0047
Sulfate (SO_4)	250.0	19.3000	18.4000	24.5000	<0.1000	13.8000
Zinc (Zn)	5.0	0.0298	<0.0200	<0.2000	<0.0200	<0.0050
Color	15 Color Units	<4.0000	<4.0000	<15.0000	<4.0000	<4.0000
Specific Conductivity	700 umhos/cm	404.0000	390.0000	493.0000	235.0000	273.0000
Total Dissolved Solids (TDS)	500	276.0000	284.0000	308.0000	150.0000	192.0000

Table 3-3 through Table 3-5 present both the latest, and previously conducted IOC analysis test results for each source well.

TABLE 3-3 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NOS. 3 & 4 (S05)					
Chemical or Physical Characteristics	MCL (mg/l)	08/02/2007	08/02/2004	09/03/1997	05/09/1994
Primary Substances					
Antimony (Sb)	0.006	<0.0050	<0.005	<0.0050	<0.0050
Arsenic (As)	0.010	<0.0020	<0.002	<0.01	<0.010
Asbestos	7 million fibers/liter	Waiver	Waiver	Waiver	Waiver
Barium (Ba)	2.0	0.5700	0.050	<0.10	<0.25
Beryllium (Be)	0.004	<0.0002	<0.0002	<0.0020	<0.0030
Cadmium (Cd)	0.005	<0.0003	<0.0003	<0.0020	<0.002
Chromium (Cr)	0.1	<0.0047	<0.0047	<0.010	<0.010
Copper (Cu)*	1.3	<0.0020	<0.002	<0.02	<0.20
Cyanide (HCN)	0.2	<0.0100	<0.01	<0.1	<0.05
Fluoride (F)	4.0	0.2000	0.17	<0.50	<0.20
Lead (Pb)*	0.015	<0.0005	<0.0005	<0.002	<0.002
Mercury (Hg)	0.0020	<0.0003	<0.0003	<0.0005	<0.0005
Nickel (Ni)	0.10	<0.0100	<0.01	<0.040	<0.040
Nitrate (as N)	10.0	1.47	1.52	1.4	1.5
Nitrite (as N)	1.0	<0.0500	<0.05	<0.5	<0.50
Selenium (Se)	0.05	<0.0050	<0.005	<0.005	<0.005
Sodium (Na)*	20	14.5000	14.6	15.0	15.0
Thallium (Tl)	0.002	<0.0010	<0.001	<0.001	<0.002
Secondary Substances					
Chloride (Cl)	250.0	8.8000	8.94	<20.0	<20.0
Fluoride (F)	2.0	0.2000	0.17	<0.50	<0.20
Iron (Fe)	0.3	0.0198	<0.0097	<0.05	<0.10
Manganese (Mn)	0.05	<0.0020	<0.002	<0.01	<0.010
Silver (Ag)	0.1	<0.0047	<0.0047	<0.010	<0.010
Sulfate (SO_4)	250.0	19.3000	19.9	20.0	23.0
Zinc (Zn)	5.0	0.0298	0.0206	<0.05	<0.20
Color	15 Color Units	<4.0000	<4	<5.0	<5.0
Specific Conductivity	700 umhos/cm	404.0000	404.0000	340.00	390.00
Total Dissolved Solids (TDS)	500	276.0000	260.0000	---	---

* No DOH established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.

TABLE 3-4 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 5 (S03)					
Chemical or Physical Characteristics	MCL (mg/l)	08/02/2007	09/27/2000	09/03/1997	05/09/1994
Primary Substances					
Antimony (Sb)	0.006	<0.0050	<0.0050	<0.0050	<0.0050
Arsenic (As)	0.010	0.0037	<0.0100	<0.01	<0.01
Asbestos	7 million fibers/liter	Waiver	Waiver	Waiver	Waiver
Barium (Ba)	2.0	0.0580	<0.1000	<0.10	<0.10
Beryllium (Be)	0.004	<0.0002	<0.0030	<0.0020	<0.003
Cadmium (Cd)	0.005	<0.0003	<0.0020	<0.0020	<0.0020
Chromium (Cr)	0.1	<0.0047	<0.0100	<0.010	<0.01
Copper (Cu)*	1.3	0.0059	<0.2000	<0.02	<0.2000
Cyanide (HCN)	0.2	<0.0100	<0.0500	<0.1	<0.050
Fluoride (F)	4.0	0.3000	0.3000	<0.50	<0.20
Lead (Pb)*	0.015	0.0006	<0.0020	<0.002	<0.002
Mercury (Hg)	0.0020	<0.0003	<0.0005	<0.0005	<0.0005
Nickel (Ni)	0.10	<0.0100	<0.0400	<0.040	<0.040
Nitrate (as N)	10.0	1.63	1.20	<0.5	1.40
Nitrite (as N)	1.0	<0.0500	<0.50	<0.50	<0.50
Selenium (Se)	0.05	<0.0050	<0.0050	<0.005	<0.005
Sodium (Na)*	20	24.4000	20.0000	21.0	23.0
Thallium (Tl)	0.002	<0.0010	<0.0020	<0.0010	<0.0020
Secondary Substances					
Chloride (Cl)	250.0	9.6900	20.0000	<20.0	10
Fluoride (F)	2.0	0.3000	0.3000	<0.50	0.3
Iron (Fe)	0.3	0.0158	<0.1000	<0.05	<0.10
Manganese (Mn)	0.05	0.0054	<0.0100	0.012	<0.010
Silver (Ag)	0.1	<0.0047	<0.0100	<0.010	<0.010
Sulfate (SO_4)	250.0	18.4000	20.0000	15	15
Zinc (Zn)	5.0	<0.0200	<0.2000	<0.05	<0.2
Color	15 Color Units	<4.0000	<5.0000	<5.0	<5.0
Specific Conductivity	700 umhos/cm	390.0000	360.0000	210	310
Total Dissolved Solids (TDS)	500	284.0000	92.0000	---	---
* No DOH established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.					

TABLE 3-5 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 6 (S04)				
Chemical or Physical Characteristics	MCL (mg/l)	09/06/2006	09/03/1997	05/09/1994
Primary Substances				
Antimony (Sb)	0.006	<0.0050	<0.0050	<0.0050
Arsenic (As)	0.010	<0.0020	<0.01	<0.010
Asbestos	7 million fibers/liter	Waiver	Waiver	Waiver
Barium (Ba)	2.0	0.1120	0.10	0.10
Beryllium (Be)	0.004	<0.0002	<0.0020	<0.0020
Cadmium (Cd)	0.005	<0.0003	<0.0020	<0.0020
Chromium (Cr)	0.1	<0.0047	<0.010	<0.010
Copper (Cu)*	1.3	<0.0020	<0.02	<0.02
Cyanide (HCN)	0.2	<0.0100	<0.10	<0.10
Fluoride (F)	4.0	0.1800	<0.50	<0.50
Lead (Pb)*	0.015	<0.0020	<0.002	<0.002
Mercury (Hg)	0.0020	<0.0003	<0.0005	<0.0005
Nickel (Ni)	0.10	<0.0100	<0.040	<0.040
Nitrate (as N)	10.0	1.48	1.3	1.5
Nitrite (as N)	1.0	<0.0500	<0.50	<0.50
Selenium (Se)	0.05	<0.0050	<0.005	<0.005
Sodium (Na)*	20	25.4000	29	27
Thallium (Tl)	0.002	<0.0020	<0.0010	<0.0010
Secondary Substances				
Chloride (Cl)	250.0	10.7000	<20.0	<20.0
Fluoride (F)	2.0	0.1800	<0.50	<0.50
Iron (Fe)	0.3	<0.1000	<0.05	<0.05
Manganese (Mn)	0.05	<0.0100	<0.01	<0.01
Silver (Ag)	0.1	<0.1000	<0.010	<0.010
Sulfate (SO_4)	250.0	24.5000	22	28
Zinc (Zn)	5.0	<0.2000	<0.05	<0.05
Color	15 Color Units	<15.0000	<5.0	<5.0
Specific Conductivity	700 umhos/cm	493.0000	390	470
Total Dissolved Solids (TDS)	500	308.0000	92.0000	---

* No DOH established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.

TABLE 3-6 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 7 (S06)					
Chemical or Physical Characteristics	MCL (mg/l)	08/02/2007	08/03/2004	09/03/1997	12/14/1994
Primary Substances					
Antimony (Sb)	0.006	<0.0050	<0.005	<0.0050	<0.0050
Arsenic (As)	0.010	<0.0020	<0.002	<0.01	<0.010
Asbestos	7 million fibers/liter	Waiver	Waiver	Waiver	Waiver
Barium (Ba)	2.0	0.0160	0.016	<0.10	<0.1
Beryllium (Be)	0.004	<0.0002	<0.0002	<0.0020	<0.0020
Cadmium (Cd)	0.005	<0.0003	<0.0003	<0.0020	<0.0020
Chromium (Cr)	0.1	<0.0047	<0.0047	<0.010	<0.01
Copper (Cu)*	1.3	<0.0020	<0.002	<0.02	<0.02
Cyanide (HCN)	0.2	<0.0100	<0.01	<0.1	<0.1
Fluoride (F)	4.0	0.9500	0.97	0.9	
Lead (Pb)*	0.015	<0.0005	<0.0005	<0.002	<0.002
Mercury (Hg)	0.0020	<0.0003	<0.0003	<0.0005	<0.0005
Nickel (Ni)	0.10	<0.0100	<0.01	<0.040	<0.040
Nitrate (as N)	10.0	<0.0500	<0.05	<0.5	<0.5
Nitrite (as N)	1.0	<0.0500	<0.05	<0.5	<0.5
Selenium (Se)	0.05	<0.0050	<0.005	<0.005	<0.005
Sodium (Na)*	20	29.4000	30.1	32	34
Thallium (Tl)	0.002	<0.0010	<0.001	<0.0010	<0.001
Secondary Substances					
Chloride (Cl)	250.0	5.0200	5.03	<20.0	20
Fluoride (F)	2.0	0.9500	0.97	0.9	
Iron (Fe)	0.3	0.0321	0.0200	<0.05	0.68
Manganese (Mn)	0.05	0.0178	0.0169	0.016	0.043
Silver (Ag)	0.1	<0.0047	<0.0047	<0.010	<0.010
Sulfate (SO_4)	250.0	<0.1000	<0.1	<10	10
Zinc (Zn)	5.0	<0.0200	<0.02	<0.05	<0.05
Color	15 Color Units	<4.0000	<4	<5.0	15.0
Specific Conductivity	700 umhos/cm	235.0000	404.000	200	230
Total Dissolved Solids (TDS)	500	150.0000	224.0000	---	---

* No DOH established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.

TABLE 3-7 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 8 (S07)			
Chemical or Physical Characteristics	MCL (mg/l)	09/25/2012	11/30/2009
Primary Substances			
Antimony (Sb)	0.006	<0.0030	0.0052
Arsenic (As)	0.010	0.0040	0.0072
Asbestos	7 million fibers/liter	Waiver	Waiver
Barium (Ba)	2.0	0.0430	<0.1000
Beryllium (Be)	0.004	<0.0002	<0.0008
Cadmium (Cd)	0.005	<0.0003	<0.0020
Chromium (Cr)	0.1	<0.0047	<0.0200
Copper (Cu)*	1.3	<0.0020	<0.0200
Cyanide (HCN)	0.2	<0.0100	<0.0100
Fluoride (F)	4.0	0.3300	<0.5000
Lead (Pb)*	0.015	0.0008	<0.0010
Mercury (Hg)	0.0020	<0.0002	<0.0004
Nickel (Ni)	0.10	<0.0050	<0.1000
Nitrate (as N)	10.0	0.4600	<0.2000
Nitrite (as N)	1.0	<0.0500	<0.2000
Selenium (Se)	0.05	<0.0020	<0.0100
Sodium (Na)*	20	19.8000	19.5000
Thallium (Tl)	0.002	<0.0010	<0.0020
Secondary Substances			
Chloride (Cl)	250.0	7.2300	<20.0000
Fluoride (F)	2.0	0.3300	<0.5000
Iron (Fe)	0.3	0.1000	1.6300
Manganese (Mn)	0.05	0.0112	0.0454
Silver (Ag)	0.1	<0.0047	<0.1000
Sulfate (SO_4)	250.0	13.8000	21.0000
Zinc (Zn)	5.0	<0.0050	<0.2000
Color	15 Color Units	<4.000	171.00
Specific Conductivity	700 umhos/cm	273.0000	210.0000
Total Dissolved Solids (TDS)	500	192.0000	100.0000
* No DOH established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.			

<u>Nitrate/Nitrite Monitoring</u>: The City of Selah conducts annual monitoring for Nitrate and Nitrite on all well sources. The maximum contaminant levels (MCL) for Nitrate and Nitrite are 10.0 mg/l and 1.0 mg/l, respectively. Nitrates exceeding this concentration in drinking water can be a health hazard, especially to infants below six months of age.

Test results for the period 2007 through 2012, summarized in Table 3-8, show the City to be in compliance with State standards. A copy of the Nitrate/Nitrite analysis test results are provided in the CHAPTER 10 of this Plan.

TABLE 3-8 NITRATE / NITRITE CHEMICAL ANALYSIS RESULTS						
	2012	2011	2010	2009	2008	2007
Well Nos. 3 & 4 (S05)						
Nitrate (NO_3-N)	<0.05	1.34	1.48	1.27	1.44	1.47
Nitrite (NO_2-N)	<0.07	<0.05	<0.05	<0.05	<0.07	<0.05
Total Nitrate/Nitrite	<0.50	1.34	1.48	1.27	1.44	1.47
Well No. 5 (S03)						
Nitrate (NO_3-N)	0.16	1.68	2.25	1.38	0.21	1.63
Nitrite (NO_2-N)	<0.07	<0.05	<0.05	<0.05	<0.07	<0.05
Total Nitrate/Nitrite	0.16	1.68	2.25	1.38	0.21	1.63
Well No. 6 (S04)						
Nitrate (NO_3-N)	1.62	1.74	1.74	1.54	1.48	1.53
Nitrite (NO_2-N)	<0.07	<0.05	<0.05	<0.07	<0.07	<0.05
Total Nitrate/Nitrite	1.62	1.74	1.74	1.54	1.48	1.53
Well No. 7 (S06)						
Nitrate (NO_3-N)	<0.05	<0.05	<0.20	<0.05	<0.07	<0.05
Nitrite (NO_2-N)	<0.07	<0.05	---	<0.05	<0.07	<0.05
Total Nitrate/Nitrite	<0.50	<0.50	---	<0.50	<0.50	<0.50
Well No. 8 (S07)						
Nitrate (NO_3-N)	0.46	1.02	---	<0.20	---	---
Nitrite (NO_2-N)	<0.05	<0.05	---	<0.20	---	---
Total Nitrate/Nitrite	0.46	1.02	---	<0.20	---	---

Volatile Organic Chemical Monitoring: Volatile Organic Chemical (VOC) monitoring is required once every year for the first three years of sampling, per 40 CFR 141.24. Samples are to be taken following water treatment. If no VOCs are detected during the first three years of testing, future monitoring shall be at least once every compliance period. The Department of Health may grant waivers for monitoring requirements. Selah conducted VOC testing on its source wells as shown in Table 3-9.

TABLE 3-9 SOURCE WELL VOC TESTING				
Well No. 3 & 4 (S05)	Well No. 5 (S03)	Well No. 6 (S04)	Well No. 7 (S06)	Well No. 8 (S07)
07/2010	07/2010	07/2010	05/2009	09/2011
07/2006	07/2006	07/2006	04/2006	06/2011
03/1999	03/2003	03/2003	02/2003	03/2011
06/1996	03/1999	03/1999	03/2002	11/2009
	06/1996	06/1996	10/2001	
	09/1993	09/1993	01/2000	

Test results show the City to be in compliance with State standards. The City tests for trihalomethanes (TTHM) along with VOC testing, and test results showed no presence of any of these substances in the water from the City's wells. Copies of the VOC and trihalomethanes test results are provided in CHAPTER 10 of this Plan.

Synthetic Organic Chemical (SOC) Monitoring: SOC monitoring is required once every year for the first three years of sampling, per 40 CFR 141.24. Samples are to be taken following water treatment. If no SOCs are detected during the first three years of testing, future monitoring shall be at least once every compliance period. The Department of Health may grant waivers for monitoring requirements. Selah conducted SOC testing on its source wells as shown in Table 3-10.

TABLE 3-10 SOURCE WELL SOC TESTING

Well No. 3 & 4 (S05)	Well No. 5 (S03)	Well No. 6 (S04)	Well No. 7 (S06)	Well No. 8 (S07)
05/2009	05/2009	08/2009	05/2009	11/2009
	06/2001			
	10/1998			

Test results show the City to be in compliance with State standards, and showed no presence of any of these substances in the water from the City's wells. A copy of the SOC analysis test results is provided in CHAPTER 10 of this Plan.

Radionuclide Monitoring: Radionuclide monitoring is required at each source once every three years, per 40 CFR 141.26. The Department of Health may reduce monitoring requirements to once every six or nine years based on criteria set forth in 40 CFR 141.26. Well Nos. 5, 6, 7, and 8 radionuclide monitoring requirements have been reduced to once every six years. Selah has completed radionuclide testing on its source wells as shown in Table 3-11.

TABLE 3-11 SOURCE WELL RADIONUCLIDE TESTING

Well No. 3 & 4 (S05)	Well No. 5 (S03)	Well No. 6 (S04)	Well No. 7 (S06)	Well No. 8 (S07)
05/2009	05/2011	08/2009	05/2009	06/2011
08/2007	11/2010	11/2004	11/2004	11/2009
11/2004	08/2007	07/2001	07/2003	
07/2001	11/2004		07/1995	
	07/2001			

Test results show the City to be in compliance with State standards. A copy of the radionuclide analysis test results is provided in CHAPTER 10 of this Plan.

3.2.2 Distribution System Sampling and Testing

Bacteriological: Drinking water samples are required to be collected monthly at various locations throughout the water distribution system for bacteriological analysis in accordance with the City's *Coliform Monitoring Plan*. The minimum number of samples required for collection by a water utility is based on the population served. The Department of Health regulations require water systems serving a population of 8,501 to 12,900 to take a minimum of ten (10) samples per month when no samples with a coliform presence are collected previous month. The City of Selah is required to sample a minimum of ten (10) locations within the distribution system. The *Coliform Monitoring Plan* and representative copies of bacteriological analysis results are provided in CHAPTER 10 of this Plan.

Disinfection Byproducts (DBPs): Selah adds chlorine to its drinking water to kill or inactivate harmful organisms that may cause various diseases, and this process is known as disinfection. However, chlorine is a very active substance and it reacts with naturally occurring substances to form compounds known as disinfection byproducts. The most common disinfection byproducts formed when chlorine is used are trihalomethanes (TTHMs) and haloacetic acids (HAA5).

In 2006, EPA enacted new rules for disinfection byproducts monitoring, known as the Stage 2 Rule. Under the Stage 2 Rule, water systems must monitor at locations with the highest averages of total trihalomethanes (TTHMs) and haloacetic acids (HAA5). To determine these locations, the Stage 2 Rule required many systems to complete an Initial Distribution System Evaluation (IDSE). However, the City of Selah was exempt from the IDSE requirement as its 40/30 certification was approved by EPA, demonstrating low historical TTHM and HAA5 distribution system concentrations. The City is required to begin routine Stage 2 monitoring starting with the year following October 1, 2013. Two dual sample sets of TTHM and HAA5 samples are required at each of two locations annually. The City has identified the sampling locations and schedules in the *Stage 2 DBP Monitoring Plan* provided in CHAPTER 10 of this Plan. The compliance determination for the Stage 2 Rule is based on a locational running annual average (LRAA), meaning compliance must be met at each monitoring location instead of the system-wide running annual average (RAA) used under the Stage 1 Rule.

Results from the latest (2012) monitoring indicated that none of the samples exceeded the federal action levels of 0.080 mg/l for TTHMs and 0.060 mg/l for HAA5 under the Stage 1 DBP Rule. Table 3-12 provides a summary of the 2012 and 2011 TTHMs and HAA5 monitoring results, which are also provided in CHAPTER 10 of this Plan.

TABLE 3-12 TTHM AND HAA5 PROGRAM SUMMARY OF RESULTS
(all values are in milligrams per liter)

Year	Sample Locations	TTHM	HAA5
2012	1111 Crestview Dr	0.0022	ND
	701/703 Jamie Dr	0.0033	ND
	815 S 4th St Loop	0.0052	ND
	1705 W Orchard	0.0024	ND
2011	1111 Crestview Dr	0.0038	ND
	701/703 Jamie Dr	ND	ND
	815 S 4th St Loop	0.0028	ND
	1705 W Orchard	0.0040	ND

* ND means not detected

Lead and Copper: Lead and copper sampling is required once every three years as approved by the Department of Health, per 40 CFR 141.86. In 1997, Selah began a tap water lead and copper monitoring program to determine the lead and copper concentrations in drinking water to which its customers may be exposed. In 2011, thirty-two (32) samples were collected from various locations throughout the water system and tested for concentrations of lead and copper. Results from the latest (2011) monitoring indicated that none of the samples exceeded the federal action levels of 1.3 mg/l for copper and 0.015 mg/l for lead. Table 3-13 provides a summary of the 2011 copper and lead monitoring results, which are also provided in CHAPTER 10 of this Plan. Test results from the 1997, 1998, 2002, 2005, and 2008 are also provided in CHAPTER 10.

TABLE 3-13 LEAD AND COPPER MONITORING PROGRAM SUMMARY OF RESULTS (all values are in milligrams per liter)			
Sample Number	Sample Location	Year 2011	
		Copper (Federal Action Level 1.3 mg/l)	Lead (Federal Action Level 0.015 mg/l)
1	1705 Cedar Lane	0.0950	<0.0005
2	905 W Goodlander Circle	0.0539	0.00129
3	201 Selah Ave	0.202	<0.0005
4	111 13th St	0.106	0.00919
5	807 W Naches Ave	0.174	0.00080
6	141 E Naches Ave	0.00808	<0.0005
7	609 N 14th St	0.117	0.00485
8	302 W Selah Ave	0.0818	<0.0005
9	410 N 10th St	0.0168	0.00465
10	207 S 3rd St	0.0116	<0.0005
11	206 Anchor Loop	0.157	0.00149
12	219 E 1st Ave	<0.002	<0.0005
13	1410 W Cherry Ave	0.276	0.00141
14	1110 Crestview Dr	0.0444	0.00072
15	511 Viewcrest Pl	0.0175	0.00087
16	505 Lacey Ave	0.0828	<0.0005
17	131 E Fremont Ave	0.00331	<0.0005
18	1108 W Pear Ave	0.109	<0.0005
19	801 W Pear Ave	0.00333	0.00128
20	113 W Naches Ave	0.00217	0.00082
21	9 N 10th St	0.0744	0.00050
22	203 Southern Ave	0.00397	0.00181
23	201 S 1st	0.0156	<0.0005
24	403 N 4th St	<0.002	0.00054
25	1105 W Goodlander Rd	0.116	0.00113
26	222 S Railroad Ave	0.0130	0.00134
27	206 W Fremont Ave	0.136	<0.0005
28	1412 W Cherry Ave	0.0832	0.00078
29	216 S 1st	0.0395	<0.0005
30	707 Daugherty Pl	0.00796	<0.0005
31	513 Harris Ave	0.0476	<0.0005
32	205 W Fremont	0.00242	0.00115

3.2.3 Future Source Water and Distribution System Sampling and Testing

A summary of future source and distribution system monitoring requirement frequencies, dates and sample status, as provided in the City's *Water Quality Monitoring Report for the Year 2013* (WQMR), is provided below in Table 3-14 and Table 3-15, respectively. A copy of the City's 2013 WQMR is provided in CHAPTER 10 of this Plan.

TABLE 3-14 FUTURE SOURCE WATER SAMPLING REQUIREMENTS				
Sample Type	Frequency	Last Sample	Next Sample	Status
Well No. 5 (S03)				
Inorganic Chemicals (IOCs)*	Once/9 years	August 2007	August 2016	Within MCLs
Nitrate/Nitrite	Once/Year	October 2013	October 2014	Within MCLs
Volatile Organic Chemicals (VOCs)*	Once/6 Years	July 2010	July 2016	Within MCLs
Synthetic Organic Chemicals (SOCs)*	Once/9 Years	May 2009	May 2018	Within MCLs
Gross Alpha	Once/3 Years	May 2011	March 2016	Within MCLs
Radium 228	Once/6 Years	May 2011	May 2017	Within MCLs
Well No. 6 (S04)				
Inorganic Chemicals (IOCs)*	Once/9 years	September 2006	September 2015	Within MCLs
Nitrate/Nitrite	Once/Year	October 2013	October 2014	Within MCLs
Volatile Organic Chemicals (VOCs)*	Once/6 Years	July 2010	July 2016	Within MCLs
Synthetic Organic Chemicals (SOCs)*	Once/9 Years	August 2009	August 2018	Within MCLs
Radium 228	Once/6 Years	August 2009	August 2015	Within MCLs
Well Nos. 3 and 4 (S05)				
Inorganic Chemicals (IOCs)*	Once/9 years	August 2007	August 2016	Within MCLs
Nitrate/Nitrite	Once/Year	September 2013	September 2014	Within MCLs
Volatile Organic Chemicals (VOCs)*	Once/6 Years	July 2010	July 2016	Within MCLs
Synthetic Organic Chemicals (SOCs)*	Once/9 Years	May 2009	May 2018	Within MCLs
Gross Alpha	Once/3 Years	May 2009	April 2014	Within MCLs
Radium 228	Once/3 Years	May 2009	June 2014	Within MCLs
Well No. 7 (S06)				
Inorganic Chemicals (IOCs)*	Once/9 years	August 2007	August 2016	Within MCLs
Nitrate/Nitrite	Once/Year	August 2013	August 2014	Within MCLs
Volatile Organic Chemicals (VOCs)*	Once/6 Years	May 2009	May 2015	Within MCLs
Synthetic Organic Chemicals (SOCs)*	Once/3 Years	May 2009	May 2018	Within MCLs
Gross Alpha	Once/6 Years	May 2009	May 2015	Within MCLs
Radium 228	Once/6 Years	May 2009	May 2015	Within MCLs
Well No. 8 (S07)				
Inorganic Chemicals (IOCs)	Once/3 Years	September 2012	September 2016	Within MCLs
Nitrate/Nitrite	Once/Year	September 2013	September 2014	Within MCLs
Volatile Organic Chemicals (VOCs)	Once/3 Years	September 2011	September 2015	Within MCLs
Synthetic Organic Chemicals (SOCs)*	Once/3 Years	November 2009	July 2015	Within MCLs
Gross Alpha	Once/6 Years	June 2011	June 2017	Within MCLs
Radium 228	Once/6 Years	June 2011	June 2017	Within MCLs
* Waiver through next sample date.				

TABLE 3-15 FUTURE DISTRIBUTION SYSTEM SAMPLING REQUIREMENTS				
Sample Type	Frequency	Last Sample	Next Sample	Status
Coliform Bacteria	10/Month	April 2014	May 2014	Within MCLs
Disinfection Byproducts[a]	2 dual sample sets/Year	July 2013	July 2014	Within MCLs
Lead & Copper	1 set of 30 samples/3 Years	September 2011	September 2014	No Exceedance
Asbestos	Waiver[b]	N/A	N/A	N/A

[a] Two dual sample sets of TTHM and HAA5 samples are required at each of two locations annually, Stage 2 Rule.
[b] Waived through December 2019.

Future sampling requirements are discussed further in CHAPTER 6 of this Plan. The City's 2012 and future WQMRs should be consulted regarding the dates for future testing.

3.3 SYSTEM DESCRIPTION AND ANALYSIS

The existing City of Selah domestic water system consists of seven distribution pressure zones, as shown in Figure 3-1 Static Pressure Zone Map, all of which provide a minimum of 30 psi static service elevation, as required by Department of Health. Information on those seven pressure zones including their service elevations, pressure ranges, and how each zone is served is provided in Table 3-16.

TABLE 3-16 SELAH WATER SYSTEM PRESSURE ZONE INFORMATION				
Service Pressure Zone	Supply Source	Storage Reservoirs	Highest Service Elevation (Static Pressure)	Lowest Service Elevation (Static Pressure)
Zone 1	Six (6) Groundwater Wells (Nos. 3, 4, 5, 6, 7 & 8)	North and Palm Park Reservoirs (OF Elev. 1,305.7 ft.)	1,200 ft. (45 psi)	<1,100 ft. (89 psi)
Zone 2	From Zone 3 via Multiple Pressure Reducing Valves	Brader Hill and Goodlander Reservoirs (OF Elev. 1,489.1 ft.)	1,300 ft. (40 psi)	1,200 ft. (97 psi)
Zone 3	Three (3) Booster Pump Stations (Well No. 6, Hospital Hill, and Palm Park)	Brader Hill and Goodlander Reservoirs (OF Elev. 1,491.8 ft.)	1,390 ft. (43 psi)	1,300 ft. (82 psi)
Zone 4 North Hill Area	From Zone 5 via Pressure Reducing Valves	Brader Hill and Goodlander Reservoirs (OF Elev. 1,491.8 ft.)	1,450 ft. (45 psi)	1,365 ft. (71 psi)
Zone 4 South Hill Area	From Zone 6 via Pressure Reducing Valve	Lookout Point Reservoir (OF Elev. 1,749.5 ft.)	1,480 ft. (44 psi)	1,390 ft. (94 psi)
Zone 5 North Hill Area	Valhalla Booster Pump Station	Valhalla Heights Reservoir (OF Elev. 1,666.0 ft.)	1,560 ft. (37 psi)	1,480 ft. (82 psi)
Zone 5 South Hill Area	From Zone 6 via Future Pressure Reducing Valves	Lookout Point Reservoir (OF Elev. 1,749.5 ft.)	1,560 ft. (47 psi)	1,480 ft. (82 psi)
Zone 6 North Hill Area	Future Zone 6 Constant Pressure Booster Pump Station	Valhalla Heights Reservoirs (OF Elev. 1,666.0 ft.)	1,650 ft. (47 psi)	1,560 ft. (86 psi)
Zone 6 South Hill Area	Brader Hill Booster Pump Station	Lookout Point Reservoir (OF Elev. 1,749.5 ft.)	1,650 ft. (47 psi)	1,560 ft. (86 psi)
Zone 7	Future Zone 7 Constant Pressure Booster Pump Station	Lookout Point Reservoir (OF Elev. 1,749.5 ft.)	1,730 ft. (51 psi*)	1,650 ft. (86 psi*)

* Estimated future pressure range.

The City is supplied water from six primary source wells. The maximum pumping capacity of the six primary wells is 6,350 GPM or 9.14 million gallons per day, although normal production is limited to 5,500 GPM or 7.92 million gallons per day due to the City's total existing certificated water rights equaling 5,500 GPM and 4,760 acre-feet per year (1,551 million gallons). Further discussion on the City's existing water rights is provided in CHAPTER 4 of this Plan.

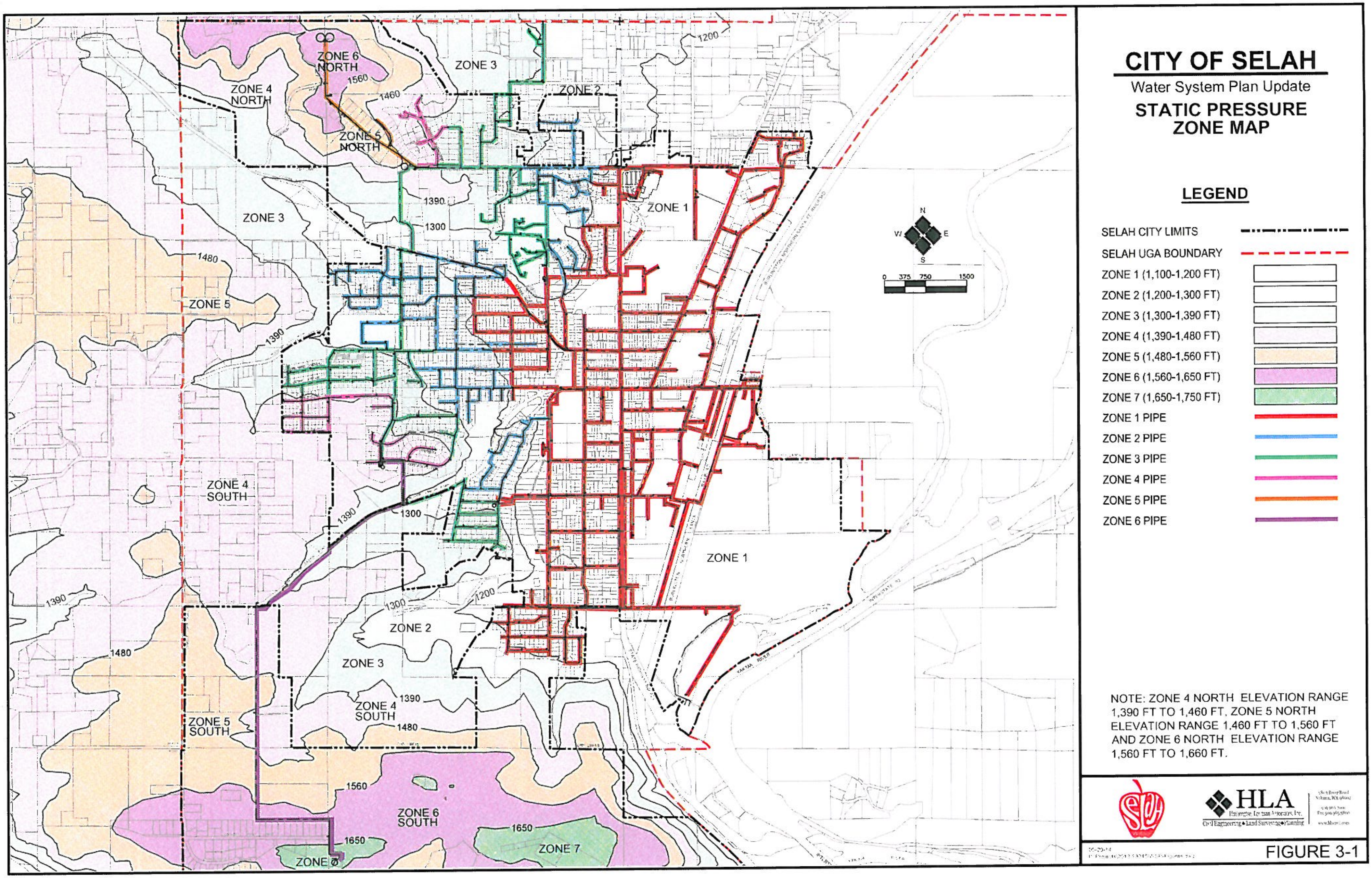
Water storage is provided by eight reservoirs within Selah's water system. The lowest pressure level (Zone 1) is served by three reinforced concrete reservoirs with the combined capacity of 1,022,000 gallons. Water from Zone 1 is boosted into the Zone 3 pressure level through three booster pump stations with a combined capacity of 2,850 GPM. Two reinforced concrete reservoirs serve Zones 2 and 3 with the combined capacity of 1,200,000 gallons. Zone 2 is supplied from Zone 3 through pressure reducing valves. Water from Zone 3 is boosted into the Zone 6 South pressure level through one duplex booster pump station with a capacity of 1,000 GPM. One steel reservoir serves Zones 4 and 6 with a capacity of 1,192,000 gallons. Water from Zone 3 is also boosted into the Zone 5 North pressure level through one duplex booster pump station with a capacity of 500 GPM. Zone 4 North is supplied from Zone 5 North through pressure reducing valves. Two reinforced concrete reservoirs serve Zone 5 North with a total capacity of 317,000 gallons. Selah's total reservoir capacity is 3,731,000 gallons.

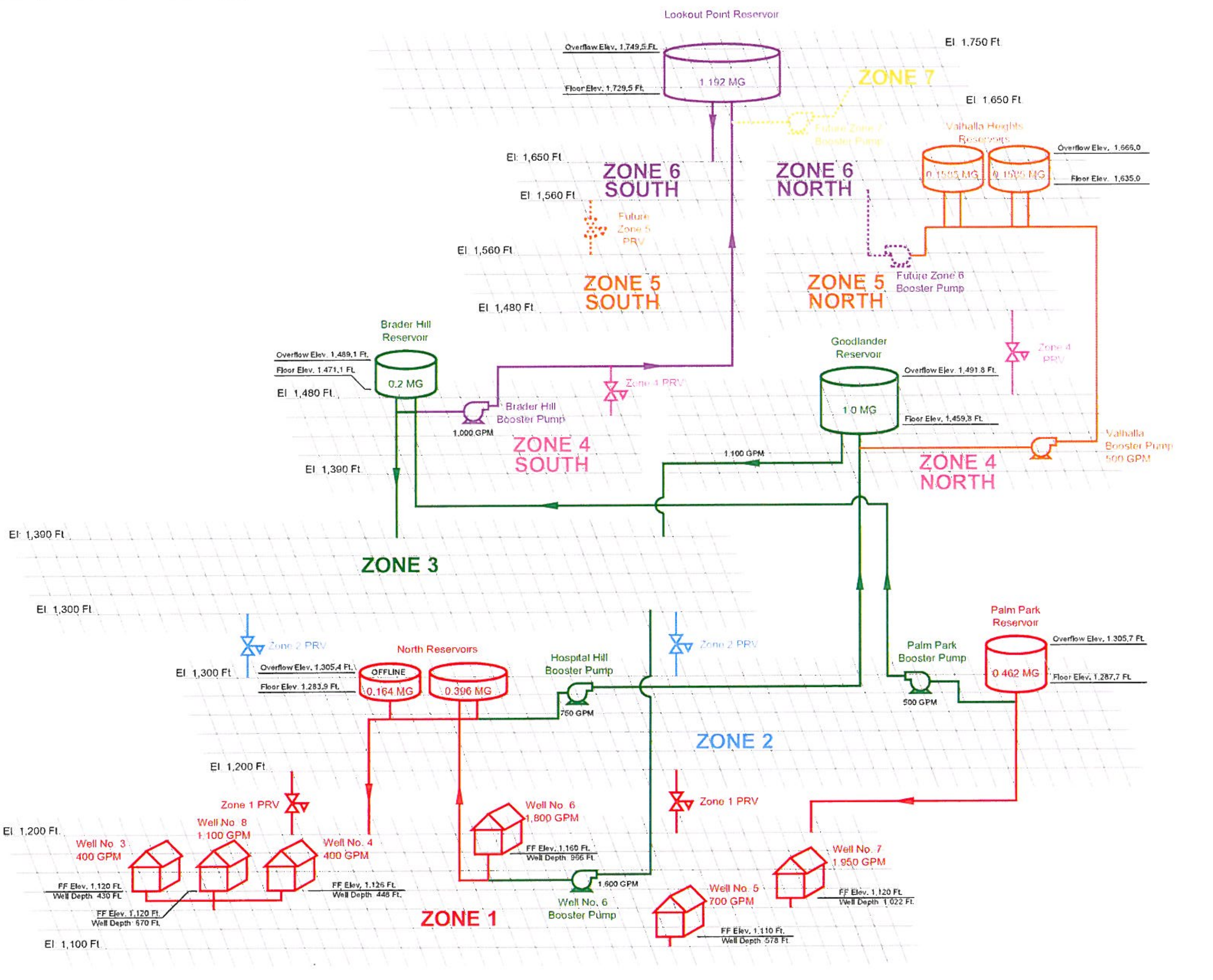
During normal operation, static pressures throughout the existing water distribution system range from a low of 37 psi to a high of 97 psi, based upon the reservoir overflow elevations, booster pump stations, and pressure reducing valves.

The entire water system is controlled by a comprehensive PLC (Programmable Logic Controller) based telemetry system. PLC telemetry units are located at all system wells, booster stations, and reservoirs, and are linked via radio communication. The telemetry system's master control station is located at the City's Public Works Shop.

Selah's water transmission and distribution system is comprised of over 230,000 lineal feet of pipe, ranging in diameter from 1-inch to 16-inch. The system is looped where possible, and a majority of the material is 6-inch or larger ductile iron or cast iron pipe. The layout of Selah's water distribution system, including pipe sizes and valve, hydrant, reservoir, and well locations is shown in Figure 3-1 Static Pressure Zone Map. The maximum water service elevation of the existing system is also indicated in Figure 3-1 Static Pressure Zone Map. An enlarged map (Map A) of the water system is included in CHAPTER 10 of this Plan

Figure 3-2 Water System Schematic, provides a schematic depicting the interrelationship between the water system components. A map of Selah's existing water system is enclosed as Map A in the back pocket of this Plan.


CITY OF SELAH
Water System Plan Update
STATIC PRESSURE ZONE MAP
LEGEND
SELAH CITY LIMITS
SELAH UGA BOUNDARY
ZONE 1 (1,100-1,200 FT)
ZONE 2 (1,200-1,300 FT)
ZONE 3 (1,300-1,390 FT)
ZONE 4 (1,390-1,480 FT)
ZONE 5 (1,480-1,560 FT)
ZONE 6 (1,560-1,650 FT)
ZONE 7 (1,650-1,750 FT)
ZONE 1 PIPE
ZONE 2 PIPE
ZONE 3 PIPE
ZONE 4 PIPE
ZONE 5 PIPE
ZONE 6 PIPE
N
W
E
S
0 375 750 1500
NOTE: ZONE 4 NORTH ELEVATION RANGE 1,390 FT TO 1,460 FT, ZONE 5 NORTH ELEVATION RANGE 1,460 FT TO 1,560 FT AND ZONE 6 NORTH ELEVATION RANGE 1,560 FT TO 1,660 FT.
HLA
FIGURE 3-1
ZONE 6 NORTH
ZONE 3
ZONE 2
ZONE 4 NORTH
ZONE 5 NORTH
ZONE 1
ZONE 3
ZONE 5
ZONE 4 SOUTH
ZONE 1
ZONE 2
ZONE 3
ZONE 4 SOUTH
ZONE 5 SOUTH
ZONE 6 SOUTH
ZONE 7
ZONE 7
1200
1560
1460
1390
1300
1480
1390
1390
1300
1390
1300
1200
1480
1390
1480
1560
1650
1650



CITY OF SELAH

Water System Plan Update

WATER SYSTEM SCHEMATIC

HLA

FIGURE 3-2

3.3.1 Water Sources

The City of Selah has six primary source wells, all located on City-owned properties within Service Pressure Zone 1, as shown in Figure 3-1 Static Pressure Zone Map and Map A, enclosed in the back of this Plan. The following are descriptions of the City's wells and pump installations.

Well No. 3 (S01): Well No. 3 is located in the southwest corner of Wixson Park at the west end of Selah Avenue as shown in Figure 3-1 Static Pressure Zone Map and Map A. Drilled in 1944, the well is 430 feet deep, and had a static water level of 40 feet deep in 1976. As a result of reduced capacity, the old well pump was replaced in 1993 with a 10-stage Peerless deep well vertical turbine pump. The current pump is powered by a 100 horsepower, 460 volt, 3 phase, 1,760 RPM U.S. Motor, and has a capacity of 700 GPM at a total dynamic head of 390 feet, although production is kept to 400 GPM to reduce the production of sand. The existing Worthington Pump discharge head was used at the surface in lieu of a Floway discharge head.

The pump is housed in an in-ground concrete vault which is ventilated but not heated. The discharge piping runs to a concrete block building where the pump controls, valving, and chlorination equipment are housed. A check valve and an air release valve are installed in the discharge piping in this building, along with a Wallace & Tiernan automatic gas chlorinator located in an adjacent room. An electromagnetic flow meter is installed on a common discharge line with Well No. 4.

Well No. 4 (S02): Well No. 4 is located at the west edge of Wixon Park immediately north of Well No. 3, as shown in Figure 3-1 Static Pressure Zone Map and Map A. Drilled in 1947, the well is 292 feet deep, and had a static water level of 60 feet deep in 1976. As a result of reduced capacity, the old 5-stage Fairbanks Morris well pump was replaced in 1993 with a new 10-stage Peerless deepwell vertical turbine pump powered by a 100 horsepower, 460 volt, 3-phase, 1,760 RPM U.S. Motor. In 2001 the vertical turbine pump was replaced with a submersible pump that is powered by a 60 horsepower, 460 volt, 3-phase, 3,370 RPM Hitachi motor, and has a capacity of 700 GPM at a total dynamic head of 390 feet, although production is kept to 400 GPM to reduce the production of sand.

The pump is housed in an in-ground concrete vault which is ventilated but not heated. The discharge piping runs to a concrete block building where the pump controls, valving, and chlorination equipment are housed. A check valve and an air release valve are installed in the discharge piping in this building, along with a Wallace & Tiernan automatic gas chlorinator located in an adjacent room. An electromagnetic flow meter is installed on a common discharge line with Well No. 3.

Well No. 5 (S03): Well No. 5 is located at the northwest corner of the intersection of First Avenue and Railroad Avenue, as shown in Figure 3-1 Static Pressure Zone Map and Map A. Drilled in 1951, the well is 578 feet deep, and had a static water level of 15 feet deep in 1986. The submersible turbine pump is a 6-stage Flowserve "Pleuger" Model QN83-6a (7.75" bowl size) with NORYL impellers, which was purchased in 2012. The pump has a 75 horsepower, 480 volt, 3-phase, 3,600 RPM submersible motor, also a Flowserve "Pleuger". The well was rehabilitated in 2012 including a new pump, motor, and level transducer. The capacity of the pump is approximately 700 GPM.

The pump is housed in a part concrete block, part wood frame building which is ventilated and heated. The wood framed walls and roof are removable. A Bailey "deepwell type" pump control valve is installed off the discharge piping. A by-pass line from this valve discharges into the City's storm drain system. A check valve and air release valve are installed within the discharge piping, as is a Filtomat in-line filter for the removal of sand from the water. An in-line Sparling flow meter is installed outside the pumphouse in a concrete piping pit. A Wallace & Tiernan automatic gas chlorinator, which injects into the discharge piping, is located in an adjacent room.

Well No. 6 (S04): Well No. 6 is located at the northwest corner of the intersection of Fifth Street and Speyers Road as shown in Figure 3-1 Static Pressure Zone Map and Map A. Drilled in 1960, the well is 966 feet deep, and had a static water level of 30 feet deep in 1976. The deepwell turbine pump is an 8-stage Worthington 12 HH (12" bowl size) which was installed in 1981, and rebuilt in 2009 when the Well No. 6 Booster Pump Station was constructed. The pump is powered by a 200 horsepower, 460 volt, 3-phase, 1,800 RPM U.S. Motor. The current capacity of the pump is approximately 1,800 GPM. The well is equipped with probe tubes and a level transducer.

The well is housed in a pump station building (shared with the Zone 3 booster pumps) which is ventilated, and has heat and air conditioning. The well is equipped with a Lakos Model IHB-0810 centrifugal-action vortex sand separator. Check valves and air release valves are installed in the discharge piping within the building. An in-line Krohne Optiflux 2000 electromagnetic flow meter is installed on the discharge pipe. A separate room within the building houses the automatic gas chlorinator.

Well No. 7 (S06): Well No. 7 is located at the northeast corner of Carlon Park, adjacent to Goodlander Road, as shown in Figure 3-1 Static Pressure Zone Map and Map A. Drilled in 1994, the well is a flowing artesian, with a shut-in pressure of 15 psi. The well was drilled to a depth of 1,011 feet, and cased to a depth of 594 feet. The horizontally mounted, split-case, centrifugal Paco Type KP booster pump (Model No. 6015-1) is powered by a 150 horsepower, 460 volt, 3 phase, 60 hertz, 1,750 RPM motor. The capacity of the pump is 1,950 GPM at a total dynamic head of 220 feet.

The pump is housed in a masonry block building in Carlon Park. The building is heated and ventilated. A 12-inch McCrometer flow meter is installed in the discharge line. A Regal automatic gas chlorinator, which injects into the discharge piping, is located in an adjacent room.

Well No. 8 (S07): Well No. 8 is located between Well Nos. 3 and 4 within Wixson Park as shown in Figure 3-1 Static Pressure Zone Map and Map A. Drilled in 2009, the well is a flowing artesian, and had artesian pressure of 0.5 feet above ground at the time of construction. The well was drilled to a depth of 670 feet, and cased to a depth of 594 feet. A submersible turbine pump was installed in 2010 and is a Goulds Model 9TLC powered by a Hitachi 200 horsepower, 460 volt, 3 phase, 42 hertz, 3,600 RPM motor. The capacity of the pump is 1,100 GPM at a total dynamic head of 500 feet.

The wellhead is housed in an above-ground utility box on a concrete pad. The piping runs to an adjacent in-ground meter vault where an electromagnetic flow meter is installed on the discharge pipe. Chlorine solution pex pipe is routed from the electrical control building to the meter vault where an injection assembly is attached to the discharge piping. A check valve, sample tap, and pressure transmitter assembly are installed on the discharge piping in the meter vault.

A summary of Selah's source wells, including well depth, current static water levels and capacity is provided in Table 3-17 below.

TABLE 3-17 SELAH SOURCE WELL INFORMATION SUMMARY						
	Well No. 3 (S01)	Well No. 4 (S02)	Well No. 5 (S03)	Well No. 6 (S04)	Well No. 7 (S06)	Well No. 8 (S07)
Date Drilled	1944	1947	1951	1960	1994	2009
DOE Well Tag ID Number	AFK978	AFK968	AFK982	ABR091	AFK967	AAS171
Ground Elevation	1,118 feet	1,125 feet	1,110 feet	1,156 feet	1,116 feet	1,121 feet
Well Depth	430 feet	448 feet	578 feet	966 feet	1,022 feet	670 feet
Depth to First Open Interval	321 feet	131 feet	201 feet	86 feet	274 feet	297 feet
Casing Size/Depth	16-inch diam. 0-316 feet 12-inch diam. to 376 feet 10-inch diam. to 430 feet	20-inch diam. 0-100 feet 12-inch diam. to 448 feet	24-inch diam. 0-70 feet 16-inch diam. to 555 feet	20-inch diam. 0-526 feet 16-inch diam. to 537 feet 10-inch diam. to 776 feet 8-inch diam. to 918 feet	26-inch diam. 0-140 feet 20-inch diam. to 293 feet 16-inch diam. to 594 feet 12-inch diam. 585-745 feet	16-inch diam. 0-304 feet 10-inch diam. to 670 feet
Static Water Level, Year (below ground surface)	40 feet, 1976	60 feet, 1976	15 feet, 1986	30 feet, 1976	-34.6 feet (artesian), 1994	-0.50 feet (artesian), 2010
Initial Flow @ Drawdown	85 GPM @ artesian pressure	1,430 GPM @ 97 feet	1,400 GPM @ 150 feet	1,500 GPM @ 110 feet	1,900 GPM @ -1.0 feet (artesian pressure)	1,100 GPM @ 183 feet
Current Capacity	400 GPM	400 GPM	700 GPM	1,800 GPM	1,950 GPM	1,100 GPM

3.3.2 Water Treatment

Selah provides no treatment of its water supply other than disinfection. Disinfection of the City's water is accomplished through chlorination of the source water as it enters the City's distribution system. Each City well is equipped with a gas chlorinator which injects chlorine into the discharge piping of each well. Information on each chlorinator is included, along with the descriptions of each well.

3.3.3 Booster Stations

Water is supplied to the Zone 3 pressure level through three booster pump stations, the Hospital Hill Booster Pump Station, the Palm Park Booster Pump Station, and the Well No. 6 Booster Pump Station. The Hospital Hill Booster Pump Station, located at the North Reservoirs (shown in Map A), has one 5" x 6" PACO Model 5015-5, 75 horsepower, 230 volt, 3 phase, 1,800 RPM split-case pump. The original 1978 pump was replaced with an identical pump in 1993, and has a capacity of 750 GPM.

The Palm Park Booster Pump Station, located at the Palm Park Reservoir (at the southwest corner of the intersection of Hillcrest Drive and Sixth Avenue, shown in Map A), has one 4" Cornell Model 4WB50-2, 50 horsepower, 230 volt, 3 phase, 3,600 RPM centrifugal pump. Installed in late 1967, this station has a capacity of 500 GPM at 200 feet of head.

The Well No. 6 Booster Pump Station, located at the Well No. 6 site (at the northwest corner of the intersection of Fifth Street and Speyers Road), has two Peerless Model 6AE16G split-case centrifugal booster pumps with 100 horsepower, 460 volt, 3 phase, 1,800 RPM Baldor motors. Installed in 2009, this station has a capacity of 1,600 GPM.

Water is supplied to the Zone 6 South pressure level through one duplex booster station located at the Brader Hill Reservoir (shown in Map A). The Brader Hill Pump Station contains two Grundfos Model CR90, 50 horsepower, 480 volt, 3 phase, 60 hz, 3,500 RPM pumps. Installed in 2005, each pump has a capacity of 500 GPM at 300 feet of head. The total capacity of the station is 1,000 GPM.

Water is supplied to the Zone 5 North pressure level through one duplex booster station located at the Goodlander Reservoir (shown in Map A). The Valhalla Booster Pump Station contains two Grundfos Model CR45-3-1, 25 horsepower, 60 hz, 3,500 RPM centrifugal pumps. Installed in 2009, each pump has a capacity of 250 GPM at 250 feet of head. The total capacity of the station is 500 GPM.

3.3.4 Pressure Reducing Valves

A number of pressure reducing valves (PRVs) are installed within the City's water system to feed water at an acceptable pressure from the Zone 3 pressure level to the Zone 2 level, and from the Zone 6 and Zone 5 levels to the Zone 4 level. PRVs are also installed between Zone 2 and Zone 1 to allow water to flow to Zone 1 under fire flow or emergency conditions. All of the PRVs have been manufactured by Cla-Val Co., and are housed in concrete vaults. Information on the City's pressure reducing valves is provided in Table 3-18.

TABLE 3-18 PRESSURE REDUCING VALVE SETTINGS						
Valve No.	Valve Location	Zone	Valve Size	Year Installed	Original Setting / Recorded[d] Inlet Pressure (psi)	Original Setting / Recorded[d] Outlet Pressure[a] (psi)
1	114 West Goodlander Rd.	1	12"	1978[b]	90 / 84	35 back 42 / 35
2 3	Goodlander Rd. & North 4th St.	2	8" 3"	1998	93 / 89 93 / 89	47 / 44 52 / 51
4 5	514 North 4th Street	2	6" 2"	1998	120 / 128 120 / 128	70 / 60 75 / 50
6 7	1401 West Fremont Ave.	2	10" 3"	1998	86 / 88 86 / 88	39 / 38 46 / 45
8	North 13th St. & W. Cherry Ave.	2	6"	1986[b]	70 / 110	65 / 60
9	North 13th St. & Home Ave.	2	3"	1998	100 / 100	58 / 60
10 11	105 South 10th Street	2	6" 2"	1998	84 / 80 84 / 80	37 / 40 42 / 40
12 13	West 5th Ave. & South 10th St.	2	6" 2"	1998	115 / 108 115 / 108	66 / 60 71 / 65
14	North 9th St. & West Pear Ave.	1	4"	1998[c]	95 / 60	42 / 45
15	702 West Orchard Ave.	1	6"	1998[c]	82 / 94	37 / 50
16	Alley Behind Lince School	1	4"	1998[c]	120 / 110	68 / 80
17	1701 W Naches Ave.	3	6"	2005	85 / 75	40 / 40
18 19	Brader Hill Pump Station	4	8" 2"	2005	120 120	35 40
22 23	Valhalla Pump Station	4	6" 2"	2009	NA[e]	44 / NA[e] 49 / NA[e]

[a] Outlet Pressure Settings per City, as of January 2014.
[b] Existing valves rehabilitated in place by GC Systems in 1998.
[c] Rehabilitated valves (by GC Systems) relocated to this location.
[d] Pressures were recorded on January 23, 2014.
[e] Valhalla Pump Station PRV will go online following Goodlander Road Zone 4 Water Main completion.

3.3.5 Storage Facilities

The City's water storage facilities consist of seven reinforced concrete reservoirs and one steel reservoir with a total capacity of 3,731,000 gallons. Water is pumped from all of the City's wells directly into the lowest pressure level (Zone 1) including the three Zone 1 reservoirs (North and Palm Park Reservoirs). Water from Zone 1 is pumped through the Hospital Hill booster station, the Palm Park Reservoir Booster Station, and the Well No. 6 Booster Pump Station into the two Zone 3 reservoirs (Brader Hill and Goodlander). Water from Zone 3 is pumped through the Brader Hill booster station into the Zone 6 reservoir (Lookout Point). Water from Zone 3 is also pumped through the Valhalla booster pump station into the Zone 5 reservoirs (Valhalla Heights). Table 3-19 summarizes information on the City's water storage facilities, descriptions of which are provided below.

TABLE 3-19 WATER RESERVOIR INFORMATION				
Reservoir Name	Pressure Zone	Capacity (gallons)	Floor Elevation (feet)	Overflow Elevation (feet)
North Reservoir (southern)	Zone 1	164,000	1,283.9	1,305.4
North Reservoir (northern)	Zone 1	396,000	1,283.9	1,305.4
Palm Park Reservoir	Zone 1	462,000	1,287.7	1,305.7
Brader Hill Reservoir	Zone 3	200,000	1,471.1	1,489.1
Goodlander Reservoir	Zone 3	1,000,000	1,459.8	1,491.8
Valhalla Heights Reservoir (western)	Zone 5	158,500	1,635.0	1,666.0
Valhalla Heights Reservoir (eastern)	Zone 5	158,500	1,635.0	1,666.0
Lookout Point Reservoir	Zone 6	1,192,000	1,729.5	1,749.5
TOTAL		3,731,000		

See Figure 3-3 Year 2012 Reservoir Storage Levels, for a schematic representation of the year 2012 reservoir level elevations. Figure 3-4 shows anticipated reservoir storage level elevations for the year 2032.

Zone 1 Reservoirs

North Reservoirs: The North Reservoirs are located north of the north end of Fifth Street and west of the Sunrise Addition development (Hillview Avenue), as shown in Map A. They consist of two in-ground reinforced concrete reservoirs, both circular in shape and 22.0 feet deep. The southernmost reservoir is 36 feet in diameter (inside dimension) with a capacity of 164,000 gallons. The northernmost reservoir is 56 feet in diameter (inside dimension) with a capacity of 396,000 gallons. The overflow elevation of each reservoir is 1,305.4 feet above sea level.

Palm Park Reservoir: The Palm Park Reservoir is located at the Southwest corner of the intersection of Hillcrest Drive and Sixth Avenue, as shown in Map A. Constructed in 1952, the Palm Park Reservoir is an above-ground, reinforced concrete, circular reservoir, 66 feet in diameter (inside dimension) and 18 feet tall. The capacity of the reservoir is 462,000 gallons, with an overflow elevation of 1,305.7 feet above sea level.

Zone 3 Reservoirs

Brader Hill Reservoir: The Brader Hill Reservoir is located north of Crusher Canyon Road at the west City Limits, as shown in Map A. Constructed in 1967, the Brader Hill Reservoir is an above-ground, reinforced concrete, circular reservoir, 41.5 feet in diameter (inside dimension) and 18 feet tall. The capacity of the reservoir is 200,000 gallons, with an overflow elevation of 1,489.1 feet above sea level.

Goodlander Reservoir: The Goodlander Reservoir is located at the west end of Goodlander Road, as shown in Map A. Constructed in 1978, the Goodlander Reservoir is a 1,000,000 gallon, above-ground, reinforced concrete, circular reservoir. The inside dimensions are 73 feet in diameter and 32 feet tall, with an overflow elevation of 1,491.8 feet above sea level.

Zone 5 Reservoirs

Valhalla Heights Reservoir: The Valhalla Heights Reservoirs are located north of Goodlander Road at the north City Limits, as shown in Map A. Constructed in 2009, the Valhalla Heights Reservoirs are above-ground, reinforced concrete, circular reservoir, 30 feet in diameter (inside dimension) and 35 feet tall. The reservoirs each have a capacity of 158,500 gallons, with overflow elevations of 1,666.0 feet above sea level.

Zone 6 Reservoir

Lookout Point Reservoir: The Lookout Point Reservoir is located at Lookout Point, as shown in Map A. Constructed in 2005, the Lookout Point Reservoir is an above-ground, circular steel reservoir, 102 feet in diameter (inside dimension) and 20 feet tall. The capacity of the reservoir is 1,200,000 gallons, with an overflow elevation of 1,749.5 feet above sea level.

3.3.6 Telemetry Control System

The entire water system is controlled by a comprehensive PLC (Programmable Logic Controller) based telemetry system, installed in 2001. PLC telemetry units are located at all system wells, booster stations, and reservoirs, and are linked via radio communication. The telemetry system's master control station is located at the City's Public Works Shop.

The source pumps and booster pump stations are controlled by the water level in the operator-selected reservoir for the respective pressure zone. The telemetry control settings for operating the various wells, booster station pumps, and control valves, based on water levels in the reservoirs, are shown in Table 3-20. A copy of the telemetry control system screen print outs are available in CHAPTER 10 of this Plan.

Should source pumps fail to respond as ordered (on or off) by the telemetry system, or a high or low water condition exists in the reservoirs, an alarm is sounded at the City's Public Works Shop. An automatic telephone dialer is also activated which then proceeds to contact preprogrammed telephone numbers of key personnel until the alarm is properly acknowledged.

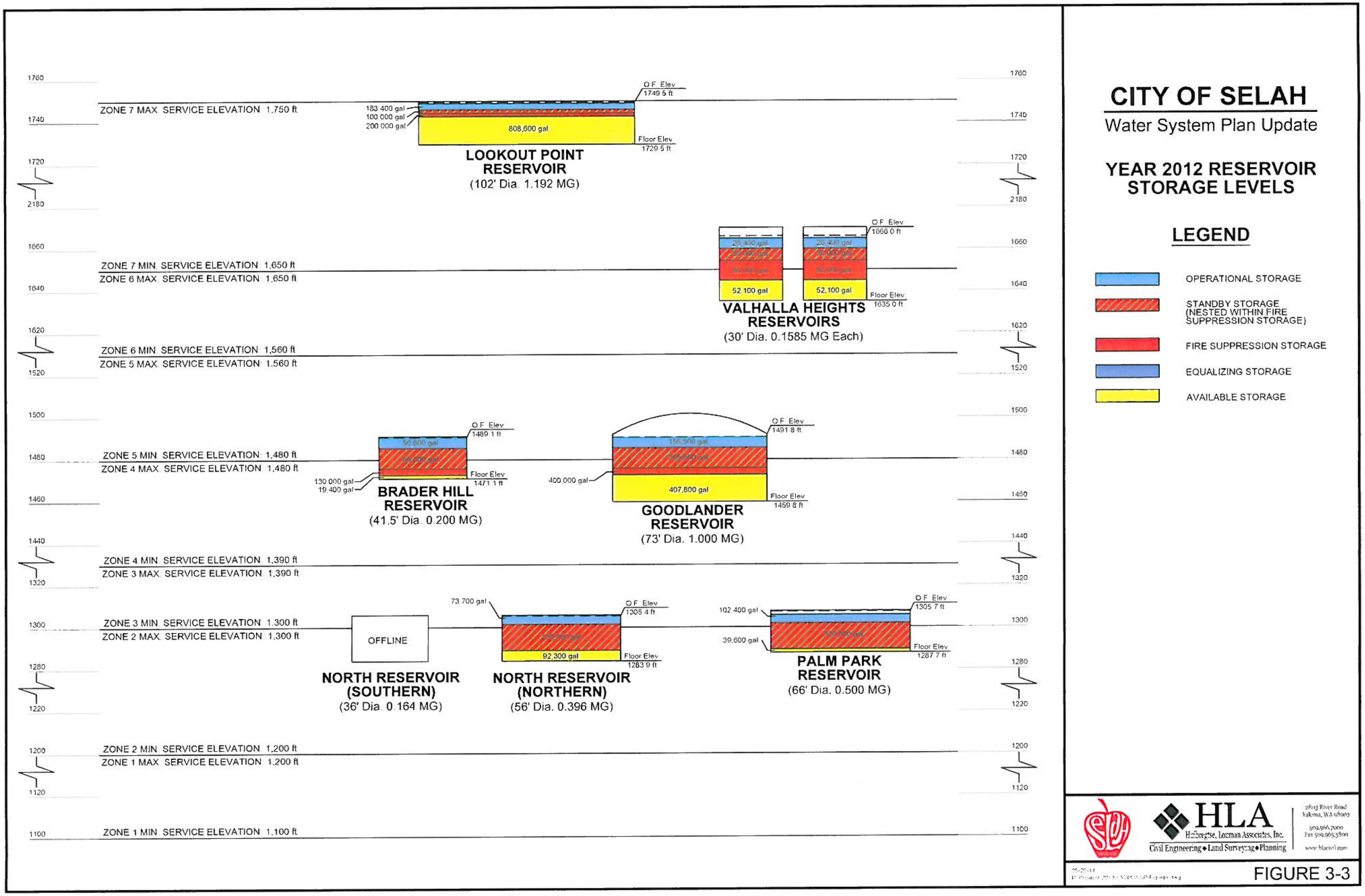
TABLE 3-20 EXISTING TELEMETRY CONTROL SETTINGS BASED ON RESERVOIR LEVELS

(All reservoir levels are in feet)

	Reservoir*									
	North Reservoir		Brader Hill		Goodlander		Valhalla Heights		Lookout Point	
Source Well / Booster Pump	Pump On	Pump Off	Pump On	Pump Off	Pump On	Pump Off	Pump On	Pump Off	Pump On	Pump Off
Well No. 3 (S01)	9.5	16.0								
Well No. 4 (S02)	9.5	16.0								
Well No. 5 (S03)	18.5	19.5								
Well No. 6 (S04)	14.0	19.0								
Well No. 7 (S06)	14.5	18.5								
Well No. 8 (S07)	15.0	18.0								
Well No. 6 Booster Pump			13.0	18.0	25.0	30.0				
Hospital Hill Booster Pump										
Normal Mode			3.0	19.0	24.0	27.0				
Refresh Mode			5.0	19.0	18.0	28.0				
Palm Park Booster Pump										
Normal Mode			12.0	15.0	18.0	28.0				
Refresh Mode			5.0	19.0	17.5	28.0				
Valhalla Booster Pump 1							19.0	20.0		
Valhalla Booster Pump 2							20.0	25.0		
Brader Hill Booster Pump 1 (Lead)									14.5	17.5
Brader Hill Booster pump 2 (Lag)									14.0	17.5
Control Valves**	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
Solenoid Control Valve 1										
Normal Mode			2.0	19.0	20.0	26.0				
Refresh Mode			6.0	19.0	28.5	29.5				
Solenoid Control Valve 2										
Normal Mode			2.0	19.0	19.0	22.0				
Refresh Mode			5.0	19.0	28.5	29.5				

* The level set points in this table represent current normal operating conditions and can be adjusted as necessary to maximize system efficiency with changes in demand.

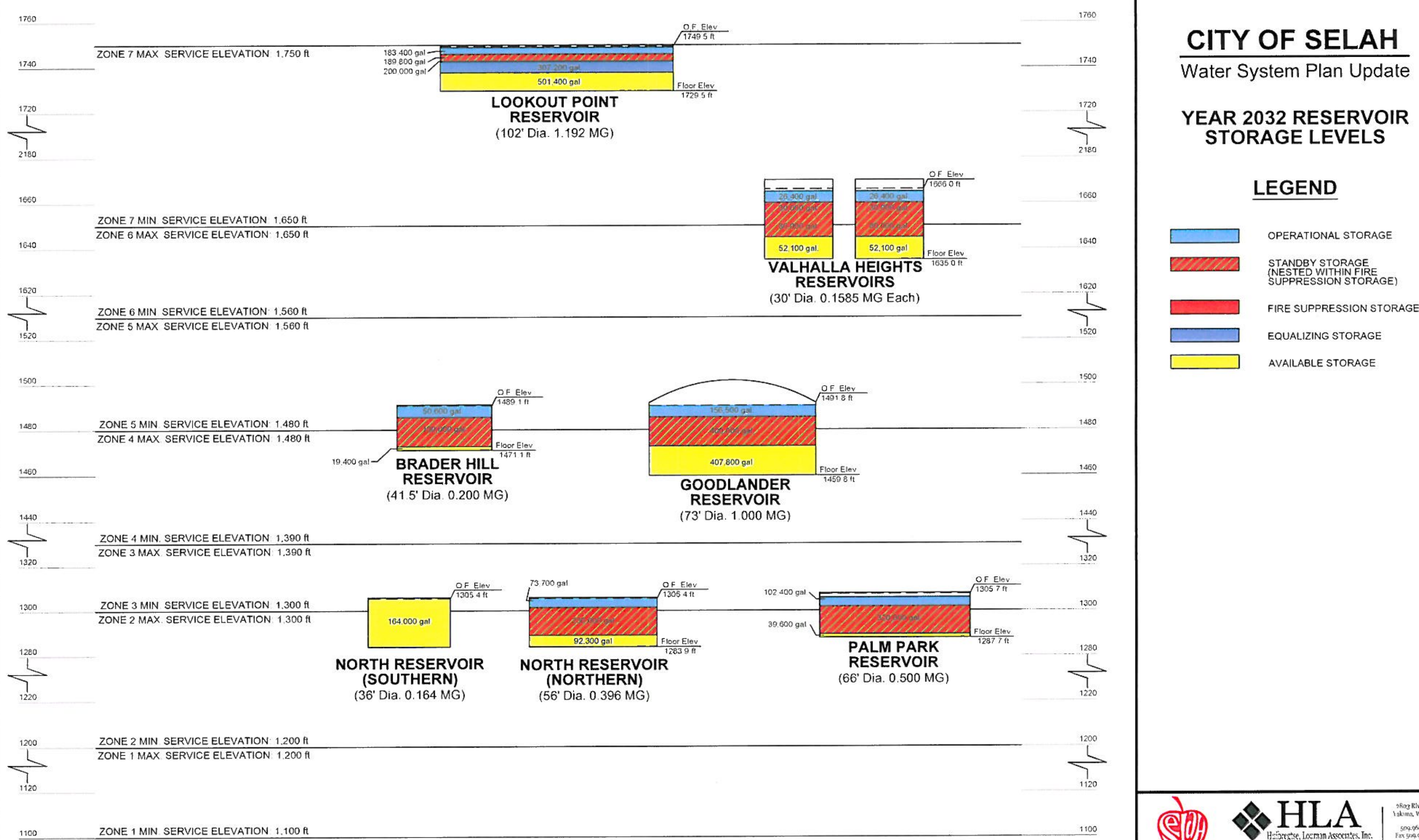
** The solenoid control valve allows water to be fed from the Lookout Point Reservoir (Zone 6) to the Zone 3 reservoirs during refresh mode or during high demand periods in the lower pressure zones. Zone 3 reservoirs are filled by the booster pumps during normal system conditions.



CITY OF SELAH
Water System Plan Update
YEAR 2012 RESERVOIR STORAGE LEVELS
LEGEND
OPERATIONAL STORAGE
STANDBY STORAGE (NESTED WITHIN FIRE SUPPRESSION STORAGE)
FIRE SUPPRESSION STORAGE
EQUALIZING STORAGE
AVAILABLE STORAGE
ZONE 7 MAX SERVICE ELEVATION 1,750 ft
183 400 gal
100 000 gal
200 000 gal
808,600 gal
O F Elev 1749 5 ft
Floor Elev 1729 5 ft
LOOKOUT POINT RESERVOIR
(102' Dia. 1.192 MG)
ZONE 7 MIN SERVICE ELEVATION 1,650 ft
ZONE 6 MAX SERVICE ELEVATION 1,650 ft
52,100 gal
52,100 gal
O F Elev 1660 0 ft
Floor Elev 1635 0 ft
VALHALLA HEIGHTS RESERVOIRS
(30' Dia. 0.1585 MG Each)
ZONE 6 MIN SERVICE ELEVATION 1,560 ft
ZONE 5 MAX SERVICE ELEVATION 1,560 ft
ZONE 5 MIN SERVICE ELEVATION 1,480 ft
ZONE 4 MAX SERVICE ELEVATION 1,480 ft
O F Elev 1489 1 ft
Floor Elev 1471 1 ft
130 000 gal
19,400 gal
BRADER HILL RESERVOIR
(41.5' Dia. 0.200 MG)
O F Elev 1491 8 ft
400 000 gal
407,800 gal
Floor Elev 1459 8 ft
GOODLANDER RESERVOIR
(73' Dia. 1.000 MG)
ZONE 4 MIN SERVICE ELEVATION 1,390 ft
ZONE 3 MAX SERVICE ELEVATION 1,390 ft
ZONE 3 MIN SERVICE ELEVATION 1,300 ft
ZONE 2 MAX SERVICE ELEVATION 1,300 ft
OFFLINE
NORTH RESERVOIR (SOUTHERN)
(36' Dia 0.164 MG)
73 700 gal
O F Elev 1305 4 ft
92,300 gal
Floor Elev 1283 9 ft
NORTH RESERVOIR (NORTHERN)
(56' Dia. 0.396 MG)
102 400 gal
39,600 gal
O F Elev 1305 7 ft
Floor Elev 1287 7 ft
PALM PARK RESERVOIR
(66' Dia. 0.500 MG)
ZONE 2 MIN SERVICE ELEVATION 1,200 ft
ZONE 1 MAX SERVICE ELEVATION 1,200 ft
ZONE 1 MIN SERVICE ELEVATION 1,100 ft
1760
1740
1720
2180
1660
1640
1620
1520
1500
1480
1460
1440
1320
1300
1280
1220
1200
1120
1100
HLA
Huibregtse, Louman Associates, Inc.
Civil Engineering ♦ Land Surveying ♦ Planning
FIGURE 3-3

CITY OF SELAH
Water System Plan Update

YEAR 2032 RESERVOIR STORAGE LEVELS



HLA
Huibregtse, Louman Associates, Inc.
Civil Engineering • Land Surveying • Planning

FIGURE 3-4

3.3.7 Transmission and Distribution Systems

The City's existing transmission and distribution system along with water main sizes, valve, and fire hydrant locations is shown in Figure 3-1 Static Pressure Zone Map and Map A, enclosed in the back pocket of this Plan. Most line sizes within the system are six-inches in diameter or larger. The majority of the City's water mains are constructed of either ductile iron or cast iron pipes, and most are looped except where topography or City limit boundaries make loops impractical. An inventory of the total length of Selah's water distribution system piping, including the length and percentage of each diameter of pipe is presented below in Table 3-21.

TABLE 3-21 WATER DISTRIBUTION SYSTEM PIPE SIZE SUMMARY

Pipe Diameter (inches)	Length (feet)	Percent of Total
1*	899	0.4%
2*	955	0.4%
4	7,304	3.1%
6	52,198	22.4%
8	87,619	37.6%
10	21,194	9.1%
12	57,112	24.5%
16	5,561	2.4%
TOTAL	232,842	100.0%

* Provides distribution to few residences, connected to 6" or larger mains on both sides.

3.4 STORAGE ANALYSIS

Reservoir facilities are necessary in a water utility's system in order to provide required storage in three critical areas:

1. Standby Storage: Adequate water reserves need to be maintained to meet the system's average daily demand in the event the largest water supply source is out of service. Standby storage may be "nested" within the fire suppression storage volume.

2. Fire Suppression Storage: Adequate water reserves need to be maintained to meet the system's highest fire flow requirement with no assistance from existing water supply sources and at a minimum pressure of 20 psi throughout the distribution system. Fire suppression storage may be "nested" within the standby storage volume.

3. Equalizing Storage: Adequate water reserves need to be maintained to meet that portion of the system's maximum instantaneous demand (peak hour), which exceeds the existing water supply source capacity. Equalizing storage must be available to all service connections at a minimum pressure of 30 psi.

Storage facilities also provide a volume of water for supply to the system between source pumping operations. This "operational" volume is established by each utility and is generally based on limiting, as much as practical, the number of pump cycles per hour.

The following storage analysis will first discuss the total water system and will then evaluate storage for the upper pressure zones separately.

3.4.1 Total System Storage Analysis

Standby Storage: The purpose of standby storage is to provide a measure of reliability should sources fail or unusual conditions impose higher demands than anticipated. The Department of Health (DOH) defines standby storage as the volume of stored water available for use during a loss of source capacity, power, or similar short-term emergency.

For communities with multiple sources of supply such as the City of Selah, the Department of Health's (DOH) 2009 *Water System Design Manual* recommends the volume of standby storage should be calculated based upon the following equation:

$$\mathrm{SBTMS} = (2\ \mathrm{days})[(\mathrm{ADD})(\mathrm{N}) - t_m\,(Q_S - Q_L)]$$ (*2009 Water System Design Manual*, Page 103)

Where:
SBTMS = Total standby storage component for a multiple source water system (gallons)
ADD = Average day demand for the design year (GPD/ERUs)
N = Number of equivalent residential users (ERUs)
Q_S = Sum of all installed and continuously available supply source capacities, except emergency sources (GPM)
Q_L = The largest capacity source available to the water system (GPM)
t_m = Time the remaining sources are pumped on the day when the largest source is not available (minutes). Unless restricted otherwise, assume 1,440 minutes

At no time, however, shall standby storage be less than 200 gallons times the number of equivalent residential users (*2009 Water System Design Manual*, Page 103).

When the above standby storage is applied to the existing and projected average day demand (ADD) and ERUs, the resulting standby storage requirements are as shown in Table 3-22.

TABLE 3-22 EXISTING AND FUTURE STANDBY STORAGE REQUIREMENTS

	2012	2018	2022	2032
ADD x 2 Days Storage Subtotal	2.046 MGD x 2 Days 4.091 MG	2.421 MGD x 2 Days 4.843 MG	2.532 MGD x 2 Days 5.065 MG	2.875 MGD x 2 Days 5.757 MG
(Source Supply – Largest Source) x 1440 minutes Supply Subtotal	3,550 GPM* x 1440 min 5.112 MG	3,550 GPM* x 1440 min 5.112 MG	3,550 GPM* x 1440 min 5.112 MG	3,550 GPM* x 1440 min 5.112 MG
Total Standby Storage Required	less than 0	less than 0	less than 0	0.645 MG
Equivalent Residential Units (ERUs) x Min. 200 gal Storage Minimum	5,573 x 200 gal 1.114 MG	6,014 x 200 gal 1.202 MG	6,290 x 200 gal 1.258 MG	7,149 x 200 gal 1.429 MG
Minimum Required Standby Storage	1.114 MG	1.202 MG	1.258 MG	1.429 MG

* Existing water rights source pumping capacity minus Well No. 7 (largest source).

Fire Suppression Storage: The Department of Health (DOH) defines fire suppression storage as the volume of stored water available during fire suppression activities to satisfy minimum pressure requirements per WAC 246-290-230. A volume of storage for fire suppression has been established based on fire flow ratings of various structures within Selah. The storage required is 1,440,000 gallons, which will allow a demand of 6,000 GPM for a 4-hour duration at the Tree Top facility. The fire suppression demand was established by the Selah Fire Department due to building type and size. The DOH minimum fire flow requirement for industrial areas is 1,000 GPM for 60 minutes. The volume of storage necessary to maintain a flow of 6,000 GPM for a 4-hour duration for fire protection is 1,440,000 gallons, which exceeds the DOH industrial requirement of 1,000 GPM for 60 minutes, or 60,000 total gallons (*WAC 246-293-640*) and will, therefore, be used for fire suppression storage planning purposes.

Equalizing Storage: The Department of Health (DOH) defines equalizing storage as the volume of storage needed to supplement supply to consumers when the peak hourly demand exceeds the total source pumping capacity. The DOH design method for calculating equalizing storage is 150 times the difference between the system's peak hour demand (PHD) in GPM and the total source production rate in GPM. Based on this method, the current and future equalizing storage requirements for Selah are as shown in Table 3-23.

TABLE 3-23 EXISTING AND FUTURE EQUALIZING STORAGE REQUIREMENTS				
	Year 2012	Year 2018	Year 2022	Year 2032
Peak Hour Demand	5,341 GPM	6,341 GPM	6,645 GPM	7,548 GPM
- Total Source Capacity*	- 5,500 GPM	- 5,500 GPM	- 5,500 GPM	- 5,500 GPM
Subtotal	less than 0	841	1,145	2,048
DOH Multiplier	x 150 gal/GPM	x 150 gal/GPM	x 150 gal/GPM	x 150 gal/GPM
Equalizing Storage Total	0 gal	0.126 MG	0.171 MG	0.307 MG
* Source capacity limited by water rights.				

Operational Storage: The Department of Health (DOH) defines operational storage as the volume of distribution storage associated with source or booster pump normal cycling times under normal operating conditions and is additive to the equalizing and standby storage components, and to fire flow storage if this storage component exists for any given tank. Currently, the City of Selah operates its lead source within the upper 4 feet of the water level in the Zone 1 reservoirs, the upper 5 feet in the Zone 3 reservoirs, the upper 5 feet in the Zone 5 reservoirs, and the upper 3 feet in the Zone 6 reservoir. This corresponds to a volume of approximately 619,462 gallons, or 111 gallons per ERU (5,573 for year 2012) for normal operational storage. The operational storage volume required to avoid excessive pump cycling only needs to be enough to limit the number of pump starts to six per hour. Under year 2012 MDD the source pumps would turn on only once every five hours and twenty-one minutes (619,462 gallons ÷ MDD x 1,440 min./day + 619,462 gallons ÷ 5,500 GPM = 321 min.) and also once every seven hours and sixteen minutes during ADD. The same operational storage levels will be sufficient to meet 20-year MDD, while keeping source pump cycle time within an appropriate range of approximately two hours and twenty-eight minutes.

Total Storage: Table 3-24 summarizes the year 2012 and future storage requirements for the water system. The year 2012 and future total storage requirements for the years 2018, 2022, and 2032 is less than the City's existing storage capacity of 3.731 million gallons.

TABLE 3-24 YEAR 2012 AND FUTURE TOTAL STORAGE REQUIREMENTS (all storage values are in million gallons)				
	Year 2012 Requirements	Year 2018 Requirements	Year 2022 Requirements	Year 2032 Requirements
Number of ERUs*	5,573	6,014	6,290	7,149
Number of Services	2,447	2,641	2,778	3,154
Standby Storage	1.115	1.203	1.258	1.430
Fire Suppression Storage**	1.440	1.440	1.440	1.440
Equalizing Storage	0.000	0.126	0.172	0.307
Operational Storage	0.619	0.619	0.619	0.619
Total Storage Required	2.059	2.185	2.231	2.366
Total Storage Capacity	3.731	3.731	3.731	3.731
* Based on ADD. ** Standby Storage will be nested with Fire Suppression Storage.				

It can be seen from Table 3-24 that the current available storage capacity is adequate to meet existing and future needs through the year 2032. Also, the required future storage volumes provided in Table 3-24 are based upon the demand projections provided in CHAPTER 2. Additional future storage capacity will be driven by future development.

3.4.2 Combined Zone 2, Zone 3, and Above Supply and Storage Analysis

The supply to and storage of the middle pressure zones (Zone 2 and Zone 3) must be analyzed separately from the total system due to their dependence on booster pump stations for water supply. All of the system's source wells are located in Zone 1.

Supply to Zone 2 and Zone 3 is boosted from Zone 1 through three pump stations. The Hospital Hill Booster Pump Station, the Palm Park Booster Pump Station, and the Well No. 6 Booster Pump Station supply 750 GPM, 500 GPM, and 1,600 GPM respectively. The total supply capacity to Zone 2 and Zone 3 is 2,850 GPM, or 4.104 MGD which exceeds the 2012 maximum day demand of the two pressure zones of 1.114 MGD. The combined pumping capacity of 2,850 GPM is greater than the year 2012 Zone 2 and Zone 3 peak hour demand of 1,393 GPM.

In 2012, these two pressure zones included 939 single-family residential services, 2 commercial services, 2 political subdivision services, outside single-family residential services, 4 apartment services, 4 irrigation only services, 8 federal state government services, 1 outside commercial service, and 1 city service. However, the total demand on Zone 2 and Zone 3 also includes year 2012 and future demand from Zone 4 through Zone 7 as shown in the storage analysis of Table 3-25, Table 3-26, and Table 3-27.

Future supply and storage requirements are based on the location of future services as discussed near the end of CHAPTER 2 of this Plan.

Storage requirements within Zone 2 and Zone 3 consist of the same four components as described previously in the total system storage analysis. Those four components are standby, fire suppression, equalizing, and operational storage. The standby, equalizing, and operational storage components for the Zone 2 and Zone 3 storage analysis must include storage capacity for the upper pressure zones, due to their dependence on Zone 2 and Zone 3 as a source of supply.

Standby Storage: Consistent with standby storage the requirements for the total water system, the requirements for standby storage within Zone 2 and Zone 3 differ when multiple sources of supply are available. Zone 2 and Zone 3 of Selah's water system are currently supplied water by three sources, with a combined rate of 2,850 GPM.

For the 2012 storage requirements, eliminating the largest supply source (Well No. 6 Booster Pump Station) results in a remaining supply capacity of 1,250 GPM. When applied to the 2012 and projected ADD and ERUs, the resulting standby storage requirements are as shown in Table 3-25.

TABLE 3-25 COMBINED ZONE 2, ZONE 3, AND ABOVE STANDBY STORAGE REQUIREMENTS

	2012	2018	2022	2032
Zone 2 & 3 ADD * x 2 Days Storage Subtotal	0.450 MGD x 2 Days 0.901 MG	0.569 MGD x 2 Days 1.138 MG	0.623 MGD x 2 Days 1.248 MG	0.769 MGD x 2 Days 1.538 MG
(Source Supply – Well No. 6 BPS) x 1440 minutes Supply Subtotal	1,250 GPM x 1440 min 1.800 MG	1,250 GPM x 1440 min 1.800 MG	1,250 GPM x 1440 min 1.800 MG	1,250 GPM x 1440 min 1.800 MG
Total Standby Storage Required	less than 0	less than 0	less than 0	less than 0
Equivalent Residential Units (ERUs) * x Min. 200 GPD Storage Minimum	1,227 x 200 0.245 MG	1,414 x 200 0.283 MG	1,546 x 200 0.309 MG	1,910 x 200 0.382 MG
Minimum Required Standby Storage	0.245 MG	0.283 MG	0.309 MG	0.382 MG

* Includes demand/ERUs for Zones 2 through 7.

Fire Suppression Storage: The storage requirement for fire suppression is computed for the highest fire-flow rated structure within these pressure zones of the City. The Selah Intermediate School requires 4,000 GPM for a 2-hour duration, which totals 480,000 gallons of fire suppression storage.

Equalizing Storage: Equalizing storage must also be provided to meet the periodic demands placed on the water system which exceed the source (booster station) pumping capacity. The DOH design method for calculating equalizing storage is 150 times the difference between the system's PHD in GPM and the source production rate in GPM. Based on this method, the year 2012 and future equalizing storage required for Selah's Zone 2, Zone 3, and above are shown in Table 3-26.

TABLE 3-26 COMBINED ZONE 2, ZONE 3, AND ABOVE EQUALIZING STORAGE REQUIREMENTS

	2012	2018	2022	2032
Peak Hour Demand *	1,582 GPM	2,007 GPM	2,197 GPM	2,716 GPM
- Total Source Capacity	-2,850 GPM	-2,850 GPM	-2,850 GPM	-2,850 GPM
Subtotal	less than 0	less than 0	less than 0	less than 0
DOH Multiplier	x 150 GPM	x 150 GPM	x 150 GPM	x 150 GPM
Equalizing Storage Total	0 MG	0 MG	0 MG	0 MG

* Includes PHD for Zones 2 through 7.

Operational Storage: The City of Selah operates the Zone 3 reservoirs (Goodlander and Brader Hill) within a 5-foot water level range. This corresponds to a volume of approximately 207,136 gallons, or approximately 169 gallons per ERU (1,227 for year 2012). For the purpose of this analysis, this amount is used for operational storage in the years 2018, 2022, and 2032, respectively, as shown in Table 3-27.

Total Storage: Table 3-27 summarizes the year 2012 and future water system storage requirements of Zone 2, Zone 3, and above. The resulting total storage requirements for the year 2012 and future years are less than the City's current storage capacity of 2.709 MG for this scenario.

TABLE 3-27 COMBINED ZONE 2, ZONE 3, AND ABOVE STORAGE SUMMARY
(all storage values are in million gallons)

	Year 2012 Requirements	Year 2018 Requirements	Year 2022 Requirements	Year 2032 Requirements
Number of ERUs*	1,227	1,414	1,546	1,910
Number of Connections	1,123	1,298	1,422	1,762
Standby Storage	0.245	0.283	0.309	0.382
Fire Suppression Storage**	0.480	0.480	0.480	0.480
Equalizing Storage	0.000	0.000	0.000	0.000
Operational Storage	0.207	0.207	0.207	0.207
Total Storage Required	0.687	0.687	0.687	0.687
Total Storage Capacity	2.709	2.709	2.709	2.709

* Based on ADD.

** Standby Storage will be nested with Fire Suppression Storage.

3.4.3 North Hill Zone 4, 5 and 6 Supply and Storage Analysis

The supply to and storage of the upper north hill pressure zones (Zones 4, 5, and 6) must be analyzed separately from the total system due to dependence on booster pump stations for water supply.

Only Zones 4 and 5 of the existing north zones have been developed and are supplied water by the Valhalla Heights Booster Pump. The Valhalla Booster Pump Station provides a supply capacity of 500 GPM. The existing residential development in Zone 4 is Goodlander Heights, located at the west end of

Goodlander Road. Goodlander Heights is supplied water by the Valhalla Heights Booster Pump Station through a PRV. The Zone 5 residential development is Valhalla Heights, located west of Goodlander Heights, and is in the construction stages. The pumping capacity of 500 GPM is greater than the year 2012 and future peak hour demands of north zones.

Zones 4 and 5 of the north zones are served by two 158,500 gallon reservoirs (Valhalla Heights Reservoirs). The Valhalla Heights Booster Pump Station supplies the Valhalla Heights Reservoirs and north pressure zones. In 2012, 10 residences in Zone 5 were served by the Valhalla Heights Reservoirs, 43 residences and one apartment in Zone 4 were supplied water through a PRV station fed by Valhalla Heights Booster Pump Station. It is not anticipated that additional residences beyond those in the planned development will be served by this station in the future.

In the future, north Zone 6 water demands will require a constant pressure booster pump station from Zone 5. This improvement will be constructed with private funds as development continues in Valhalla Heights. Currently, there is no demand in Zone 6 of the north zone area.

Storage requirements for the year 2012 and future north Zones 4, 5, and 6 consist of the same four components as discussed for the entire water system. Those four components are standby, fire suppression, equalizing, and operational storage. The Valhalla Heights Reservoirs provide storage within this area.

Standby Storage: Current north hill standby storage requirements are calculated based on there being only one source of supply for the Zones 4 and above. For only one source of supply available, the DOH 2009 *Water System Design Manual* recommends that the volume of standby storage be calculated based upon the following equation:

$$\mathrm{SBTSS} = (2\ \mathrm{days})(\mathrm{ADD})(\mathrm{N})$$ (*2009 Water System Design Manual*, Page 103)

Where:
SBTSS = Total standby storage component for a single source water system (gallons)
ADD = Average day demand for the design year (GPD/ERUs)
N = Number of equivalent residential users (ERUs)

When this equation is applied to the existing and future equivalent residential units (ERUs), and the ADD per ERU, the resulting standby storage requirement for the existing north Zone 4 demand is as shown in Table 3-28.

TABLE 3-28 NORTH ZONE 4, 5, AND 6 STANDBY STORAGE REQUIREMENTS

	2012	2018	2022	2032
North Zone 4, 5 & 6 ADD* x 2 Days Standby Storage Required	0.016 MGD x 2 Days 0.032 MG	0.018 MGD x 2 Days 0.035 MG	0.018MGD x 2 Days 0.035 MG	0.131MGD x 2 Days 0.047 MG
Equivalent Residential Units (ERUs) x Min. 200 gal. Storage Minimum	47 x 200 0.009 MG	47 x 200 0.009 MG	47 x 200 0.009 MG	119 x 200 0.024 MG
Minimum Required Standby Storage	0.032 MG	0.035 MG	0.035 MG	0.047 MG

* Includes north Zone 6 future ADD because of its dependence on north Zones 4 and 5 for supply.

** Currently the only source to the north pressure zones is the Valhalla Booster Pump Station with (2) 250 GPM Booster Pumps.

Fire Suppression Storage: The storage requirement for fire suppression is based upon the highest fire flow rated structure within this area of the City. Currently, no structures in these zones have been rated for fire flow by the Selah Fire Department. All current and future services in Zones 4, 5, and 6 of the north hill area of Selah are residential with the exception of one apartment service, so the minimum fire flow requirement used is based upon WAC 246-293-640 requirements for multifamily residential home, which is equal to 750 GPM for a 60-minute duration. Therefore, the required fire suppression storage volume for this analysis is 45,000 gallons as shown in Table 3-30.

Equalizing Storage: Equalizing storage must also be provided to meet the periodic demands placed on the water system which exceed the source (booster station) pumping capacity. The DOH design method for calculating equalizing storage is 150 times the difference between the system's PHD in GPM and the source production rate in GPM. Based on this method, the 2012 and future equalizing storage required for Selah's north Zones 4 and 5 will be as shown in Table 3-29. PHD values include future demand from the future upper pressure north zone (Zone 6) to account for total booster pump station demands on the system.

TABLE 3-29 NORTH ZONE 4, 5, AND 6 EQUALIZING STORAGE REQUIREMENTS

	2012	2018	2022	2032
Peak Hour Demand	61 GPM	67 GPM	67 GPM	172 GPM
- Total Source Capacity	-500 GPM	-500 GPM	-500 GPM	-500 GPM
Subtotal	less than 0	less than 0	less than 0	less than 0
DOH Multiplier	x 150 GPM	x 150 GPM	x 150 GPM	x 150 GPM
Equalizing Storage Total	0 MG	0 MG	0 MG	0 MG

Operational Storage: The City of Selah operates the North Zone 5 reservoirs (Valhalla Heights Reservoirs) within a 5-foot water level range. This corresponds to a volume of approximately 52,877 gallons, or approximately 1,125 gallons per ERU (47 for year 2012). For the purpose of this analysis, this volume is used for operational storage in the years 2018, 2022, and 2032, respectively, as shown in Table 3-30.

Total Storage: Table 3-30 summarizes the year 2012 and future storage requirements for the north zones 4, 5, and 6. The resulting total storage requirements for the year 2012 and future years are less than the City's current storage capacity of 0.317 MG for this scenario.

TABLE 3-30 NORTH ZONE 4, 5, AND 6 STORAGE SUMMARY
(all storage values are in million gallons)

	Year 2012 Requirements	Year 2018 Requirements	Year 2022 Requirements	Year 2032 Requirements
Number of ERUs*	47	47	47	119
Number of Connections	44	44	44	116
Standby Storage	0.032	0.032	0.032	0.047
Fire Suppression Storage**	0.045	0.045	0.045	0.045
Equalizing Storage	0.000	0.000	0.000	0.000
Operational Storage	0.053	0.053	0.053	0.053
Total Storage Required	0.098	0.098	0.098	0.100
Total Storage Capacity	0.317	0.317	0.317	0.317

* Based on ADD.

** Standby Storage will be nested with Fire Suppression Storage.

3.4.4 South Hill Zone 4, 5, 6, and 7 Supply and Storage Analysis

The supply to and storage of the upper south pressure zones (Zones 4, 5, 6, and Zone 7) must be analyzed separately from the total system due to dependence on booster pump stations for water supply.

Supply to the south Zones 4, 5, 6, and 7 is boosted from pressure Zone 3 through one duplex pumping station. The Brader Hill Booster Pump Station has two pumps, each with a capacity of 500 GPM, with a total capacity of 1,000 GPM. In 2012, there was no demand in south Zone 7. Future south Zone 7 demands will be supplied through a future booster pump station. The south hill pressure zones are served by one 1.192 MG reservoir (Lookout Point Reservoir), supplied by the Brader Hill Booster Pump Station.

Year 2012 total water services in the upper south pressure zones included 91 single-family residential services and one irrigation-only service.

The year 2012 supply capacity to south Zones 4, 5, 6, and 7 was 1,000 GPM, or 1.440 MGD, which exceeds the maximum day demand of 0.097 MGD and the peak hour demand of 121 GPM. Future supply and storage requirements are based on the anticipated location of future services as discussed near the end of CHAPTER 2 of this Plan.

Storage requirements within south Zones 4, 5, 6, and 7 consist of the same four components as described previously in the total system storage analysis. Those four components are standby, fire suppression, equalizing, and operational storage.

<u>Standby Storage</u>: South pressure Zones 4, 5, 6, and 7 are supplied by one source with two pumps, the Brader Hill Booster Pump Station. This source can supply south hill pressure Zones with water at a rate of 1,000 GPM. DOH 2009 *Water System Design Manual* recommends that the volume of standby storage be calculated based upon the following equation:

$\text{SBTSS} = (2\text{ days})(\text{ADD})(\text{N})$ (*2009 Water System Design Manual*, Page 103)

Where:
SBTSS = Total standby storage component for a single source water system (gallons)
ADD = Average day demand for the design year (GPD/ERUs)
N = Number of equivalent residential users (ERUs)

When this equation is applied to the existing and future equivalent residential units (ERUs), and the ADD per ERU, the resulting standby storage requirement for the south pressure Zones 4, 5, 6, and 7 demand is shown in Table 3-31.

TABLE 3-31 SOUTH ZONE 4, 5, 6, AND 7 STANDBY STORAGE REQUIREMENTS

	2012	2018	2022	2032
Zone 4, 5, 6 & 7 ADD * x 2 Days Standby Storage Required	0.034 MGD x 2 Days 0.068 MG	0.053 MGD x 2 Days 0.106 MG	0.053 MGD x 2 Days 0.106 MG	0.076 MGD x 2 Days 0.151 MG
Equivalent Residential Units (ERUs) * x Min. 200 GPD Storage Minimum	97 x 200 0.019 MG	137 x 200 0.027 MG	137 x 200 0.027 MG	193 x 200 0.039 MG
Minimum Required Standby Storage	0.068 MG	0.0106 MG	0.106 MG	0.151 MG

* South Hill Zone 7 ADD is included due to its dependence on Zones 4, 5, and 6 for supply.

<u>Fire Suppression Storage</u>: The storage requirement for fire suppression is based upon the highest fire-flow rated structure within this area of the City. Currently, no structures in these zones have been rated for fire flow by the Selah Fire Department. All current and future services in Zones 4, 5, 6, and 7 of the south hill area of Selah are residential, so the minimum fire flow requirement used is based upon WAC 246-293-640 requirements for a single-family residential home, which is equal to 500 GPM for a 30-minute duration. Therefore, the required fire suppression storage volume for this analysis will be 15,000 gallons as shown in Table 3-33.

<u>Equalizing Storage</u>: Equalizing storage must also be provided to meet the periodic demands placed on the water system which exceed the source (booster station) pumping capacity. The DOH design method for calculating equalizing storage is 150 times the difference between the system's PHD in GPM and the source production rate in GPM. Based on this method, the 2012 and future equalizing storage required

for Selah's south hill Zone 4, 5, 6, and 7 will be as shown in Table 3-32. PHD values include demand from the upper future pressure zone (Zone 7) to account for total booster pump station demands on the system.

TABLE 3-32 SOUTH ZONE 4, 5, 6, AND 7 EQUALIZING STORAGE REQUIREMENTS				
	2012	2018	2022	2032
Peak Hour Demand *	121 GPM	192 GPM	192 GPM	274 GPM
- Total Source Capacity	-1,000 GPM	-1,000 GPM	-1,000 GPM	-1,000 GPM
Subtotal	less than 0	less than 0	less than 0	less than 0
DOH Multiplier	x 150 GPM	x 150 GPM	x 150 GPM	x 150 GPM
Equalizing Storage Total	0 MG	0 MG	0 MG	0 MG
* Includes South Hill Zone 7 PHD.				

Operational Storage: The City of Selah operates the south Zone 6 reservoir (Lookout Point Reservoir) within a 3-foot water level range. This corresponds to a volume of approximately 183,377 gallons, or approximately 1,890 gallons per ERU, (97 for year 2012). For the purpose of this analysis, this volume is used for operational storage in the years 2018, 2022, and 2032, respectively, as shown in Table 3-33.

Total Storage: Table 3-33 summarizes the year 2012 and future water system storage requirements of south pressure Zones 4, 5, 6, and 7. The resulting total storage requirements for the year 2012 and future years are less than the City's current storage capacity of 1.192 MG for this scenario.

TABLE 3-33 SOUTH ZONE 4, 5, 6, AND 7 STORAGE SUMMARY (all storage values are in million gallons)				
	Year 2012 Requirements	Year 2018 Requirements	Year 2022 Requirements	Year 2032 Requirements
Number of ERUs*	97	137	137	193
Number of Connections	92	132	132	188
Standby Storage	0.068	0.106	0.106	0.151
Fire Suppression Storage**	0.015	0.015	0.015	0.015
Equalizing Storage	0.000	0.000	0.000	0.000
Operational Storage	0.002	0.003	0.003	0.004
Total Storage Required	0.021	0.030	0.030	0.043
Total Storage Capacity	1.192	1.192	1.192	1.192
* Based on ADD. ** Fire Suppression Storage will be nested with Standby Storage.				

3.5 FIRE FLOW

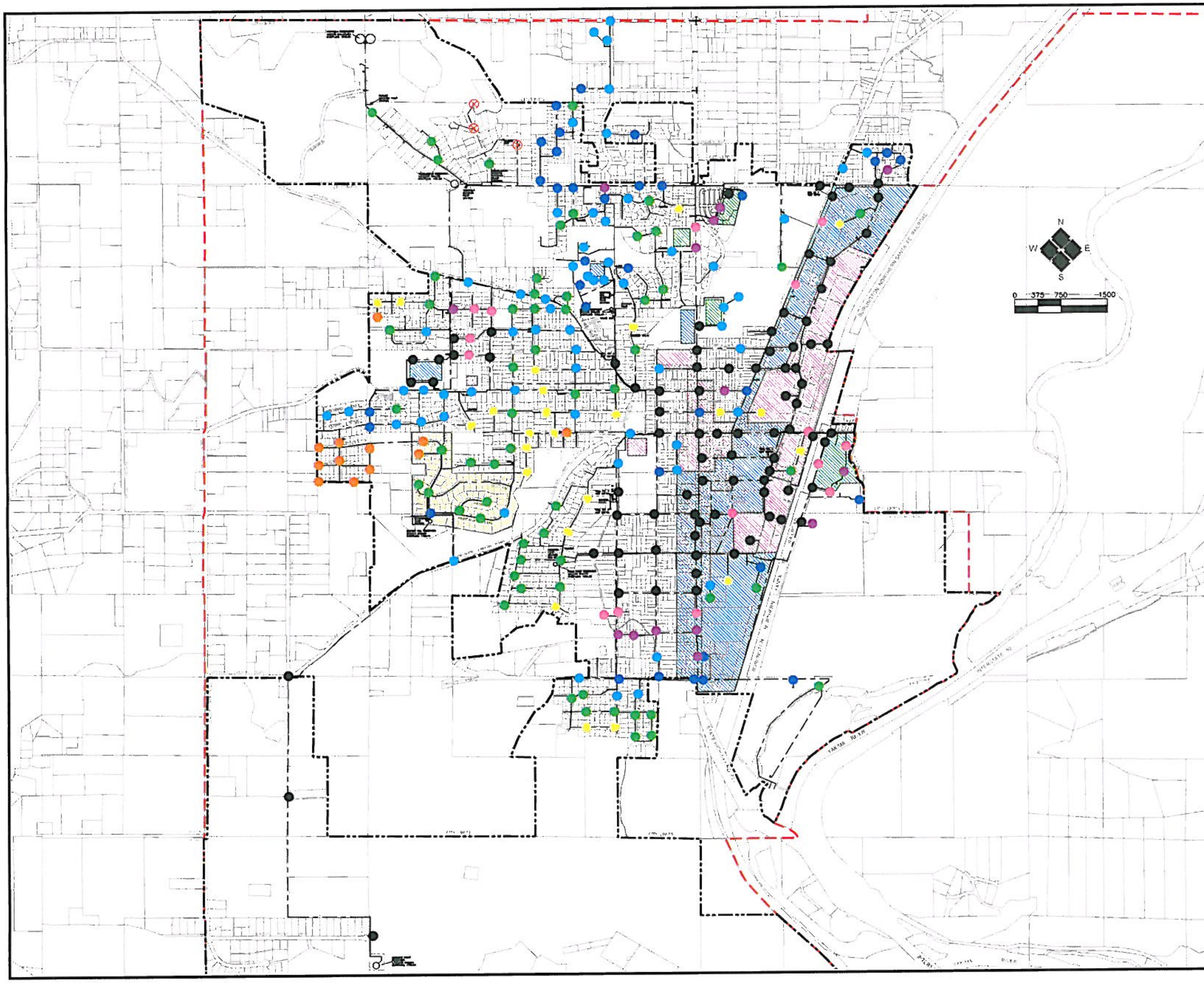
The demand fire flows place upon a water system is typically the most significant element when analyzing the piping network. Every water system which is required to have a Water System Plan must address fire flow. At a minimum, a water utility must comply with fire flow standards shown in Table 3-34, established by the Department of Health (DOH). A community may, however, develop its own standards as long as they exceed the DOH minimum requirements.

TABLE 3-34 DOH MINIMUM FIRE FLOW REQUIREMENTS	
Land Use Type	Flow Requirement
Residential	500 GPM for 30 minutes
Commercial and Multi-Family	750 GPM for 60 minutes
Industrial	1,000 GPM for 60 minutes
Source: *WAC 246-293-640*	

The City of Selah has developed desired fire flows for major structures within the City based on the standards of the Washington Survey and Rating Bureau. The Selah Fire Department performed a few selected building analyses using the Insurance Services Office (ISO) grading schedule. In addition, the Selah Fire Department analyzed fire flow requirements of select buildings based on the *2012 International Fire Code*. Results of the analysis have been used to generate desired fire flow capacities for areas within the City.

In Selah, the greatest fire flow requirements are within industrial and commercial areas, with isolated large demands at locations such as the Tree Top Facility and Selah schools. Fire flow requirements were used to develop Figure 3-5, which shows the locations of required minimum fire flow and the actual calculated fire flow capacity at selected locations within those areas. The Selah Fire Department has requested that all locations without a specified minimum fire flow range are required to have a minimum fire flow capacity of 1,000 GPM.

A computer hydraulic analysis was used to determine the existing fire flow capacities at certain locations shown in Figure 3-5. The hydraulic analysis parameters are discussed later in Section 3.6. As can be seen in Figure 3-5 the greatest fire flow requirements are within the industrially and commercially-zoned areas and at public schools. It can be seen in Figure 3-5 that most all locations throughout the distribution system are able to provide the required minimum fire flow capacities. Recommended system improvements to correct any fire flow deficiencies are discussed further in CHAPTER 8.



CITY OF SELAH

Water System Plan Update

YEAR 2012 MAX DAY DEMAND FIRE FLOW CAPACITIES MAP

LEGEND

RETAIL SERVICE AREA (CITY LIMITS)

FUTURE SERVICE AREA BOUNDARY (URBAN GROWTH AREA)

FIRE FLOW RANGE	EXISTING CAPACITY	REQUIRED FLOW
≤ 500 GPM	⊗	
500-1000 GPM	●	MINIMUM 1000 GPM
1000-2000 GPM	●	
2000-3000 GPM	●	
3000-4000 GPM	●	
4000-5000 GPM	●	
5000-6000 GPM	●	
6000-7000 GPM	●	
≥ 7000 GPM	●	

HLA
Huibregtse, Louman Associates, Inc.
Civil Engineering • Land Surveying • Planning

FIGURE 3-5

3.6 HYDRAULIC ANALYSIS

A hydraulic analysis of a water utility system is a method of calculating pressures and flows throughout the distribution network under various conditions of demand at a given instant. Since the advent of personal computers, hydraulic analyses are typically performed by utilizing computer programs which model the piping, reservoir, pumps and specialty valves of a given water system.

Numerous computer programs have been developed for performing network analyses. The program utilized for the modeling and analysis of the City of Selah water system is called WaterCAD (Version 8i), distributed by Bentley Systems, Inc. WaterCAD can perform instantaneous and extended period simulations of complete distribution networks including reservoirs, source pumps, booster pumps, pressure reducing valves, pressure sustaining valves, check valves, flow control valves, pressure switches, and up to 1,000 pipes and 1,000 nodes (pipe junctions).

The program utilizes Genetic Algorithm calculations (Darwin modules) to solve the pressure networks. All water system components are entered into the computer, supply rates and user demands input, and reservoir water levels are established. Once this base information has been loaded, various options such as increasing system demand, lowering reservoir levels, shutting off source pumps, adding system improvements, and simulating fire flow conditions can be analyzed for their impact on the system.

3.6.1 Assumptions

In order to analyze the water system at a given moment in time, it is necessary to assume certain existing conditions and to program the status of key system components. The following general assumptions have been made for the hydraulic analysis of the City of Selah water system:

- Roughness coefficients (C values) for most eight-inch or larger pipes were assumed to be 120. Pipes six-inch or smaller were assumed to have a C value equal to 110. Known old or poor condition pipes were assumed at C=100.
- Nominal pipe diameters were input for inside pipe diameters.
- Node elevations are based on available contour and topographic survey elevations.

Table 3-35 identifies the specific parameters used in the hydraulic analysis performed for existing and future peak hour demand (PHD) and for existing and future fire flow capacities at 20 psi residual pressure during maximum day demand (MDD) conditions. The PHD hydraulic analysis assumes that all primary source wells are operating and that the equalizing storage volume has been depleted from all tanks. The fire flow analysis, during MDD, assumes that the starting elevation in all tanks is with equalizing and fire suppression storage depleted. The fire flow analysis also assumes that all source wells are operating.

Initial elevations for the hydraulic analysis are calculated from the current and future reservoir pump-off elevations to represent current and future maximum storage conditions. The operational storage range and volume can be operator-adjusted based upon current demand, but the elevations (volumes) used represent normal operating conditions. Lower or higher initial water elevations could affect the calculated results provided in this Plan.

TABLE 3-35 HYDRAULIC ANALYSIS PARAMETERS

Water System Feature	Zone No.	Hydraulic Analysis Scenario: Year 2012 Peak Hour Demand [a] (5,341 GPM)	Year 2012 Fire Flow w/MDD [b] (2,967 GPM)	Year 2032 Peak Hour Demand [a] (7,548 GPM)
North Reservoirs Levels	1			
Maximum Elevation		1,305.4 Ft.	1,305.4 Ft	1,305.4 Ft
Initial Elevation		1,303.4 Ft.	1,290.9 Ft.	1,303.4 Ft.
Floor / Minimum Elevation		1,283.9 Ft.	1,283.9 Ft.	1,283.9 Ft.
Palm Park Reservoir Levels	1			
Maximum Elevation		1,305.7 Ft.	1,305.7 Ft.	1,305.7 Ft.
Initial Elevation		1,304.7 Ft.	1,292.2 Ft.	1,304.7 Ft.
Floor / Minimum Elevation		1,287.7 Ft.	1,287.7 Ft.	1,287.7 Ft.
Brader Hill Reservoir Levels	3			
Maximum Elevation		1,489.1 Ft.	1,489.1 Ft.	1,489.1 Ft.
Initial Elevation		1,489.1 Ft.	1,476.3 Ft.	1,489.1 Ft.
Floor / Minimum Elevation		1,471.1 Ft.	1,471.1 Ft.	1,471.1 Ft.
Goodlander Reservoir Levels	3			
Maximum Elevation		1,491.8 Ft.	1,491.8 Ft.	1,491.8 Ft.
Initial Elevation		1,489.8 Ft.	1,477.0 Ft.	1,489.8 Ft.
Floor / Minimum Elevation		1,459.8 Ft.	1,459.8 Ft.	1,459.8 Ft.
Valhalla Reservoirs Levels	5			
Maximum Elevation		1,666.0 Ft.	1,666.0 Ft.	1,666.0 Ft.
Initial Elevation		1,660.0 Ft.	1,644.9 Ft.	1,660.0 Ft.
Floor / Minimum Elevation		1,635.0 Ft.	1,635.0 Ft.	1,635.0 Ft.
Lookout Point Reservoir Levels	6			
Maximum Elevation		1,749.5 Ft.	1,749.5 Ft.	1,749.5 Ft.
Initial Elevation		1,747.0 Ft.	1,743.7 Ft.	1,742.0 Ft.
Floor / Minimum Elevation		1,729.5 Ft.	1,729.5 Ft.	1,729.5 Ft.
Source Well Status				
Well No. 3 (S01)	1	400 GPM	400 GPM	400 GPM
Well No. 4 (S02)	1	400 GPM	400 GPM	400 GPM
Well No. 5 (S03)	1	700 GPM	700 GPM	700 GPM
Well No. 6 (S04)	1	1,800 GPM	1,800 GPM	1,800 GPM
Well No. 7 (S05)	1	1,950 GPM	1,950 GPM	1,950 GPM
Well No. 8 (S07)	1	1,100 GPM	1,100 GPM	2,000 GPM
Total Supply		5,500 GPM	5,500 GPM	5,500 GPM [c]
Booster Pump Station Status				
Hospital Hill BPS	3	750 GPM (262 Ft. TDH)	750 GPM (262 Ft. TDH)	750 GPM (262 Ft. TDH)
Palm Park BPS	3	500 GPM (200 Ft. TDH)	500 GPM (200 Ft. TDH)	500 GPM (200 Ft. TDH)
Well No. 6 BPS	3	1,600 GPM (275 ft. TDH)	1,600 GPM (275 ft. TDH)	1,600 GPM (275 ft. TDH)
Brader Hill BPS	6	1,000 GPM (300 Ft. TDH)	1,000 GPM (300 Ft. TDH)	1,000 GPM (300 Ft. TDH)
Valhalla Heights BPS	5	500 GPM (264 Ft. TDH)	500 GPM (264 Ft. TDH)	500 GPM (264 Ft. TDH)

[a] Equalizing Storage depleted.
[b] Equalizing and Fire Suppression Storage depleted.
[c] Limited to 5,500 GPM by Water Rights.

3.6.2 Analysis Scenarios

The existing water system was first analyzed considering a present peak hour demand of 5,341 GPM, based on the total calculated peak hourly flow on August 4, 2009. All nodes providing domestic service within the system did so with a minimum residual pressure of 30 psi or greater with all source pumps in operation. Pipe velocities remained below the eight feet per second (FPS) maximum velocity design parameter. A copy of the computer printouts of this scenario and all other hydraulic analyses results discussed in this section are provided in CHAPTER 10 of this Plan. Map B in the back of this Plan shows the computer model with the pipe and node numbers for identification.

A future PHD analysis was run on the system using the PHD for the year 2032 of 7,548 GPM. This scenario was conducted with the year 2032 equalizing storage volume depleted. All service pressures were greater than 30 psi and pipe velocities were below eight (8) FPS with all source pumps in operation.

Fire flows were considered at all hydrant locations throughout the pipe network while assuming an existing system consumptive demand of 2,967 GPM, based on the total calculated MDD on August 4, 2009. The computer hydraulic model was used to calculate the maximum flow attainable at designated hydrant nodes while providing a positive pressure of 20 psi. Equalizing and fire suppression storage were depleted at the start of the fire flow analysis. The resulting fire flow capacities are shown in Figure 3-5, along with the fire district requested fire flow capacities as previously discussed. Several locations were calculated to be deficient in meeting the specified fire flow capacities, as shown in Figure 3-5. A future fire flow analysis was performed on the system with the 2032 maximum day demands to verify adequate fire flow capacity is available. Again, the same locations were calculated to be deficient in meeting the current fire flow requirements.

3.6.3 Model Calibration

In 2010, the City of Selah performed static pressure tests at fire hydrants in several different areas of the City under normal operating conditions. These static pressures were compared to the computer model under an average day demand scenario with the initial reservoir levels listed in Table 3-35. Ideally, the pressure test results would be compared to a computer model under average day demand with reservoir levels set to the actual reservoir levels at the time of testing, but reservoir levels from the time of testing were not available. Pressures from fire hydrant nodes in the model were generally within five psi of the test pressure readings, verifying that actual system pressures are comparable to the calculated pressures of the computer model. Samples of fire flow test results are shown in Table 3-36 and are compared with fire flow model results in Table 3-37.

Available Fire flow was calculated using the measured pressures and flows from the field tests. Fire flow in GPM at 20 psi of residual pressure was calculated using the following equation (simplified Hazen Williams):

$$\text{Available Fire Flow @ 20 psi Residual} = \text{Total Fire Flow} \times \sqrt{\frac{\text{Static Pressure} - 20\text{ psi}}{\text{Static Pressure} - \text{Residual Pressure}}}$$

It is recommended that updated pressure and flow tests be conducted in the future by the City and/or Fire District at representative locations throughout the distribution system including noting reservoir levels, to more accurately calibrate future system models and provide updated system information for future fire insurance assessments.

TABLE 3-36 FIRE FLOW FIELD TEST RESULTS												
			Flow Hydrant A			Flow Hydrant B			Static/Residual Hydrant			
Flow Test No.	Test Year	Location	Node No.	Pressure During Flow (psi)	Fire Flow (GPM)	Node No.	Pressure (psi)	Fire Flow (GPM)	Node No.	Static Pressure (psi)	Residual Pressure (psi)	Available Calculated Fire Flow (GPM)[a]
1	2010	Lince School	J-75	47	1,240	J-78	55	1,150	J-77	76	67	6,320
2	2010	Lacey Ave. & S. 4th St.	J-7	46	1,140	J-9	32	950	J-6	66	55	4,490
3	2010	Bartlett Ave. by John Campbell School	J-135	22	1,125	J-118	45	790	J-139	73	65	5,230
4	2010	1st St. & Wernex Loop	J-198	30	1,150	J-182	47	920	J-183	62	60	10,230
5	2010	3rd Ave. & Pleasant Ave.	J-27	65	1,350	J-28	55	1,240	J-29	94	85	7,910

[a] At 20 psi residual pressure.
Note: See Map B for Junction Node Locations.

TABLE 3-37 FIRE FLOW MODEL RESULTS						
			Static/Residual Hydrant			
Flow Test No.	Year	Location	Node No.	Static Pressure (psi)	Residual Pressure (psi)	Available Calculated Fire Flow (GPM)[a]
1	2012	Lince School	J-77	73	70	4,060
2	2012	Lacey Ave. & S. 4th St.	J-6	61	60	3,130
3	2012	Bartlett Ave. by John Campbell School	J-139	72	70	3,190
4	2012	1st St. & Wernex Loop	J-183	67	65	5,240
5	2012	3rd Ave. & Pleasant Ave.	J-29	89	88	6,290

[a] At 20 psi residual pressure.
Note: See Map B for Junction Node Locations.

3.7 SUMMARY OF SYSTEM DEFICIENCIES

The following is a listing and brief description of deficiencies which have been identified in the present water system. The deficiencies have been grouped within three system categories (supply, storage, and distribution) and are generally placed in order of their importance. The deficiencies may be operational in nature (which have been identified by the City's Water Department personnel) or maintenance related, inadequate present or future capacities, and/or system hydraulics problems.

3.7.1 Supply

Water Rights – A City's water right status is crucial in determining the amount of possible future growth. Currently, Selah has annual rights (Q_a) of 4,760 acre-feet per year and instantaneous rights (Q_i) of 5,500 GPM. As discussed in CHAPTER 2 of this Plan, current water rights are adequate in providing for existing and projected year 2032 demands, but will become the limiting factor in the City's future physical system capacity beyond the 20-year planning horizon. Should population trends and demand projections change, the water rights may be exceeded by year 2032.

As discussed in CHAPTER 1 of this Plan, the City currently requires that any proposed new development, which will exceed the City's current water right capacity, to transfer any water right the developer may hold to the City, prior to approval of the new development.

The *2008 Comprehensive Water Plan* describes the need for the City to control large industrial water use and explore the potential of transferring existing water rights owned by industries to the City. Industrial water consumption is still the highest among all user categories and projected future demands will need to be closely monitored by the City.

Source Well Capacity – Selah's source wells are limited by the City's water rights of 5,500 GPM, but are capable of producing 6,350 GPM should additional water rights be acquired. The year 2012 source capacity is adequate to meet current and anticipated 2032 demands. However, if population trends and demand projections change, the source well capacities may need to be reevaluated for year 2032.

Booster Pump Stations – Rehabilitation of the Palm Park booster pump station was identified as a recommended system improvement in the *2008 Comprehensive Water Plan*, but was never implemented. This booster pump station still needs to be rehabilitated to make it a more reliable source of supply to the upper pressure zones. Currently, the Palm Park booster pump is only used continuously at peak times of the year (summer months) when demand is high.

Any future development within Zone 6 north (Valhalla Heights) will require a new booster pump station to serve this pressure zone. Similarly, when anticipated development of Zone 7 occurs, a new booster pump station will be necessary to supply this upper pressure zone. These improvements are shown in Figure 8-1.

3.7.2 Storage

Storage Capacity – As discussed previously in this Chapter and in CHAPTER 2 of this plan, the City's reservoir storage capacity is adequate to meet the 20-year projected demand, by nesting fire suppression and standby storage. Therefore, no improvement project is recommended at this time. If future water demands change, the City may need to reevaluate the need for additional storage.

Reservoir Cleaning and Maintenance – The North Reservoirs were constructed in 1938 and have some minor cracking and signs of age. The smaller North Reservoir has been offline for some time due to a leak. It is recommended both reservoirs be rehabilitated and the smaller reservoir be reincorporated into the water system.

3.7.3 Distribution

Service Meters – The City's existing water service meters are primarily hand-read. It is recommended the City implement radio-read service meters in the future, requiring less labor and more accurate, readily available consumption data. Replacement of older service meters is necessary to improve accuracy and potentially reduce the DSL percentage.

Fire Flow Capacity – Figure 3-5 identifies existing system fire flow capacities along with the minimum fire flow requirements for regions within the City. As shown on the figure, some locations are deficient based on the computer hydraulic model. Refer to Figure 8-1 for suggested improvements to address deficiencies.

Water Main Upsizing and Replacement – Most of the deficiencies identified, as shown in Figure 3-5, can be addressed by upsizing water mains. Suggested Improvements for water main upsizing are shown in Figure 8-1.

Pressure – Water services currently range in elevation from 1,080 to 1,500 feet, with static pressures ranging from 37 to 97 psi. Higher pressures are experienced at lower portions of the distribution system, at locations furthest away from reservoirs in respective pressure zones. Typically, distribution system pressures should not exceed 100 psi, unless the design engineer can justify the need for the excessive pressure, and verify the pipe material is appropriate. High pressures are beneficial at these locations for fire flow reliability. Few locations experience pressure greater than 100 psi. In those locations, the City will install and maintain individual service PRVs if determined necessary by the Public Works Supervisor.

3.7.4 Telemetry

Selah's telemetry control system was installed in 2001 and is controlled by a master Programmable Logic Controller (PLC), which is located at the City's public works office. The Human Machine Interface (HMI) computer is the City's connection to the master PLC for making operational adjustments to the water system. A new HMI computer was purchased in 2012.

3.8 SELECTION AND JUSTIFICATION OF PROPOSED IMPROVEMENT PROJECTS

The following discussion identifies recommended system improvements proposed to eliminate or reduce deficiencies described in the previous section. References to prioritized improvements specified in Section 8.2 and Section 8.3 of this Plan are provided. Further description of the water system improvements is provided in CHAPTER 8 of the Plan.

3.8.1 Supply

Water Rights – Though the current water rights exceed the existing and projected 20-year demands, additional water rights may need to be obtained in the future should demand projections change. Currently there are no plans for purchase of any properties that have water rights transferable to the City of Selah for municipal use. Any future property purchases or water right transfers will be accomplished with the City's operational budget. **[Not identified as a system improvement in Figure 8-1]**

Source Well Capacity – Routine maintenance of the City's existing well sources is necessary to sustain their current capacity, supply efficiency, and reliability. Well Nos. 3 and 4 have not been serviced in over 20 years and are due for rehabilitation. **[O&M Improvement No. 12]**

Booster Pump Stations – The proposed Zone 6 booster pump station will eventually be constructed with private developer funds. This improvement will provide supply capacity to the north Zone 6 pressure zone, improve system reliability, and meet the projected future demands. **[Capital Improvement No. 12]**

The Palm Park booster pump station was built in 1967 and is in need of mechanical and electrical upgrades. The booster pump station is currently used as a supplemental pumping supply to Zone 3 during peak demand periods. Replacement of this pump station is necessary to improve source reliability to Zone 3 and the serviceability of this booster pump station. **[Capital Improvement No. 2]**

The proposed Zone 7 booster pump station will eventually be constructed with private developer funds. This improvement will provide supply capacity to the south Zone 7 pressure zone, improve system reliability, and meet the projected future demands. **[Capital Improvement No. 15]**

3.8.2 Storage

Reservoir Cleaning and Maintenance – Routine cleaning and inspection of the City's water storage reservoirs are necessary to maintain water quality and monitor structural integrity. The City plans to clean and inspect the reservoirs routinely every five years. **[O&M Improvement Nos. 4 and 5, 7-9, and 11]**

Storage Capacity – The smaller of the North Reservoirs is not in service due to leakage. Repairing this reservoir will provide additional capacity and reliability to the entire water system. The smaller North Reservoir should be cleaned and coated. **[O&M Improvement No. 10]**

3.8.3 Distribution

Source Meter Calibration – To ensure the accuracy of well production data and potentially reduce the percentage of DSL, as described in CHAPTER 4 of this Plan, the City should begin routine calibration of source meters. **[O&M Improvement No. 1]**

Water Main Replacement and Upsizing – As shown in Figure 3-5, there are multiple locations where the required fire flow is not met. Upsizing water mains in these locations will improve fire flow and water pressure. Although there are several additional locations in the City in need of water main replacements due to leakage and corrosion, the improvement locations were limited to critical improvements for fire flow requirements. **[Capital Improvement Nos. 1, 3, 4, 5, 7, 9, and 10]**

Fire Flow Capacity – As shown in Figure 3-5, there are multiple locations where the required fire flow is not met. Looping water mains at dead ends in these locations will improve fire flow and water quality. **[Capital Improvement Nos. 8, 13, and 14]**

Service Meter Replacement – It is recommended the City replace all hand-read meters with auto radio read meters. New meters will improve accuracy, monthly meter reading efficiency, and potentially reduce future DSL percentages. **[Capital Improvement No. 11]**