CHAPTER 3

SYSTEM ANALYSIS

The purpose of this chapter is to determine the ability of the City's existing potable water system to meet current and future water quality and system demand requirements. Items discussed in this chapter include water system design standards, water quality analysis, facility analysis, operations and maintenance, system deficiencies, and proposed system improvements.

SYSTEM DESIGN STANDARDS

WAC 246-290 contains general criteria and standards that must be followed in development of public water systems. In addition, the Washington State Department of Health's (DOH) 2001 Water System Design Manual (WSDM) provides specific guidance for water system design.

GENERAL FACILITY STANDARDS

DOH relies on various regulations, publications, and the purveyor to establish design criteria. WAC 246-290 is the primary drinking water regulation used by DOH to assess capacity, water quality, and compliance with drinking water standards. The WSDM serves as guidance for the preparation of plans and specifications for Group A public water systems in compliance with WAC 246-290. The WSDM also references the following codes and guidelines.

- Uniform Building Code (the International Building Code was adopted by all state and local agencies in 2004)
- Uniform Plumbing Code
- Recommended Standards for Water Works (RSWW), Ten State Standards
- Local codes
- American Water Works Association (AWWA) Standards
- American Society of Civil Engineers (ASCE) Standards
- American Public Works Association (APWA) Standards

Table 3-1 lists the suggested WSDM guidance and the City's policies with regard to each standard for general facility requirements. The design standards for the following subjects are discussed in the order shown below:

TABLE 3-1
General Facility Requirements

Standard	Department of Health Water System Design Manual	City of Chelan Standards
Average Day and Maximum Day Demand	Average Day Demand (ADD) should be determined from metered water use data. Maximum Day Demand (MDD) is estimated at approximately two times the ADD if metered data is not available.	ADD = Metered production MDD = 2.6 * ADD based on historical ADD data.
Peak Hour Demand	Peak hour demand (PHD) is determined using the following equation: PHD = (MDD/1440)*(CN +F)+ 18, where MDD is in gpd/ERU, and C and F are coefficients based on N, the number of ERUs. See Eq. 5-3, WSDM	Calculated PHD = 1.7 * MDD based on Eq. 5-3, WSDM. A more conservative value of PHD = 2.0*MDD will be used in this plan for consistency with previous planning efforts (See Chapter 2 discussion).
Source Capacity	Capacity must be sufficient to meet MDD and replenish fire suppression storage within 72 hours.	Same as WSDM, Chapter 7.
Storage Requirements	The sum of: <u>Operational Storage</u> Volume sufficient to prevent pump recycling. <u>Equalizing Storage</u> $V_{ES} = (Q_{PH} - Q_S) * 150$ <u>Standby Storage</u> $V_{SB} = (2 * ADD * N) - t_m * (Q_S - Q_L)$ <u>Fire Suppression Storage</u> $V_{FSS} = NFF * T$ ADD = average day demand, gpd/ERU N = number of ERU's Q_{PH} = peak hour demand, gpm Q_S = capacity of all sources, excluding emergency sources, gpm Q_L = capacity of largest source, gpm t_m = daily pump source run time, min (1440) NFF = needed fire flow, gpm T = fire flow duration, min	Same as WSDM, using the formulas provided in the manual, Chapter 9.
Minimum System Pressure	The system should be designed to maintain a minimum of 30 psi in the distribution system under peak hour demand and 20 psi under fire flow conditions during MDD.	Same as WSDM, Chapter 8.
Fire Flow Rate & Duration	The minimum fire flow shall be determined by the local fire authority or WAC 246-293 for systems within a critical water supply service area (CWSSA) or in a system with more than 1000 connections.	Fire flow requirements are based on the (local) fire district standards and building official requirements.
Minimum Pipe Size	The diameter of a transmission line shall be determined by hydraulic analysis. The minimum size distribution system line shall not be less than 6-inches in diameter.	Same as WSDM, Chapter 8.

TABLE 3-1 (con't.)
General Facility Requirements

Standard	Department of Health Water System Design Manual	City of Chelan Standards
Reliability Recommendations	• Sources capable of supplying MDD within an 18-hour period • Sources meet ADD with largest source out of service • Back-up power equipment for pump stations unless there are two independent public power sources • Provision of multiple storage tanks • Standby storage equivalent to ADD x 2, with a minimum of 200 gpd/ERU • Low and high level storage alarms • Looping of distribution mains when feasible • Pipeline velocities not > 8 fps at PHD • Flushing velocities of 2.5 fps for all pipelines	Same as WSDM, Chapter 5.
Valve and Hydrant Spacing	Sufficient valving should be placed to keep a minimum of customers out of service when water is turned off for maintenance, repair, replacement or addition. As a general rule valves and distribution mains 12-inches and smaller should be provided every 1,000 feet. Fire hydrants on laterals should be provided with their own auxiliary gate valve.	Valve and hydrant standards are outlined in the City of Chelan's Development Standards Manual.
Water Quality Standards	The primary drinking water regulation utilized by Health to assess capacity, water quality, and overall compliance with drinking water standards.	WAC 246-290

CONSTRUCTION STANDARDS

The City has prepared a set of standards for developers and the City to follow when constructing water system components. These standards are included in Appendix C so they can be approved by DOH as part of this plan. Such approval is one of the requirements that will allow the City to construct distribution mains and distribution-related projects without submittal to DOH of project reports in accordance with WAC 246-290-110 and construction documents in accordance with WAC 246-290-120.

FIRE FLOW DEMANDS AND MINIMUM PRESSURE

Table 3-2 shows the highest required fire flow rate and duration for each pressure zone. Consistent with WAC 246-290-230, the City requires a minimum pressure of 30 psi under PHD conditions and 20 psi during MDD and fire flow conditions. The City's fire flow standards are also shown on Figure 3-1.

TABLE 3-2
Chelan Fire Flow Requirements(1)

Pressure Zone	Required Fire Flow Rate (gpm)	Required Fire Flow Duration (hr)	Total Req'd Fire Suppression (gal)
Main	2,000	4	480,000
South Chelan	1,750	2	210,000
Lakeside	1,500	2	180,000
High Street	1,000	2	120,000
Hospital	1,500	2	180,000
Darnell's	2,500	2	300,000
Golf Course	1,000	2	120,000
Golf Course Terrace	1,000	2	120,000
Orchard View	1,000	2	120,000
Stehekin Way	1,000	2	120,000
Boyd Road	1,000	2	120,000
Pinnacle	1,000	2	120,000
Washington Street(2)	1,500	2	180,000
Wilmorth(3)	---	---	---

(1) Highest fire flow rates and durations within each pressure zone provided by Fire District No. 7.
(2) From Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan, assumed constant.
(3) Closed pressure zone that serves area outside City corporate limits.

WATER QUALITY ANALYSIS

Group A public community water systems must comply with the drinking water standards of the federal Safe Drinking Water Act and its amendments. The Washington State Department of Health adopted these federal standards under WAC 246-290. To enable Group A water systems to comply with the regulations, DOH issues each system a Water Quality Monitoring Report (WQMR) listing that system's reporting requirements. The City's current WQMR is provided in Appendix E.

The City has had one water quality event since the 2002 Water System Plan. A positive coliform test resulted from a sample taken from the City's distribution system on January 10, 2006. Repeat samples tested satisfactory. The City is currently in compliance with all other State and federal water quality requirements. The City's most recent water quality exceedance test results are presented in Appendix E.

FACILITY ANALYSIS

This section presents an evaluation of the City's water system source, storage, transmission, distribution, and telemetry facilities. The City's existing water system facilities are shown on Figure 1-1. A summary of the City's water system deficiencies and proposed improvements is presented in Table 3-17. A comprehensive description of proposed improvements including costs and a schedule for implementation is presented in Chapter 4.

SOURCE

As described in Chapter 1, the City's drinking water supply is derived from Lake Chelan. A raw water pumping station located near the lake's outlet pumps water from the lake to the City's water treatment plant. The rated capacity of the raw water pumping station is 8,400 gpm. The water treatment plant capacity is 6.7 mgd, with expansion capabilities of up to 10 mgd.

Source Capacity and Reliability

WAC 246-290-222(4) requires total source capacity to be sufficient to provide a reliable supply of water equal to or exceeding the MDD. Capacity of the raw water pumping station with one pump out of service is approximately 5,600 gpm, while the available capacity of the water treatment plant is approximately 4,650 gpm (6.7 mgd), both of which exceed the City's maximum instantaneous water right of 4,488 gpm. The limiting instantaneous water right capacity of 4,488 gpm will be used to analyze the City's ability to meet projected MDD requirements. The City's raw water pumping station is equipped with a variable frequency drive (VFD) that can adjust the pump speed to the capacity of the limiting instantaneous water right. Table 3-3 compares the City's current maximum instantaneous water rights with projected MDD requirements through the year 2027.

TABLE 3-3
Source Production Capacity Analysis

	Excluding Proposed Developments			Including Proposed Developments		
Year	**Source Capacity(1) (gpm)**	**MDD (2) (gpm)**	**Surplus (+) Deficit (-) (gpm)**	**Source Capacity(1) (gpm)**	**MDD (3) (gpm)**	**Surplus (+) Deficit (-) (gpm)**
2008	4,488	2,549	+1,939	4,488	**2,549**	+1,939
2013	4,488	2,940	+1,548	4,488	4,373	+115
2027	4,488	4,399	+89	4,488	6,675	-2,187

(1) Current maximum instantaneous water right; available capacity of the City's WTP is 4,650 gpm.
(2) Table 2-14
(3) Table 2-15

Table 3-3 indicates that the City has sufficient instantaneous water rights to meet MDD through the 6- and 20-year planning periods assuming proposed developments do not occur. However, including proposed developments indicates that the City will need to acquire additional instantaneous water rights to meet MDD requirements soon after the 6-year planning period. The City plans to obtain sufficient water rights to meet the WTP's full expansion capacity of 10 mgd (6,940 gpm), which will be needed to meet MDD near the end of the 20-year planning period.

In addition to the requirements of WAC 246-290-222 (4), the WSDM recommends that systems wishing to provide a high level of reliability to their customers consider the following source criteria for emergency conditions:

1. Provide sufficient source capacity to meet the MDD and replenish fire suppression storage within 72 hours. The largest fire suppression storage requirement is 480,000 gallons (2,000 gpm for 4 hours**).**
2. Meet the MDD with 18 (rather than 24) hours of pumping.
3. Meet the ADD with the largest source out of service.
4. Provide two independent power feeds, or portable or in-place backup power unless the power grid meets the following minimum reliability criteria:
    - Outage frequency averages three or less per year based on data for the three previous years with no more than six outages in a single year. A power outage is considered a loss of power for 30 minutes or longer.
    - Outage duration averages less than four hours based on data for the three previous years with not more than one outage during the three previous year period exceeding eight hours.

Tables 3-4a and 3-4b summarize the City's ability to meet the first three of these recommendations by the end of the 20-year planning period.

TABLE 3-4a
2027 Source Production Capacity Analysis – Excluding Proposed Developments Using WSDM Recommended Criteria

Recommendation	Q (req'd) (gpm)	WTP		Instant. Water Right	
		Q (avail.) (gpm)	Surplus (+) / Deficit (-) (gpm)	Q (avail.) (gpm)	Surplus (+) / Deficit (-) (gpm)
1. Meet MDD & Replenish FSS w/i 72 hrs(2)	4,510	4,650(1)	+140	4,488(5)	-22
2. Meet MDD w/ 18 hrs Pumping(3)	5,865	4,650(1)	-1,215	4,488(5)	-1,377
3. Meet ADD w/o Largest Source(4)	1,692	6,940	+5,248	4,488(5)	+2,796

(1) Current WTP capacity.
(2) 2027 MDD = 4,399 gpm (Table 2-14). FSS = 480,000 gal (2,000 gpm for 4 hrs); Q (req'd) = 4,399 + 480,000/72/60 = 4,510 gpm.
(3) Q (req'd) = 4,399 / 18 * 24 = 5,865 gpm.
(4) 2027 WTP capacity of 6,940 gpm; 2027 ADD = 2,436,000 gpd (Table 2-14) = 1,692 gpm. Additional instantaneous water rights required.
(5) Current maximum instantaneous water right.

TABLE 3-4b
2027 Source Production Capacity Analysis – Including Proposed Developments Using WSDM Recommended Criteria

Recommendation	Q (req'd) (gpm)	WTP		Instant. Water Right	
		Q (avail.) (gpm)	Surplus (+) / Deficit (-) (gpm)	Q (avail.) (gpm)	Surplus (+) / Deficit (-) (gpm)
1. Meet MDD & Replenish FSS w/i 72 hrs(2)	6,786	4,650(1)	-2,136	4,488(5)	-2,298
2. Meet MDD w/ 18 hrs Pumping(3)	8,900	4,650(1)	-4,250	4,488(5)	-4,412
3. Meet ADD w/o Largest Source(4)	2,567	6,940	+4,373	4,488(5)	+1,921

(1) Current WTP capacity.
(2) 2027 MDD = 6,675 gpm (Table 2-15). FSS = 480,000 gal (2,000 gpm for 4 hrs); Q (req'd) = 6,675 + 480,000/72/60 = 6,786 gpm.
(3) Q (req'd) = 6,675 / 18 * 24 = 8,900 gpm.
(4) 2027 WTP capacity of 6,940 gpm; 2027 ADD = 3,697,000 gpd (Table 2-15) = 2,567 gpm. Additional instantaneous water rights required.
(5) Current maximum instantaneous water right.

Table 3-4a indicates the City's source capacity and instantaneous water rights are sufficient to meet the third reliability recommendation through 2027, not sufficient to meet second recommendation, and incapable of meeting the first recommendation shortly past 2027. Additional instantaneous water rights and improvements to the City's water treatment plant to provide 10 mgd would be required to meet 2027 MDD and replenish fire suppression storage and meet 2027 MDD with 18 hours of pumping. The City does have sufficient source capacity to meet 2027 MDD with 24 hours of pumping rather than the 18 hours of pumping that the WSDM recommends.

Table 3-4b indicates the City's source capacity and instantaneous water rights are sufficient to meet the third reliability recommendation but not the first and second recommendations through 2027. Additional instantaneous water rights and improvements to the City's water treatment plant to provide more than 10 mgd would be required to meet 2027 MDD and replenish fire suppression storage and meet 2027 MDD with 18 hours of pumping.

Regarding the fourth recommendation, power outages in the Chelan area are usually short and infrequent. Appendix I contains recorded power outages for the previous 4 years. Because of the infrequent and short duration of power outages in the City, together with the availability of an alternate power feed to the City's raw water pumping station, the availability of standby power at the WTP, and a majority of open-system pressure zones with standby storage throughout the City, the City only considers a standby generator at Darnell's booster station an urgent need at this time.

Water Rights

The City holds several water right permits and certificates, and has several pending change applications and two pending applications for new permits. These rights and applications are summarized in Table 3-5, the City's water rights self assessment forms. A brief description of each right and application is provided below.

Certificates and Permits

The City has two certificates and two permits that make up the majority of the water right quantities authorized for withdrawal at the WTP raw water intake. The maximum allowable withdrawal quantities under these four rights are Qi = 4,488 gpm and Qa = 4,283 ac-ft/yr. The City also has rights to the quantities listed under the Campbell right (Certificate CS4-08093, discussed below under Other Water Rights) to the extent they are available after irrigation of the municipal golf course.

Certificate CSWC4018. Qi = 898 gpm (additive). Qa = 896 ac-ft/yr. This 1948 right was originally authorized for withdrawals from the Marina pumping station, and was changed in 1996 to add the WTP raw water intake. This right and the following three rights allow the City to withdraw water from Lake Chelan at the raw water intake for the WTP. The maximum Qa that can be withdrawn under these four rights is 4,283 ac-ft/yr.

Certificate CSWC10891. Qi = 799 gpm (additive). Qa = 896 ac-ft/yr. This 1967 right was originally authorized for withdrawals from the Lakeside pumping station, and was changed in 1996 to add the WTP raw water intake. The maximum allowable Qa under this right, the preceding right, and the following two permits is 4,283 ac-ft/yr.

Permit S4-30166P. Qi = 799 gpm (additive). Qa = 1,290 ac-ft/yr. This 1990 permit was originally authorized for withdrawals from the Lakeside pumping station, and was changed in 1996 to add the WTP raw water intake. The maximum allowable Qa under this right, the preceding two certificates, and the following permits 4,283 ac-ft/yr. The permit remains in good standing.

Permit S4-30167P. Qi = 1,992 gpm (additive). Qa = 3,214 ac-ft/yr. This 1990 permit was originally authorized for withdrawals from the Marina pumping station, and was changed in 1996 to add the WTP raw water intake. The maximum allowable Qa under this permit and the preceding three rights is 4,283 ac-ft/yr. The permit remains in good standing.

Other Water Rights

The City uses two water rights to irrigate its golf course with non-potable water. One is the Campbell right discussed above. The second is discussed below.

Certificate G4-29044. Qi = 50 gpm (additive). Qa = 18.1 ac-ft/yr (additive). This ground water right issued in 2005 for use at the City's secondary wastewater treatment

facility on the Columbia River. Of the annual quantity, 2.3 ac-ft/yr is for year-round plant maintenance and restroom facilities and 15.8 ac-ft/yr is for seasonal irrigation of the wastewater plant's grounds.

Certificate S4-25651. Qi = 139 gpm, Qa = 71 ac-ft/yr for community domestic use, and Qi = 310 gpm, Qa = 46 ac-ft/yr for commercial/industrial use. The right also includes an allocation for irrigation of 39 acres. This water right is associated with the Chelan River Irrigation District, whose domestic water system the City recently acquired. The City plans to transfer the community domestic and the commercial/industrial portions of this right to the City for municipal use. The City plans to initiate this change in 2010.

Certificate CS4-08093. Qi = 538 gpm (additive). Qa = 240 ac-ft/yr (additive). This right, also known as the "Campbell right", was transferred to the City in 2009. The right identifies the intake for the City's golf course at Spaders Bay City's and the WTP raw water intake as points of diversion. The City uses this right at the WTP intake to the extent it is available after irrigation of the golf course.

Certificate SWC 3244. Qi = 525 gpm for irrigation of 116.5 acres. A specific Qa is not identified on the certificate. This right is also known as the "Gaukroger right". The City is the successor in interest to this water right. The place of use identified on the certificate includes the golf course and the point of withdrawal includes the golf course intake. This right in conjunction with the Campbell right for golf course irrigation.

Pending Permit Applications

The City has two pending applications for new permits.

Application S4-32847. Qi = 152 gpm (additive), Qa = 53 ac-ft/yr. This application requests a withdrawal at Don Morse Park (Marina Pump Station) for the irrigation of 15 acres of the park.

Application S4-35072. Qi = 10,000 gpm (additive), Qa = 3,800 ac-ft/yr. This 2005 application requests additional municipal withdrawals at the raw water intake. The application is intended to provide the City with sufficient water rights to serve its municipal customers through buildout of its 2005 UGA.

Pending Transfers

The City has the following pending water right change applications.

Certificate CS4-SWC4511@1. Qi = 153 gpm, for use on 25 acres. This certificate was acquired from the Crystal View developer in the northeast part of the City. The change application that was submitted in 1998 proposes to move the point of diversion and place of use to Don Morse Park in the central part of the City. The time of use would remain as the irrigation season.

Certificate CS4-SWC5043@1. Qi = 112 gpm, for use on 22 acres. This certificate was acquired from the Crystal View developer in the northeast part of the City. The change application that was submitted in 1998 proposes to move the point of diversion and place of use to (a) the Lakeside Pumping Station for use at Lakeside Park, and (b) the ball fields near the Lake Chelan Dam for irrigation of the ball fields. The time of use would remain as the irrigation season.

Permit CS4-30361@2. Qi = 444 gpm, Qa = 50 ac-ft/yr. This permit was acquired from the Crystal View developer in the northeast part of the City. The change application proposes to move the point of diversion to the raw water intake, and to change the place of use to the service area defined in the City's most recent water system plan. The purpose of use would be changed from community, in-house domestic to municipal.

Certificate S4-28906. Qi = 129 gpm, Qa = 41.36 ac-ft/yr. This right, known as the Legacy Ridge or RAD water right, is pending consideration at the Chelan County Water Conservancy Board. If approved, these rights will be additive to the City's municipal rights.

The following water rights, known as the "Talley rights", have been transferred to the City as part of a development agreement for a project on the North Shore known as Granite Ridge.

Certificate CS4-SWC710. Qi = 175 gpm, Qa = 104 ac-ft/yr.

Certificate CS4-SWC709. Qi = 148 gpm, Qa = 33.6 ac-ft/yr.

Certificate S4-28458. Qi = 85 gpm, Qa = 59 ac-ft/yr.

The rights are subject to certain Ecology provisions regarding consumptive use and a 2012 development schedule, and an agreement between the City and the developer.

- Consumptive Use. CS4-SWC709 and CS4-SWC458 are subject to consumptive use limitations, that is, the City's consumptive use cannot be greater than the consumptive use of the original irrigation rights.
- Fixed and Determined Plan. CS4-SWC709 only becomes available to the City after the developer has put the water right to full beneficial use on the Granite Ridge property prior to expiration of the development schedule.
- Additional Development. The developer may be able to designate all or a portion of the any of the three rights transferred to the City (in excess of the needs of the City to serve the Granite Ridge development) for use for irrigation within Granite Ridge or another future development.

These water rights will be additive to the City's rights when Ecology issues the superseding certificates (subject to future extensions).

Certificate CS4-SWC178. Qi = 83.4 gpm, Qa = 39.53 ac-ft/yr. This is an irrigation right the Holiday Hills developer is proposing to transfer to the City as part of a development agreement. The application is being processed by the Chelan County Water Conservancy Board. The transfer proposes to add the City's diversion points at the WTP intake, the Lakeside intake, the Marina, and the golf course to the existing diversion point. It also proposes to change the place of use to the City's water service area, and to change the purpose of use from seasonal irrigation to continuous municipal.

Insert Table 3-5 here.

Insert Table 3-5 here.

Insert Table 3-5 here.

TABLE 3-6a
Water Rights Adequacy – Excluding Proposed Developments

Year	MDD(1) (gpm)	Qi(2) (gpm)	+/- (gpm)	ADD(1) (af/yr)	Qa(2) (af/yr)	+/- (af/yr)
2008	**2,549**	4,488	+1,939	1,582	4,283	+2,701
2013	2,940		+1,548	1,823		+2,460
2027	4,399		+89	2,728		+1,555

Note: Qi = instantaneous withdrawal quantity; Qa = annual withdrawal quantity.
(1) From Table 2-14.
(2) From Table 3-5.

TABLE 3-6b
Water Rights Adequacy – Including Proposed Developments

Year	MDD(1) (gpm)	Qi(2) (gpm)	+/- (gpm)	ADD(1) (af/yr)	Qa(2) (af/yr)	+/- (af/yr)
2008	**2,549**	4,488	+1,939	1,582	4,283	+2,701
2013	4,373		+115	2,713		+1,570
2027	6,675		-2,187	4,141		+142

Note: Qi = instantaneous withdrawal quantity; Qa = annual withdrawal quantity.
(1) From Table 2-15.
(2) From Table 3-5.

As summarized in Table 3-6a, the City has sufficient instantaneous and annual withdrawal water rights to meet current and 20-year projected MDD based on projected growth rates only. Table 3-6b indicates that although the City currently has sufficient instantaneous and annual withdrawal water rights to meet the MDD, based on demand projections from Table 2-15, the City's MDD will exceed its instantaneous water rights soon after 2013 when proposed developments are included in the analysis. To address this shortfall, Table 3-5 indicates that the City has pending change applications for additional instantaneous and annual withdrawal water rights that would increase the City's total water rights. In addition, the City has adopted an ordinance requiring developers to either provide sufficient water rights for their projects or pay a fee sufficient to enable the City to purchase the same amount. Finally, the City has applied to Ecology for a new permit that would provide the City with sufficient instantaneous and annual quantities through full build out of the City.

Source Protection

Water systems are required to meet the source protection requirements of WAC 246-290-135. This statute requires that the City develop and implement a watershed control program. The City participated in the development of the 1989 Lake Chelan Water Quality Assessment, a report that contains the basic elements of a watershed control program as outlined in the WAC. This report also identifies a recommended regulatory approach for watershed control measures. A copy of these recommendations is contained in Appendix H.

The 1991 Lake Chelan Water Quality Plan was also completed with the City's assistance. This plan contains the elements of a watershed control program and established a Lake Chelan Water Quality Board to promote water quality protection. The City is an active member of that Board. Contained in Appendix H are the Table of Contents, Executive Summary, and recommended improvements from this Plan. It is the City's intent to meet WAC requirements for a watershed control program through continued planning within the Lake Chelan Water Quality Board, the contents of the two plans cited, and a commitment to participate in required future regional plans regarding watershed planning. The City recognizes that independent pursuit of a watershed control program by the City would result in less benefit than active participation in the organized water quality planning efforts that are currently in place.

STORAGE

As outlined in WAC 246-290 and the WSDM, storage volume requirements for reservoirs are based on the sum of Operational Storage (OS), Equalizing Storage (ES), Fire Suppression Storage (FSS), and Standby Storage (SB). Definitions for these reservoir storage volumes follow.

Operational Storage

Operational storage is the water volume that typically corresponds to the band of storage between the lead pump-off and lag pump-on conditions. Operational storage for the City's storage reservoirs was determined from operational set points provided by the City or as indicated in Tables 3-7 and 3-8.

TABLE 3-7
Operational Storage – Main, South Chelan and Lakeside Pressure Zones

Parameter	Main Treatment Plant East	Main Treatment Plant West	Main Treatment Plant South	South Chelan	Lakeside North	Lakeside South	Lakeside West
Diameter	50	50	90	26	21	21	30
Overflow Elevation	1303	1303	1301.5	1301.5	1299	1299	1299
Operational Set Point (Off)(1)	1300.5	1300.5	1300.5	1296	1298.5	1298.5	1298.5
Operational Set Point (On)(1)	1298.5	1298.5	1298.5	1288	1293.5	1293.5	1293.5
Operational Storage, gal	154,000			32,000	52,000		
Base Elevation, ft.	1282.5	1282.5	1284.5	1267	1278.5	1278.5	1274

(1) Operational set point elevations for Main and South Chelan pressure zones provided by City; operational set point elevations for Lakeside pressure zone set to provide maximum fire suppression storage.

TABLE 3-8
Operational Storage – Darnell's, Golf Course Terrace, Boyd Road, and Washington Street Pressure Zones

Parameter	Darnell's Chelan Hills East	Darnell's Chelan Hills West	Golf Course Terrace	Boyd Road (Pinnacle Res.)	Washington Street (Wilmorth Res.)(1)
Diameter	53	30	26	30	45
Overflow Elevation	1653	1653	1780	1780	1430.5
Operational Set Point (Off)(1)	1650.5	1650.5	1779	1779	1428.5
Operational Set Point (On)(1)	1648.5	1648.5	1775	1777	1426.5
Operational Storage, gal	44,000		16,000	11,000	24,000
Base Elevation, ft.	1624	1624.5	1751	1758	1409

(1) Operational set point elevations provided by City.

Equalizing Storage

This storage component consists of the amount of storage that is needed to make up the difference between the PHD and the capacity of the delivery system. The WSDM requires sufficient ES to make up this difference for 150 minutes, i.e.,

$$ES = (PHD - Q_S)(150\text{min})$$

Where,

ES = Equalizing Storage (gallons)
PHD = Peak Hour Demand (gpm)
Qs = Sum of all installed and active source of supply capacities, excluding emergency sources of supply, in the zone supplying the reservoir (gpm)

WAC 246-290-230 (5) requires a minimum pressure of 30 psi at the bottom of the ES elevation.

Equalizing storage as shown in Tables 3-9a and 3-9b was calculated using peak hour demands for each pressure zone. Current available source capacity, excluding emergency sources, for the Main pressure zone is 4,650 gpm (6.7 mgd), South Chelan zone is 200 gpm, Lakeside zone is 600 gpm, Darnell's zone is 1,400 gpm, Golf Course Terrace zone is 510 gpm, Boyd Road zone is 300 gpm, and the Washington Street pressure zone is 400 gpm. Available 2027 source capacity for the Main pressure zone is 6,940 gpm (10 mgd), assuming that required improvements to increase plant capacity to 10 mgd to meet 2027 source capacity requirements with proposed developments as shown in Table 3.3 are constructed.

Fire Suppression Storage

Fire suppression storage is the amount of storage required to fight a fire. WAC 246-290-230 (6) requires a minimum pressure of 20 psi when the system is simultaneously providing MDD plus the required fire flow. The required FSS is determined to be the amount of required fire flow multiplied by the fire flow duration.

$$FSS = (FF)(t_M)$$

Where,

FSS = Fire Suppression Storage (gallons)
FF = Required fire flow (gpm), as specified by the local fire protection authority
t_m = Duration of the required fire flow (min), as specified by the local fire protection authority

Standby Storage

The purpose of standby storage is to provide a measure of reliability when sources fail, power outages occur, or another emergency places the burden of water system supply solely on storage. With the approval of the local fire authority, WAC 246-290-235 allows fire suppression storage and standby storage to be nested, with the larger of the two volumes being the minimum required. Section 9.0.4 of the WSDM indicates that SB should provide for two days of ADD assuming the largest water source is out of service, i.e.,

$$SB_{TMS} = (2\text{days})(ADD)(N) - t_m(Q_S - Q_L)$$

Where,

SB_{TMS} = Total standby storage component for a multiple source system (gallons)
ADD = Average Day Demand for the system (gpd/ERU)
N = Number of ERUs
Q_S = Sum of all installed and continuously available source of supply capacities, excluding emergency sources (gpm)
Q_L = The largest capacity source available to the system (gpm)
t_m = Time that remaining sources are pumped on the day when the largest source is not available (min)

According to the WSDM, in no case should the standby storage volume be less than 200 gallons/ERU.

The current available source capacity with the largest source capacity out of service for the Main pressure zone is 2,320 gpm (treatment plant capacity with one filtration unit out of service), South Chelan zone is 0 gpm, Lakeside zone is 300 gpm, Darnell's zone is 700 gpm, Golf Course Terrace zone is 0 gpm, Boyd Road zone is 150 gpm, and the Washington Street pressure zone is 200 gpm. Available 2027 source capacity for the Main pressure zone is 4,630 gpm (treatment plant capacity with one filtration unit out of service, assuming that required improvements to increase plant capacity to 10 mgd to

meet 2027 source capacity requirements with proposed improvements as shown in Table 3.3 are constructed).

Total Storage Requirements

Total storage volumes available in the City's reservoirs for the next 20 years are shown in Tables 3-9a and 3-9b. Required storage volumes have been rounded up to the nearest 1,000 gallons.

TABLE 3-9a
Total Storage Requirements – Excluding Proposed Improvements

Pressure Zone	OS (gal)	ES (gal)	SB1 (gal)	SB2 (gal)	FSS(7) (gal)	Total Required(8) (gal)	Total Available (gal)	Surplus (+)/ Deficit (-) (gal)
2007 Storage Calculations(10)								
Main(1)	154,000	0	<0	329,000	480,000	634,000	1,290,000	+656,000
S. Chelan(2)	32,000	0	130,000	26,000	210,000	242,000	116,000	-126,000
Lakeside(3)	52,000	0	<0	42,000	180,000	232,000	233,000	+1,000
Darnells(4)	44,000	0	<0	118,000	300,000	344,000	567,000	+223,000
GC Terrace(5)	16,000	0	51,000	10,000	120,000	136,000	111,000	-25,000
Boyd Road(6)	11,000	0	<0	13,000	120,000	131,000	111,000	-20,000
Wash. St.(9)	24,000	0	<0	17,000	180,000	204,000	256,000	+52,000
2013 Storage Calculations(10)								
Main(1)	154,000	0	<0	407,000	480,000	634,000	1,290,000	+656,000
S. Chelan(2)	32,000	0	151,000	29,000	210,000	242,000	116,000	-126,000
Lakeside(3)	52,000	0	<0	47,000	180,000	232,000	233,000	+1,000
Darnells(4)	44,000	0	<0	131,000	300,000	344,000	567,000	+223,000
GC Terrace(5)	16,000	0	56,000	12,000	120,000	136,000	111,000	-25,000
Boyd Road(6)	11,000	0	<0	15,000	120,000	131,000	111,000	-20,000
Wash. St.(9)	24,000	14,000	<0	58,000	180,000	218,000	256,000	+38,000
2027 Storage Calculations(10)								
Main(1)	154,000	203,000	<0	665,000	480,000	1,022,000	1,290,000	+268,000
S. Chelan(2)	32,000	0	187,000	38,000	210,000	242,000	116,000	-126,000
Lakeside(3)	52,000	0	<0	62,000	180,000	232,000	233,000	+1,000
Darnells(4)	44,000	25,000	<0	174,000	300,000	369,000	567,000	+198,000
GC Terrace(5)	16,000	0	73,000	15,000	120,000	136,000	111,000	-25,000
Boyd Road(6)	11,000	0	<0	20,000	120,000	131,000	111,000	-20,000
Wash. St.(9)	24,000	200,000	662,000	204,000	180,000	886,000	256,000	-630,000

(1) Main pressure zone storage consists of Treatment Plant East, West & South reservoirs.
(2) South Chelan pressure zone storage consists of South Chelan reservoir.
(3) Lakeside pressure zone storage consists of Lakeside North, South, and West reservoirs.
(4) Darnell's pressure zone storage consists of Chelan Hills East & West reservoirs.
(5) Golf Course Terrace pressure zone storage consists of Golf Course reservoir.
(6) Boyd Road pressure zone storage consists of Pinnacle reservoir.
(7) From Table 3-2.
(8) Total Required Storage = OS + ES + [larger of SB or FSS].
(9) OS from the City; FSS from the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan assuming constant FSS requirement throughout the planning period; Washington Street pressure zone storage consists of the Wilmorth reservoir.
(10) For Washington Street pressure zone, storage calculations are for years 2006, 2012, and 2026.

TABLE 3-9b
Total Storage Requirements – Including Proposed Improvements

Pressure Zone	OS (gal)	ES (gal)	SB1 (gal)	SB2 (gal)	FSS(7) (gal)	Total Required(8) (gal)	Total Available (gal)	Surplus(+)/ Deficit (-) (gal)
2007 Storage Calculations(10)								
Main(1)	154,000	0	<0	329,000	480,000	634,000	1,290,000	+656,000
S. Chelan(2)	32,000	0	130,000	26,000	210,000	242,000	116,000	-126,000
Lakeside(3)	52,000	0	<0	42,000	180,000	232,000	233,000	+1,000
Darnells(4)	44,000	0	<0	118,000	300,000	344,000	567,000	+223,000
GC Terrace(5)	16,000	0	51,000	10,000	120,000	136,000	111,000	-25,000
Boyd Road(6)	11,000	0	<0	13,000	120,000	131,000	111,000	-20,000
Wash. St.(9)	24,000	0	<0	17,000	180,000	204,000	256,000	+52,000
2013 Storage Calculations(10)								
Main(1)	154,000	0	<0	407,000	480,000	634,000	1,290,000	+656,000
S. Chelan(2)	32,000	0	141,000	29,000	210,000	242,000	116,000	-126,000
Lakeside(3)	52,000	0	<0	47,000	180,000	232,000	233,000	+1,000
Darnells(4)	44,000	0	<0	141,000	300,000	344,000	567,000	+223,000
GC Terrace(5)	16,000	0	56,000	12,000	120,000	136,000	111,000	-25,000
Boyd Road(6)	11,000	0	<0	15,000	120,000	131,000	111,000	-20,000
Wash. St.(9)	24,000	14,000	<0	58,000	180,000	218,000	256,000	+38,000
2027 Storage Calculations(10)								
Main(1)	154,000	0	<0	713,000	480,000	867,000	1,290,000	+423,000
S. Chelan(2)	32,000	0	187,000	38,000	210,000	242,000	116,000	-126,000
Lakeside(3)	52,000	0	<0	62,000	180,000	232,000	233,000	+1,000
Darnells(4)	44,000	116,000	<0	241,000	300,000	460,000	567,000	+107,000
GC Terrace(5)	16,000	0	73,000	15,000	120,000	136,000	111,000	-25,000
Boyd Road(6)	11,000	0	<0	20,000	120,000	131,000	111,000	-20,000
Wash. St.(9)	24,000	200,000	662,000	204,000	180,000	886,000	256,000	-630,000

(1) Main pressure zone storage consists of Treatment Plant East, West & South reservoirs.
(2) South Chelan pressure zone storage consists of South Chelan reservoir.
(3) Lakeside pressure zone storage consists of Lakeside North, South, and West reservoirs.
(4) Darnell's pressure zone storage consists of Chelan Hills East & West reservoirs.
(5) Golf Course Terrace pressure zone storage consists of Golf Course reservoir.
(6) Boyd Road pressure zone storage consists of Pinnacle reservoir.
(7) From Table 3-2.
(8) Total Required Storage = OS + ES + [larger of SB or FSS].
(9) OS from the City; FSS from the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan assuming constant FSS requirement throughout the planning period; Washington Street pressure zone storage consists of the Wilmorth reservoir.
(10) For Washington Street pressure zone, storage calculations are for years 2006, 2012, and 2026.

As indicated in Tables 3-9a and 3-9b, the South Chelan, Golf Course Terrace, Boyd Road, and Washington Street pressure zones do not have sufficient storage capacity to meet fire flow requirements without additional storage or fire pumps.

South Chelan - Required fire flow for the South Chelan pressure zone is 210,000 gal (1,750 gpm for 2 hours). The fire flow storage deficiency of 126,000 gal or 1,050 gpm, is resolved through the two 700 gpm fire pumps located in the Farnham booster station.

Golf Course Terrace - Fire suppression storage for the proposed Lake Hills reservoir, located at a higher elevation than the Golf Course Terrace reservoir, can be utilized for the Golf Course Terrace reservoir. A pressure reducing valve will be installed that will allow the transfer of water from the upper zone to the Golf Course Terrace zone. As much as 96,000 gallons (800 gpm for 2 hrs) can be transferred to the Golf Course Terrace pressure zone through the 4" pressure reducing valve, eliminating the 25,000 gallon, or 208 gpm, Golf Course Terrace reservoir storage deficit.

Boyd Road - The maximum required fire flow within the Boyd Road pressure zone is 120,000 gal (1,000 gpm for 2 hours). The Pinnacle reservoir's fire suppression storage deficit of 20,000 gal, or 167 gpm, will be resolved through the installation of new fire pumps to serve this pressure zone.

Washington Street – The 2027 fire suppression storage deficit of 630,000 gallons shown in Tables 3-9a and 3-9b within the Washington Street pressure zone can be reduced to approximately 172,000 gallons by increasing the capacity of the Washington Street booster pump station to 1,350 gpm as discussed in this chapter to meet future demands. This improvement will decrease the standby storage requirement at the Wilmorth reservoir, assuming nesting of standby storage and fire suppression storage. The remaining 172,000 gallon storage deficit will be resolved through the construction of a new reservoir to serve this pressure zone.

2027 Storage conditions for the City's reservoirs, assuming proposed developments are constructed, are shown in Tables 3-10 through 3-15.

TABLE 3-10
2027 Storage Conditions – Treatment Plant Reservoirs(1)

Component	Elev. (ft)	Static Pressure (psi) High Point(4)	Static Pressure (psi) Low Point	Incremental Storage (gal)	Total Storage (gal)
Top of Storage(2)	1300.5	37	82	N/A	N/A
Operational (OS)	1298.5	36	82	154,000	154,000
Equalization (ES)	1298.5	36	82	0	154,000
FSS/SB	1289.7	32	78	678,000	832,000
Base of Reservoir(3)	1284.5	30	76	458,000	1,290,000

(1) Treatment Plant East, West and South reservoirs
(2) Elevation for Main pressure zone controlling reservoir, Treatment Plant South.
(3) Base elevation of Treatment Plant South reservoir; base elevation of Treatment Plant East and West reservoirs is 1282.5.
(4) High point is highest service elevation for all storage components except FSS, which is highest fire hydrant or service elevation in system.

TABLE 3-11
2027 Storage Conditions – South Chelan Reservoir

Component	Elev. (ft)	Static Pressure (psi) High Point(2)	Static Pressure (psi) Low Point	Incremental Storage (gal)	Total Storage (gal)
Top of Storage	1296.0	33	72	N/A	N/A
Operational (OS)	1288.0	30	68	32,000	32,000
Equalization (ES)	1288.0	30	68	0	32,000
FSS/SB(1)	1274.0	20	62	56,000	88,000
Base of Reservoir	1267.0	21	59	28,000	116,000

(1) FSS/SB elevation determined from minimum pressure of 20 psi under fire flow conditions; required FSS is 210,000 gal (1750 gpm for 2 hrs); remainder of FSS required (126,000 gal or 1,050 gpm) is provided by two 700 gpm fire pumps located in Farnham BPS.
(2) High point is highest service elevation for all storage components except FSS, which is highest fire hydrant or service elevation in system.

TABLE 3-12
2027 Storage Conditions – Lakeside Reservoirs(1)

Component	Elev. (ft)	Static Pressure (psi) High Point(4)	Static Pressure (psi) Low Point	Incremental Storage (gal)	Total Storage (gal)
Top of Storage(2)	1298.5	40	86	N/A	N/A
Operational (OS)	1293.5	38	84	52,000	52,000
Equalization (ES)	1293.5	38	84	0	52,000
FSS/SB	1276.3	31	76	180,000	232,000
Base of Reservoir(3)	1274.0	36	75	1,000	233,000

(1) Lakeside North, South and West reservoirs.
(2) Elevation for Lakeside pressure zone controling reservoir, Lakeside West.
(3) Base elevation of Lakeside West reservoir; base elevation of Lakeside North and South reservoirs is 1278.5
(4) High point is highest service elevation for all storage components except FSS, which is highest fire hydrant or service elevation in system.

TABLE 3-13
2027 Storage Conditions – Chelan Hills Reservoirs(1)

Component	Elev. (ft)	Static Pressure (psi) High Point(4)	Static Pressure (psi) Low Point	Incremental Storage (gal)	Total Storage (gal)
Top of Storage(2)	1650.5	65	91	N/A	N/A
Operational (OS)	1648.5	64	90	44,000	44,000
Equalization (ES)	1643.4	62	88	111,000	155,000
FSS/SB	1629.6	21	82	300,000	455,000
Base of Reservoir(3)	1624.5	19	80	112,000	567,000

(1) Chelan Hills East and West reservoirs.
(2) Elevations for Darnell's pressure zone controlling reservoir, Chelan Hills West.
(3) Base elevation of Chelan Hills West reservoir; base elevation of Chelan Hills East reservoir is 1624.0.
(4) High point is highest service elevation for all storage components except FSS, which is highest fire hydrant or service elevation in system.

TABLE 3-14
2027 Storage Conditions – Golf Course Reservoir

Component	Elev. (ft)	Static Pressure (psi) High Point(2)	Static Pressure (psi) Low Point	Incremental Storage (gal)	Total Storage (gal)
Top of Storage	1779.0	60	90	N/A	N/A
Operational (OS)	1775.0	58	89	16,000	16,000
Equalization (ES)	1775.0	58	89	0	16,000
FSS/SB(1)	1751.0	48	78	95,000	111,000
Base of Reservoir	1751.0	48	78	0	111,000

(1) Required FSS is 120,000 gal (1,000 gpm for 2 hrs); remaining FSS required (25,000 gal or 210 gpm) to be provided by fire suppression storage in Lake Hills reservoir via 4" bypass PRV.
(2) High point is highest service elevation for all storage components except FSS, which is highest fire hydrant or service elevation in system.

TABLE 3-15
2027 Storage Conditions – Pinnacle Reservoir

Component	Elev. (ft)	Static Pressure (psi) High Point(2)	Static Pressure (psi) Low Point	Incremental Storage (gal)	Total Storage (gal)
Top of Storage	1779.0	45	56	N/A	N/A
Operational (OS)	1777.0	44	55	11,000	11,000
Equalization (ES)	1777.0	44	55	0	11,000
FSS/SB(1)	1758.0	36	47	100,000	111,000
Base of Reservoir	1758.0	36	47	0	111,000

(1) Required FSS is 120,000 gal (1,000 gpm for 2 hrs); remaining FSS required (20,000 gal or 170 gpm) to be provided by new fire pumps.
(2) High point is highest service elevation for all storage components except FSS, which is highest fire hydrant or service elevation in system.

BOOSTER PUMP STATIONS

The City currently owns and operates eleven booster pumping stations (BPSs) and one raw water pumping station. After completion of the Higgs BPS, the Bogey BPS will be decommissioned and the Lake Hills BPS will begin operation to serve the Lake Hills pressure zone. The characteristics of the BPSs and raw water pumping station are provided in Table 1-4. The City's BPSs pump to both open systems (pressure zones with storage reservoirs open to atmospheric pressure) and closed systems (pressure zones not open to atmospheric pressure). Open system BPSs include Darnell's, Lakeside, Bogey (to be replaced by the Higgs BPS), Boyd Road, Farnham, and Washington Street. Closed system BPSs include Highland, Hospital, High Street, Pinnacle, and Wilmorth. Soon to be completed Lake Hills and Higgs BPSs will pump to open systems.

Open System Booster Pumping Station Analysis

Based on the DOH WSDM, the City's open pressure zone booster stations must meet the following requirements:

1. The BPS shall supply the ADD in the high pressure system with the largest pump out of service.
2. The BPS shall supply a minimum pressure of 30 psi during the PHD in the supplying system and during the MDD in the high pressure system with all pumps in service.
3. During the MDD and fire demand of the supplying system, the BPS may need to include provisions to lock out the pump operation whenever either of the following conditions exists:
    a. At a suction pressure that would cause the pressure at service connections along the supplying distribution system to fall below 20 psi.
    b. At a suction pressure less than 10 psi anywhere in the suction end of the BPS piping. Storage in the high pressure system would provide water during the lock-out period.
4. It is recommended that the BPS be connected to a 24-hour alarm system.
5. Back-up power should be provided and operated through an automatic transfer switch.

A hydraulic analysis was performed to determine each open system BPS's capacity to meet the DOH's requirements discussed herein for the 6- and 20-year planning periods.

Results of the open system booster pump capacity analysis indicate that supply zone system pressures under MDD and fire flow conditions at the Lakeside BPS will not meet DOH requirements within the 6-year planning period. Improvements to address this deficiency are shown in Table 3-17 and discussed in more detail in Chapter 4.

The City plans to provide back-up power to Darnell's BPS. Back-up power availability to the Darnell's BPS is essential since this BPS provides water to the entire north shore service area of the City.

Improvements are identified in the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan to increase capacity of the Washington Street BPS to meet future water system demands. These improvements are shown in Table 3-17 and discussed in more detail in Chapter 4.

Closed System Booster Pumping Station Analysis

Based on the DOH Water System Design Manual, the City's closed pressure zone BPSs must meet the following requirements:

1. The BPS shall supply the PHD in both the high pressure system and supplying system with all pumps in service, at a minimum pressure of 30 psi at all service connections throughout the distribution system.
2. It is recommended that the BPS be able to supply the PHD in the high system and supplying system with the largest pump out of service.
3. The BPS shall be capable of meeting the fire suppression requirements (if fire flow is to be provided) by the fire pump(s), or a combination of the fire pump(s) and domestic pump(s).
4. If fire flow is to be provided in the high system, the BPS shall be capable of supplying the MDD plus the required fire flow in the high system, plus the PHD in the supplying system, at a pressure of at least 20 psi in the high system and the supplying system, and under the condition where all equalizing and fire suppression storage has been depleted.
5. If fire flow is to be provided in the supplying system, the BPS shall be capable of supplying the MDD plus the required fire flow in the supplying system at a pressure of at least 20 psi, plus the PHD in the high system at a pressure of at least 30 psi, and under the condition where all equalizing and fire suppression storage has been depleted.
6. If the public water system is located in an area governed by the Public Water System Coordination Act (PWSCA), the fire flow shall be met under the conditions in No. 4 above, even when the largest capacity booster pump is out of service.
7. It is recommended that the BPS be connected to a 24-hour alarm system.
8. Back-up power should be provided and operated through an automatic transfer switch.

A hydraulic analysis was performed to determine each closed system BPS's capacity to meet the DOH's requirements discussed herein for the 6- and 20-year planning periods. Analysis for the Wilmorth BPS is contained in the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan.

Results of the closed system BPS capacity analysis indicate that supply zone and high zone system pressures under PHD and MDD plus fire flow conditions at the Highland and Hospital BPSs do not meet DOH requirements within the planning periods of this plan. Improvements required to resolve low system pressures include upsizing various water lines within the Hospital pressure zone are indicated in Table 3-17 and discussed in Chapter 4.

In addition, improvements to increase capacity of the High Street and Pinnacle BPSs to meet MDD plus fire flow requirements are needed. The City plans to address this issue through future development within these pressures zones as it occurs. Until that time, the City will coordinate hydrant use with the fire district by painting the hydrants black and notifying the fire district of the flow conditions.

Improvements are also required at the Highland BPS to meet MDD plus fire flow conditions. These improvements are indicated in Table 3-17 and discussed in Chapter 4.

TREATMENT

As described in Chapter 1, the City receives it potable water from the outlet of Lake Chelan via its 5,600 gpm capacity raw water pump station. Raw water is filtered and treated at the City's Water Treatment Facility (WTF) prior to entry into the City's water distribution system. As described herein, improvements to increase the WTF's capacity from its current capacity of 6.7 mgd to 10 mgd will be required before the end of the 20-year planning period to meet projected water demands within the City's system.

In addition, the City has identified the need for a roof on the second backwash basin to protect backwash water from potential contaminants and eliminate a potential safety hazard.

TELEMETRY

As discussed in Chapter 1, the City operates and maintains a radio telemetry system for its water system. This system is old and components of the telemetry system have failed during inclement weather. Because of the system's age, the City has had difficulty procuring replacement parts. The City has also indicated that the remote telemetry units located at each booster station need to be replaced with more current units. Telemetry improvements are shown in Table 3-17 and discussed in more detail in Chapter 4. A detailed description of the systems configuration and operation is described in Appendix G: Operation and Maintenance.

CONSUMPTION DATA COLLECTION

The City currently collects water consumption data by physically reading meters at the meters locations throughout the City. The City plans to implement a meter upgrade program, using automatic meter reading (AMR) technologies, such as touch-read and/or radio frequency (hand-held, mobile, or fixed network). Meter upgrade improvements are shown in Table 3-17 and discussed in more detail in Chapter 4.

DISTRIBUTION SYSTEM IMPROVEMENTS

A hydraulic model was developed for the City of Chelan's water system using the CYBERNET computer model by Haestad Methods, Inc. to model the City's distribution system, reservoirs, booster pump stations and pressure reducing valves. The model is utilized to determine system component capacity for current and future water peak hour and maximum day demands and fire flow scenarios. Model runs were performed for the 6- and 20-year planning periods of this Plan. For modeling purposes, it was assumed that demands are spread evenly at nodes throughout each pressure zone. The City's largest water users and largest proposed developments water users' demands were placed at the nodes nearest their connection to the distribution system. Demands in areas of little or no development were set at zero. Modeling information and fire flow data are contained in Appendix J.

Results of the hydraulic analysis identified areas within the City's water distribution system where improvements are needed in order to provide required peak hour and/or maximum day and fire flow demands. Most of the improvements identified to alleviate these system deficiencies consist of the replacement of existing 4- and 6-inch distribution lines with 8-inch lines. Distribution system improvements are shown in Table 3-17 and discussed in more detail in Chapter 4.

Water system modeling of the recently acquired water distribution system located within the Washington Street and Wilmorth pressure zones is presented in the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan. Improvements identified within this plan are also shown in Table 3-17 and discussed in more detail in Chapter 4.

Peak Hour Evaluation

The ability of the water system to meet existing and future PHD was evaluated using the hydraulic model in accordance with design standards as outlined in Table 3-1. Improvements identified to resolve PHD deficiencies are identified in Table 3-17. A detailed description of proposed improvements including costs and a schedule for implementation is presented in Chapter 4.

Fire Flow Evaluation

The City's fire flow standards are shown in Table 3-2. The water system must have sufficient supply, storage, and distribution system capacity to supply fire-fighting requirements during MDD and also maintain a minimum pressure of 20 psi to its customers. Improvements identified to resolve MDD plus fire flow deficiencies are identified in Table 3-17. A detailed description of proposed improvements including costs and a schedule for implementation is presented in Chapter 4.

WATER SYSTEM CAPACITY ANALYSIS

Chapter 6 of the WSDM provides methodology for determining physical capacity of a water system using the ERU as the basic unit of measure. The production capacity required to serve an ERU is defined in Chapter 2 as the average amount of water used by a residential household plus distribution system leakage, or 531 gpd.

Historically, the DOH has used the physical capacity of a water system (based on the limiting system component) to establish system growth limits for the system. Table 3-16 summarizes the water system physical capacity for source, storage, and water rights. This analysis is based on future demands from Table 2-15, which uses current usage per ERU to determine future system requirements.

TABLE 3-16
2027 System Component Physical Capacity(1)

System Component	Capacity Available (ERUs)	Surplus (+) Deficit (-)
Source ADD (18 hour day)(2)	17,088	+9,689
Source MDD (18 hour day)(2)	6,527	-871
Source MDD (24 hour day)(2)	8,703	+1,304
Treatment ADD (18 hour day)(3)	14,118	+6,719
Treatment MDD (18 hour day)(3)	5,393	-2,006
Treatment MDD (24 hour day)(3)	7,190	-208
Equalizing Storage Components(4)		
Main Zone	5,287	+1,899
South Chelan Zone(5)	57	-126
Lakeside Zone(5)	93	-209
Darnell's Zone	780	-20
Golf Course Terrace Zone	501	+429
Boyd Road Zone	351	+258
Washington Street Zone	1,585	+570
ES Total	8,654	+2,800
Standby Storage Components(6)		
Main Zone	3,389	0
South Chelan Zone	903	+721
Lakeside Zone	302	0
Darnell's Zone	801	0
Golf Course Terrace Zone	344	+272
Boyd Road Zone	93	0
Washington Street Zone	3,296	+2,280
SB Total	5,831	+993
Water Rights, Qi(7)	4,488	-2,187
Water Rights, Qa(7)	4,283	+142

(1) Estimated 2027 ERU requirement = 7,399 ERU (Table 2-15).
(2) Based on 2027 raw water pump station capacity of 8,400 gpm w/one pump out of service (Table 3-4).
(3) Based on 2027 WTP capacity of 10 mgd (6,940 gpm)(Table 3-3).
(4) Eq. 6-4 WSDM; 2027 Source capacities are Main (6,940 gpm), S. Chelan (200 gpm), Lakeside (300 gpm), Darnell's (700 gpm), Golf Course Terrace (510 gpm – Higgs BPS), Boyd Road (150 gpm), and Washington Street (1,350 gpm).
(5) Although South Chelan and Lakeside reservoirs "float" off WTP reservoirs, only booster station pumping capacities used for this analysis.
(6) Eq. 6-5 WSDM, using 1 day of standby storage usage.
(7) From Table 3-6b; Qi units are gpm; Qa units are acre-ft/year.

Table 3-16 indicates that physical capacity of the City's water system will not meet projected 2027 MDD because of source and treatment capacity deficiencies. Expansion of the treatment plant beyond its 10 mgd expansion capability will be required along with further improvements to the raw water pump station to meet 2027 MDD.

Table 3-16 also indicates that the City's MDD will exceed its instantaneous water rights soon after 2013. As shown in Table 3-5, the City has pending change applications for additional instantaneous and annual withdrawal water rights that would increase the

City's total water rights to 5,350 gpm and 4,476 ac-ft, respectively. In addition, the City has applied for a new permit and it is anticipated that future growth will provide an opportunity for the City's to acquire additional instantaneous and annual withdrawal water rights through annexation or transfers.

SYSTEM DEFICIENCIES

Table 3-17 summarizes the deficiencies identified in this chapter and the improvements the City plans to implement. A schedule for the improvements planned within the next six years is presented in Chapter 4. Preliminary cost estimates are also provided in Chapter 4.

TABLE 3-17
Summary of System Deficiencies and Proposed Improvements

System Deficiency	Proposed Improvement
Source Capacity	
Current raw water intake capacity of 5,600 gpm is insufficient to meet 2027 MDD.	Add a fourth raw water pump to expand raw water intake capacity to 8,400 gpm.
The City's instantaneous water right is not adequate to meet 20-year demands.	Obtain additional instantaneous and annual water rights through pending permit and change applications and new development.
Treatment	
Current water treatment plant capacity of 6.7 mgd is insufficient to meet 2027 MDD.	Expand treatment plant capacity to 10 mgd.
Protection of backwash water from potential contamination.	Provide roof on Backwash Basin No 2.
Storage	
Pinnacle reservoir storage deficit under MDD + FF conditions.	Deficiency to be addressed with new fire pumps to supply pressure zone.
Washington Street pressure zone storage deficit.	Deficiency to be addressed with new storage reservoir to serve this zone.
Telemetry	
Old telemetry system failing, becoming obsolete.	Replace remote telemetry units at City booster pump stations.
Meters	
Old water meters need to be upgraded.	Upgrade water meters with up-to-date meter reading technologies.
Booster Stations	
Back-up power recommended for Darnell's booster station.	Provide permanent back-up generator for Darnell's BPS.
Highland BPS requires additional capacity to eliminate fire flow deficiency.	Supplement 1,000 gpm fire pump in Highland BPS with a 500 gpm booster pump to meet MDD + FF.
Washington Street BPS cannot provide future PHD requirements.	Increase capacity of BPS to 1,350 gpm to meet future PHDs.
Distribution System	
W. Woodin Avenue from Bridge to Lakeside BPS – 8" water line insufficient to provide future MDD + FF and minimum required supply system pressures to Lakeside BPS w/proposed developments.	Upsize to 16" on bridge to the Lakeside BPS.
Washington Street BPS cannot provide future PHD requirements.	Upsize to 8" water main.
Prospect St. and Alley – 3" and 4" water lines cannot provide MDD + FF.	Upsize to 8" water mains.

TABLE 3-17 con't
Summary of System Deficiencies and Proposed Improvements

System Deficiency	Proposed Improvement
Distribution System con/t	
Wapato Avenue Alley area – 6" water line insufficient to provide MDD + FF.	Upsize to 8" water main.
Hospital Area – 4" & 6" water lines insufficient to provide PHD, MDD + FF and minimum required supply and high zone pressures to Highland/Hospital BPSs.	Upsize to 8" water mains.
Stehekin Way – 6" water line insufficient to provide MDD + FF.	Upsize to 8" water main.
Junior Point – 4" dead end water line insufficient to provide MDD + FF.	Upsize to 8" water main.
El Dorado Way – 4" water line insufficient to provide MDD + FF.	Upsize to 8" water main.
Whisper View – Improvement identified in the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan to provide improved system capacity and pressures near new development.	Provide 8" water main to loop City's distribution system in this area.
Washington Street – Improvement identified in the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan to meet future demands due to anticipated growth.	Upsize to 12" water main.
Wilmorth Drive – Improvement identified in the Chelan River and Isenhart Irrigation Districts' 2007 Comprehensive Water System Plan to meet future demands due to development.	Upsize to 12" water main.