City of Leavenworth

WATER SYSTEM PLAN

JULY 2011 - *FINAL*

VARELA & ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT
PLANNING • DESIGN • MANAGEMENT • INSPECTION

City of Leavenworth

WATER SYSTEM PLAN

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CITY OF LEAVENWORTH, WASHINGTON
WATER SYSTEM PLAN

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Section 2 – Description of Water System

- The City of Leavenworth's water system consists of two pressure zones, one booster station, two wells adjacent to the Wenatchee River, one surface water treatment plant drawing from Icicle Creek, and two reservoirs.
- This Water System Plan is consistent with the City's Comprehensive Plan and Chelan County's Comprehensive Plan.

Section 3 – Planning Data

- The City serves approximately 1,363 residential and commercial connections, approximately 72% of which lie within City Limits. The City estimates its water system serves approximately 3,020 people which consists of a combination of residential and commercial customers.
- Over the past three years the City has produced an average of 332 million gallons annually. The City recorded its highest annual water production in 1987 (also refer to **Section 5.3** for water rights discussion).
- Average daily water use by an equivalent residential unit (ERU) has decreased since the City's previous Water System Plan. The City attributes this change to higher water rates and voluntary conservation by customers. An ERU currently uses approximately 304 gpd.
- The City projects water use to increase 1.2% annually; this equates to an increase of approximately 27% over the next 20 years. The City expects this growth to occur in the main zone and the existing Ski Hill zone during the 6-year planning horizon. Growth in the 20-year horizon will likely require additional Ski Hill pressure zones.
- The City has contemplated future urban growth area (UGA) boundary amendments, where they might occur, and the density at which the land included in the boundary might be built. The City has chosen to include an area north of the existing UGA as a potential area for future UGA inclusion. The City based its 2008 Water Distribution System and Sewer Collection System Master Plan on this concept. This Water System Plan carries forward the planning numbers developed in the Master Plan and infrastructure proposed herein has been sized to meet the projected demands.

Section 4 – Design Standards

- In general, the City structures its standards based on regulatory requirements, engineering judgment, industry practice, staff expertise, customer input, and aesthetic considerations.
- Some of the City's standards exceed regulatory requirements (e.g. the City endeavors to provide 40 psi minimum pressure during peak hour demand (PHD), DOH requires 30 psi minimum pressure during PHD).

Section 5 – System Analysis

- The City's wells and water treatment plant (WTP) have adequate capacity to meet existing and projected 20-year system demands with the largest producing supply facility (Well #1 or the WTP) offline. Supply facility redundancy will decrease as the City demand increases with growth.
- The WTP Operator has identified several non-critical shortcomings of the WTP that affect its ease of operation.
- Chlorination facilities at the City's wells and WTP provide continuous disinfection of the City's water supplies.
- The wells and WTP have excellent water quality and comply with all existing sampling and testing regulatory requirements.
- The City has annual water rights in the amount of 2,185.95 ac-ft and instantaneous water rights in the amount of 5.25 cfs uninterruptible and an additional 2.39 cfs interruptible. The City has filed suit against the Department of Ecology because of a dispute regarding the City's annual quantity of water rights.
- The City has adequate storage to meet existing and projected needs. However, when the City establishes additional pressure zones on Ski Hill, an additional reservoir will likely be built.
- The hydraulic analysis indicates that some high elevation areas of the system do no meet pressure goal during peak hour demand (PHD). Other isolated areas do not meet fire flow criteria under max day demand (MDD).

Section 6 – Improvements

- To increase supply redundancy and perfect unused instantaneous water rights under groundwater permit G4-29958 the City plans to expand the pumping capacity of the well field.
- The City plans several minor improvements to the WTP to improve operability/functionality: onsite maintenance water storage, expanded lab/office, and fencing around the perimeter of the WTP site. The City does not at this time plan to expand the WTP during the 20-year planning period. However, at some point beyond the 20-year planning period the City will require expanded supply facilities.
- The City does not plan to acquire additional water rights during the 20-year planning period. At some point beyond the 20-year planning period the City will need to either acquire additional water rights or reduce consumption through conservation.
- The Ski Hill area requires two additional booster zones to serve the area within the UGA. Zone 3 will be an open system with a gravity reservoir and Zone 4 will be a closed system.
- Relatively small isolated areas within the existing system do not meet the City's PHD pressure and MDD fire flow criteria. The City plans to address existing distribution system deficiencies through implementation of distribution system improvements identified in the City's Water Distribution System and Wastewater Collection System Master Plan.

- The water system requires approximately $3M in improvements to meet existing deficiencies, $6M in improvements as facilities deteriorate or no longer meet regulatory requirements, and $3M in improvements to serve future growth. Improvements total approximately $11M-12M to meet ultimate system needs.

Section 7 – Implementation

- The minor improvements planned for the WTP have potential to affect the City's ability to use the WTP as a source. It appears the City can time the modifications to coincide with low demand periods and supply the system exclusively from the wells during this period.
- Upgrading the pumps in the Zone 2 booster station will temporarily interrupt the City's ability to supply Zone 2. The City plans to time these improvements such that they occur during low demand periods when the Zone 2 standby storage can supply Zone 2 for the duration of the upgrade.
- Establishing additional pressure zones to serve the higher elevation areas on Ski Hill (Zone 3 and Zone 4) will require acquisition of property and construction of a distribution system.
- Zone 1 transmission and distribution system improvements will likely cause brief water service interruptions for existing customers and may cause traffic detours common to construction in roadways.
- Many of the planned improvements will require a DOH Project Report.
- The City will fund improvements with a combination of local reserves and a combination of the following depending on the situation: developer financing, revenue bonds, LID bonds, RD loans/grants, PWTF, and DWSRF.

Section 8 – Finances

- The City has solvent finances; revenues cover operating expenses and allow the City to allocate money each year to reserves which in turn fund capital improvements.
- The base residential monthly water rate for services inside City Limits is about $43 which includes the first 15,000 gallons of water. Commercial base water rates vary based on meter size and include the first 15,000 gallons of water.
- The City reads residential water meters monthly April through October and reads commercial meters monthly year round.
- Total system revenue varies little from year to year.
- If the City implemented $3.2M in improvements to address existing system deficiencies the impacts to residential customers' water rates would likely be an additional $5-10 per month depending on the funding package.

Capital Improvements Plan

- The Capital Improvements Plan from **Section 7** has been reproduced in this Executive Summary for reader convenience.

Table 7-2 City of Leavenworth Capital Improvements Plan

Category	Component	Project	2011-2016	2017-2031
Supply	WTP	Onsite water storage and pump system for maintenance	45,000	
		Expand lab/office	60,000	
		Fence Perimeter of WTP	20,000	
		Renovate, replace, or abandon WTP		
	Wells	Expand pumping capacity of well field	300,000	
Booster Zones	Zone 2	Upgrade booster pump capacity in Zone 2 booster station		20,000
	Zone 3	New booster station, reservoir, and transmission main to serve Zone 3		1,100,000
	Zone 4	New closed system booster station to serve Zone 4		400,000
Distribution System	Supply Transmission	3,400 LF of 18" main on Icicle Rd from wells t-main to Icicle Reservoir	600,000	
		2,000 LF of 20" main from Icicle Reservoir to Commercial St & Mill St	460,000	
	Downtown Transmission	1,400 LF of 18" main on Commercial St from Mill St to 3rd St	290,000	
		1,600 LF of 18" main on Commercial St from 3rd St to 8th St (1)	330,000	
		2,350 LF of 12" main on Commercial St from 8th St to 14th St	350,000	
		2,350 LF of 12" main on Front St from 8th St to 14th St	350,000	
	Deteriorating Mains	1,400 LF of 16" main on East Leavenworth Rd (problem area) (2)	620,000	
		15,000 LF of 16" main on East Leavenworth Rd (2)		2,000,000
		12,400 LF of 18" main from WTP to East Leavenworth Rd		2,200,000
	PRV	PRV between Zone 2 (Titus Rd) and Zone 1 (Chumstick Hwy)	40,000	
Non-Capital Items	Water Rates	Water Rates Study		15,000
	WUE	Budget for Water Use Efficiency measures	1,000	1,000
		Total	3,466,000	5,736,000

(1) *The City's Master Plan indicates that either 16" or 18" main will meet the City's criteria; the CIP assumes the City installs 18" main.*

(2) *The City's Master Plan calls for 12" or 16" main depending on location of future storage; this CIP assumes the City will install the 16" main*

1.0 INTRODUCTION

The City of Leavenworth initiated this Water System Plan (WSP) in compliance with Washington State Department of Health (DOH) requirements. This WSP has been prepared in accordance with WAC 246-290 and the DOH Water System Design Manual.

City staff provided extensive assistance in the development of this Water System Plan. Dave Schettler, Connie Krueger, Chantell Steiner, Joel Walinski, Stan Adams, Tracy Valentine, and Terry Gildersleeve deserve special recognition for their contributions.

2.0 DESCRIPTION OF WATER SYSTEM

2.1 Ownership and Management

The water system is owned and operated by the City of Leavenworth.

DOH ID Number:	46500
Address:	City of Leavenworth 700 Hwy 2 PO Box 287 Leavenworth, WA 98826
Phone:	(509) 548-5275
Public Works Director:	Dave Schettler, P.E.
Water Treatment Plant Operator:	Stan Adams (WTPO-2)
Water Distribution Operator:	Terry Gildersleeve (WDM-2)

2.2 System Background

2.2.1 History of Water System Development

Leavenworth developed rapidly as a railroad and lumber town in the early 1900's, reaching a peak population of almost 1800 by 1920. After closure of the lumber mill and rerouting of the railroad in the 1920's, the population declined, and Leavenworth settled into its role as a small town based on fruit, forest products and local trade.

The revitalization of Leavenworth began with a study in 1962, which resulted in the creation of a Bavarian theme for Leavenworth, including remodeling of the buildings located in the downtown commercial district, public facility improvements, and the initiation of seasonal festivals. The efforts resulted in the emergence of tourism as a principle source of economic activity and growth in the City.

2.2.2 Geography/Location

The City of Leavenworth is located along State Highway 2 in the Wenatchee River valley near the confluence with Icicle Creek. High mountains rise above the valley floor on all sides of the City. Substantial variations in elevation necessitate the use of multiple pressure zones to provide water service.

2.2.3 Tourism

Tourism is a substantial component of the local economy in Leavenworth. Sources estimate that up to 2,000,000 people visit Leavenworth annually and that some festival weekends attract as

many as 60,000 tourists. As a result, water use by businesses can vary substantially with tourism peaks. These large variations in water use necessitate vigilant observation of water demand conditions by water treatment plant operators.

2.2.4 Neighboring Purveyors

The nearest public potable water system is located in Peshastin, approximately 4 miles away. In addition, the Upper Ski Hill Water Association and the River Bend Park Water System (both of which are private potable water systems) are located within the City's urban growth area (UGA).

2.2.5 Ordinances

Refer to **Appendix D** for the City's water/sewer ordinances.

2.3 Inventory of Existing Facilities

The City has water customers both inside and outside the City Limits. The water system utilizes two pressure zones designated Zone 1 and Zone 2. The surface water treatment plant (WTP) and wells supply Zone 1 and the Icicle reservoir provides storage for Zone 1. In general, the WTP provides primary water supply and the wells provide secondary supply when system demands exceed capacity of the WTP. The intake for the WTP is on Icicle Creek and the wells are adjacent to the Wenatchee River. The Ski Hill booster station supplies Zone 2 and the Ski Hill reservoir provides storage to Zone 2; the City constructed the Ski Hill booster station and reservoir in 2005.

The following sections provide a detailed description of system components.

2.3.1 Surface Water Supply – Icicle Creek Water Treatment Plant

The City's primary water supply is the Icicle Creek water intake and filter plant, located about 4½ miles southwest of the City. The filter plant was constructed in 1969 and is an Infilco direct filtration dual media plant, with a pretreatment reaction tank, four sand-anthracite filter beds totaling 476 SF filter area, 133,000 gallon chlorine contact basin, and two vertical turbine finished water pumps. The plant was originally designed for a maximum 4 MGD (about 6 gpm/sf including backwash loss at 5%). The intake pipe limits practical plant capacity to approximately 2.3 MGD; the flocculation chamber has a cold water capacity of approximately 2.0 MGD and a warm water capacity of at least 2.3 MGD. The plant finished water clearwell and contact basin hydraulic grade line (HGL) are approximately at elevation 1,367, which is roughly 26 feet higher than the Icicle reservoir overflow elevation (1,341); this allows gravity supply from the filter plant at about 2.0 MGD (1,390 gpm). Prior to the installation of the chlorine contact basin, the WTP utilized finished water pumps when necessitated by demand. The pumps are 20 HP and 125 HP, and are manually controlled. The larger pump has a maximum rated capacity of approximately 4 MGD (2,800 gpm) and the smaller pump (which is also used for pumping backwash supply) has a capacity of approximately 1.9 MGD (1,350 gpm). However, after installing the chlorine contact basin between the pumps and the transmission main, the WTP lost the ability to pump directly to the transmission main using the finished water pumps (i.e. the pumps can no longer be used for their original purpose of increasing the flow rate out of the WTP).

Icicle Creek water quality varies widely depending upon the season. Water turbidity increases during spring snowmelt and periodically during heavy rainfalls in the summer. In general, turbidity remains low during autumn, winter and most of summer. The water is usually very cold, and has low alkalinity. In the past, these raw water characteristics have made the Icicle Creek supply difficult to treat; however, modern water chemistry has made these variations in raw water quality largely innocuous to the WTP's ability to meet treatment requirements.

2.3.2 Ground Water Supply – Wenatchee River Well Field

In 1989 the City constructed two wells in the vicinity of the City's old collector well. The table following summarizes the wells details:

Table 2-1 Description of Wells

Description	Well #1	Well #2
Total Well Depth	106 ft.	94 ft.
Casing Diameter	12"	16"
Screen Diameter	12"	16"
Pump Type	Lineshaft	Submersible
Pump Motor Horsepower	125 HP	75 HP
Pump Speed (nominal)	1800 RPM	3600 RPM
Pump Capacity (approximate)	1300 gpm	750 gpm

(3) *Note that both wells' log incorrectly states the legal description. The correct legal description for each well is SW¼ SE¼ NE¼ of Section 14, T 24N, R17E.*

The water surface level in the Icicle reservoir controls operation of the well pumps. The operator can manipulate lead/lag well pump and on/off levels via the SCADA system. The City has equipped Well #1 with a soft start and Well #2 has variable speed capability. The City conditions power coming into the pump station to ensure compatibility with the soft start and VFD.

The well pump station includes a chlorination room; the chlorine gas injection system provides continuous chlorination when the well pumps operate. A variable speed chlorine gas injection pump matches dosing with flow rate from either or both wells. A 24" ductile iron transmission main connects the wells to the distribution system; this large diameter transmission main provides approximately 10 minutes chlorine contact time when both pumps operate from point of injection to the first customer service.

2.3.3 Booster Stations

The City currently has only one booster station.

The Ski Hill booster station pumps from Zone 1 to Zone 2. The booster station fills the Ski Hill reservoir. At present two identical 10 HP pumps provide approximately 200 gpm each to Zone 2. The table following summarizes booster station details:

Table 2-2 Description of Booster Station

Description	Ski Hill Booster
Building/Enclosure Type	CMU Block Building
Suction Zone	Zone 1
Discharge Zone	Zone 2
Number of Pumps	Two (identical)
Pump Type	Close Coupled End Suction
Pump Motor Horsepower	10 HP (each)
Pump Speed (nominal)	3,600 RPM
Pump Capacity (approximate)	200 gpm (each)

The booster station piping has provision for installation of a third pump as eventual growth in Zone 2 causes demand to increase. However, present demand in Zone 2 does not sufficiently cycle the Ski Hill reservoir during the winter months and can cause ice to accumulate and water quality to deteriorate. The City installed a diaphragm valve between the suction and discharge piping where the third pump will eventually sit; this valve bleeds back approximately 100 gpm to Zone 1 in order to cycle the Ski Hill reservoir. As Zone 2 demands increase with growth the City will eventually cease bleeding back water to Zone 1.

2.3.4 Reservoirs

The City has two reservoirs: the Icicle reservoir serves Zone 1 and the Ski Hill Reservoir serves Zone 2. The table following summarizes reservoir details:

Table 2-3 Description of Reservoirs

Description	Zone 1 (Icicle) Reservoir	Zone 2 (Ski Hill) Reservoir
Zone Served	Zone 1	Zone 2 and Zone 1 via PRVs
Year Built/Rehabilitated	1938, 1954, 1970, 1990, 2008	2004
Construction Type	Cast in Place Concrete	Welded Steel
Shape	Rectangular	Round
Approximate Footprint	50 ft x 120 ft	74 ft diameter
Depth to Overflow	18.5 ft	23.25 ft
Approximate Overflow Elevation	1,341	1,423.75
Approximate Base Elevation	1,322.5	1,400.5
Approximate Volume	800,000 gal	700,000 gal

The Icicle reservoir was originally constructed in 1938, and is located on a rocky hillside at the southwest end of the City near the intersection of Hwy 2 and Icicle Rd. In 2008 the City demolished the Icicle reservoir and rebuilt the existing structure on the same site. A 14” ductile iron main installed in 1990 connects the Icicle reservoir to the 12” transmission/distribution main on Icicle Road.

The City constructed the Ski Hill reservoir in 2005 at the same time it built the Ski Hill booster station. These improvements established Zone 2 and allowed the City to serve higher elevation portions of the Ski Hill area unserviceable by the main zone. The main transmission link between the Ski Hill booster and the Ski Hill reservoir consists of approximately 2,400 LF of 12” main and 1,900 LF of 16” main.

2.3.5 Transmission and Distribution System

A 16" steel transmission main conveys treated water northeast from the WTP until it branches into a 12" steel main on Icicle Rd and a 10" steel main on E Leavenworth Rd. These two mains convey water from the WTP to the City; the mains run from near the south end of the Icicle valley to the south limits of the distribution system. The transmission mains from the WTP on Icicle Rd and E Leavenworth Rd also serve as distribution mains with a combined total of approximately 300 service connections. Total length of 16" main from the WTP to the intersection of E Leavenworth Rd and Icicle Rd is approximately 12,300'. From that point approximately 11,200' of 12" main runs to the City along Icicle Road and about 16,000' of 10" runs to the City along E Leavenworth Road. The 24" well field transmission main connects to the 12" main on Icicle Rd approximately one mile south of the City near the Wenatchee River Bridge. Supply from the well field flows into the Icicle Road main through a 24" transmission main approximately 1000' in length. Records indicate the City installed the 10" main on E Leavenworth Rd. in the 1930's, and the 16" and 12" mains on Icicle Rd between 1955 and 1967.

The water distribution system within the City consists of mains ranging in diameter from 4" to 12". Pipe materials include steel, cast iron, ductile iron, and PVC. Steel mains generally are dipped and wrapped with o-ring type joints while the cast and ductile iron mains have push-on rubber gasket type joints. The Icicle Valley south of the City has minimal water distribution facilities; pipes in this area consist mostly of privately owned small diameter service lines connected to the transmission/distribution mains on Icicle Rd and E Leavenworth Rd. This plan does not contain detailed records of pipe sizes and locations for the services along Icicle Road and East Leavenworth Road.

The table following summarizes total lengths and diameters of distribution/transmission mains:

Table 2-4 Lengths of Transmission/Distribution Mains

Main Diameter	Length
4"	9,100
6"	21,600
8"	30,100
10"	18,600
12"	26,400
14-24"	17,100
Total	122,900

2.3.6 Number of Service Connections

DOH's 2008 Water Facilities Inventory (WFI) Form indicates the City has 1,351 service connections and that the system has approval for up to 2,234 connections (see **Appendix B** for City's most recent WFI Form). The City last updated the WFI form in November 2008; the actual current number of connections may not match exactly the number of connections stated on the WFI. The City updates the WFI annually to ensure the information contained therein remains current.

Most of the residential and small commercial services within the City are ¾" iron pipe, with a corp stop and copper meter setter which is connected to iron service pipe. The City meters all service connections.

2.3.7 Interties with Neighboring Water Systems

Leavenworth has no interties with other water systems.

2.4 Overview of System Operation

From a supply standpoint, the WTP Operator generally uses the WTP as the primary source of supply and uses the wells to supplement supply as demands fluctuate throughout the day. Seasonally the Operator adjusts the various sources of supply to match demand conditions.

2.5 Related Planning Documents

Planning activities of other institutions or government entities can affect planning for water utilities. The City of Leavenworth seeks to reduce potential conflicts and overlaps in planning through coordination with local entities that may impact the City's water system. The sections following outline the City's efforts to coordinate the planning efforts of this Water System Plan with entities that have interest.

2.5.1 City of Leavenworth Water/Sewer Master Plan

In 2008 the City undertook a planning effort relating strictly to the City's water distribution system and sewer collection system utilities. The City's Water Distribution System and Sewer Collection System Master Plan (2008) is not required nor governed by the Growth Management Act (GMA). The Master Plan goes beyond the 20-year planning period required by the GMA and includes area north of the existing UGA that may in the future become part of the UGA. These projections are discussed in greater detail in **Section 3.2.2**.

The Master Plan estimates the build-out development potential for the Leavenworth UGA and future service area (UGA and potential expansion area) and identifies the water and sewer infrastructure needed to serve the future population. This Water System Plan contains numerous references to the Master Plan because the City has chosen to oversize some of the water system infrastructure improvements selected herein to meet the growth projected in the Master Plan. As such, this Water System Plan is consistent with the Master Plan.

2.5.2 City of Leavenworth Comprehensive Plan

The City's Comprehensive Plan lays out a vision for the future of Leavenworth during a 20-year period and fulfills the requirements of the Growth Management Act; the City updates the Comprehensive Plan annually. This Water System Plan is consistent with the City's Comprehensive Plan. Refer to **Appendix A** for a copy of the City's planning consistency checklist.

2.5.3 Chelan County Comprehensive Plan

The City believes this Water System Plan is consistent with Chelan County's Comprehensive Plan. It is important to note that the population projections used within this Plan are for the purposes of this Plan only and do not reflect those population projection which were agreed upon by Chelan County and its incorporated cities via interlocal agreement to aid in distribution of OFM population projections pursuant to the requirements of the Growth Management Act.

2.5.4 Water Resource Inventory Area (WRIA) 45 Watershed Plan

The City believes this Water System Plan is consistent with Water Resource Inventory Area (WRIA) 45's Watershed Plan.

2.6 Existing Service Area Characteristics

2.6.1 Existing Service Area

Figure 2 contains a schematic map of the City's existing water system facilities. This Figure shows locations of the water treatment plant, wells, reservoirs, booster station, water mains, and pertinent elevation data as needed to understand the hydraulics of the system.

2.6.2 Zoning and Land Use

Figures 1A and **1B** contain current zoning.

2.7 Retail Service Area and Water Rights Place of Use

Figure 1A shows the City's Retail Service Area (RSA) boundary; the City intends the RSA to be identical to the UGA boundary defined in the City's Comprehensive Plan. **Figure 1A** also shows the City's Service Area Expanded Water Rights Place of Use Boundary in accordance with the 2003 Municipal Water Law.

The City has special policies concerning water service in the area outside of the City Limits and UGA/RSA but within the water service area boundary. The City originally provided service in this area prior to the GMA. This area is outside the City Limits and UGA/RSA but the City provides water service in this area under limited circumstances.

The City's Comprehensive Plan states the following on this topic:

> *Capital Facilities Element, General Goal 1, Policy 9:*
> *Consumption of the City's water rights should be limited to the urban growth area and the incorporated City limits.*
> *Rationale: Allowance of additional hook-ups outside of the City and urban growth area encourages residential densities beyond those of a rural nature. This policy allows the City to continue to be a limited purveyor of water while not promoting additional urban sprawl.*
>
> *Capital Facilities Element, General Goal 1, Action Items:*
> *Additional connections to the City of Leavenworth water system shall not be allowed outside of the urban growth area or the incorporated City limits except for:*

- *A water hook-up outside the urban growth area may be allowed when a person has provided documentation that the lot was legally created prior to March 12, 1996 and at least two attempts to drill wells in different locations on parcels 5 acres or greater and one attempt on parcels less than five acres down to bedrock yielded no potable water.*
- *Water hook-up may be allowed for a recorded plat or short plat in situations where the City indicated that water would be available and the County approved the lot sizes and final plat based on the City's commitment to provide water.*
- *Water hook-up may be allowed if the lot was legally created prior to March 12, 1996, PROVIDED, the applicant upgrades or installs a new 8 inch water main; however, the City Public Works Director may authorize connection, but not extension to an existing City-approved substandard main if the substandard main meets the requirements of WAC 246-290-230.*
- *The City of Leavenworth may impose a moratorium on the future hook-ups in the Icicle Road-East Leavenworth Road area when the 150 water connections authorized by Resolution 8-1992 have been consumed.*

In addition, City Ordinance No. 1355 outlines the conditions under which the City will allow additional connections in the area outside of the retail service area, but within the water service area boundary:

- A water connection may be allowed when a person has provided documentation that the lot was legally created prior to March 12, 1996 and at least two attempts to drill wells in different locations on parcels 5 acres or greater and one attempt on parcels less than five acres down to bedrock yielded no potable water.
- Water connection may be allowed for a recorded plat or short plat in situations where the City indicated that water would be available and the County approved the lot sizes and final plat based on the City's commitment to provide water.
- Water connection may be allowed if the lot was legally created prior to March 12, 1996, PROVIDED, the applicant upgrades or installs a new 8 inch water main; however, the City Public Works Director may authorize connection, but not extension to an existing City-approved substandard main if the substandard main meets the requirements of WAC 246-290-230.
- Multiple structures located on one lot which share one water connection shall not be allowed to split the connection into two or more for purposes of subdividing the lot.

As alternative to the criteria outlined above, property owners outside the UGA and RSA can petition the City for inclusion in the UGA and RSA.

2.8 Duty to Serve and Conditions of Service

The City has a duty to provide service to all new connections within the RSA (refer to **Figure 1A** for RSA and refer to **Section 2.6.2** for conditions of service pertaining to those areas outside of the existing retail service area but inside of the water service area boundary) when the circumstances meet four threshold factors (see RCW 43.20.260):

1. The City has sufficient capacity to serve water in a safe and reliable manner.
2. The service request is consistent with adopted local plans and development regulations.
3. The City has sufficient water rights to provide service.
4. The City can provide service in a timely and reasonable manner.

The City's is working on additional regulations to outline conditions for water service. The City's process for addressing a request for service determines whether the request meets the four threshold factors defined in RCW 43.20.260.

Process for Requesting Service
The City is currently working on refinement of this process and therefore this information is not provided at this time.

System Capacity Determination
The City consults the Water System Plan, Comprehensive Plan, and applicable regulations to see if obvious issues exist that would prevent service of an additional customer. The City consults the City Engineering Consultant if it appears the system may not have capacity to serve the proposed connection. The City Engineering Consultant then conducts an analysis to ascertain whether sufficient system capacity exists (supply, storage, distribution system, water rights, etc.) to serve the requesting customer and determines what additional improvements are required to provide service. Specific financing requirements depend on a variety of factors; in general, the customer requesting service is responsible for financing the system improvements necessary to provide service.

Non-Technical Conditions Affecting Provision of Service
Those requesting annexation must comply with relevant City ordinances and development codes. The City can only provide service if adequate water rights are available to serve the requestor (see System Capacity Determination above).

Denial of Service and Appeals
The City is in the process of developing a policy for denial of service and appeals.

2.9 Service Area Agreements

In the interest of efficient planning, adjacent water systems can establish service area agreements to prevent overlap of future service areas. This helps prevent duplication and/or costly over sizing of system facilities. The Upper Ski Hill Water Association and the River Bend Park Water System are non-expanding water systems inside the City's UGA. At present the City does not have a service area agreement with the Upper Ski Hill Water Association or River Bend Park Water System nor has one been proposed by the City or either of the two entities.

2.10 Service Policies and Regulations

Title 13 of the City's Municipal Code governs the City's water and sewer systems. The following Table summarizes topics relating to the water system from Title 13.

Table 2-5 Service Policies and Regulations

Section	Title
13.04.010	Purpose
13.04.020	Scope
13.04.040	Definitions
13.04.040	Mandatory domestic service and private irrigation wells
13.04.050	Application, contract and installation of new service
13.04.060	Owner of rental properties responsibilities
13.04.070	Meter reading, billing and adjustments
13.04.080	Payment of bills
13.04.090	Provisions for shutoff of water
13.04.100	Service charges
13.04.110	Monthly water rates and tap fees
13.04.120	Mailing and receiving city communications
13.04.130	Change of occupancy
13.04.140	Transfer of previous unpaid accounts
13.04.150	Resale
13.04.160	Point of service, delivery, care and ownership of facilities
13.04.170	Repair and maintenance of service lines
13.04.180	Customer's responsibility for city property
13.04.190	Right of access
13.04.200	Inspection
13.04.210	Meter tests
13.04.220	Separate meter for each class of service
13.04.230	Home occupations
13.04.240	Water use during fire
13.04.250	Fire protection piping
13.04.260	Fire hydrant--Obstruction prohibited
13.04.270	Fire hydrant--Unauthorized use prohibited
13.04.280	Fire hydrant spacing—Installation required
13.04.290	Right to restrict water use
13.04.300	Water saver devices required
13.04.310	Cross-connection control
13.04.320	Negligent use, condition of customer's facilities
13.04.330	City representation by employees
13.04.340	Violations

The City of Leavenworth has begun work on comprehensive development policies and regulations. The draft documents contain policies and requirements for development within the City limits and the UGA. In 2011, City staff plans to continue work on the draft documents to move toward final adoption.

The table following summarizes the topics of the draft development policies and regulations. Please note that each of the topics included in this list may not be addressed and others not mentioned below may be introduced when the final version of the ordinances are adopted.

Table 2-6 Development Policies and Regulations

Description
Sections
Purpose and Limitations
Policy Goals
City Authority and Responsibilities under GMA
Policy Questions
Additional Considerations
Development Policy
Development Agreements
Connection to City Water, Wastewater, or Stormwater Systems
Access to City Infrastructure Facilities and Capacity
Infrastructure Requirements
Financing
Water Rights
Design Standards

2.11 Satellite Management

At present the City does not manage or operate any private systems. Leavenworth does not seek to become a satellite management agency (SMA). The City may consider take over a failing water system located within or adjacent to the service area if ownership, management, financing, and capital improvement issues were worked out in a satisfactory manner in advance.

2.12 Complaints

Water system customers may register complaints at City Hall. The City deals with complaints on a case by case basis. Complaints which cannot be resolved by City staff can be brought to the City Council for further consideration.

3.0 PLANNING DATA

3.1 Current System Data

3.1.1 Types and Numbers of Connections

The Table following contains the City's connections and dwelling units statistics as of Fall 2009.

Table 3-1 Connections and Dwelling Units

Class	Description	Connections	Dwelling Units	Comments
Residential	Inside City Limits	679	679	
	Outside City Limits	353	353	
	Senior inside City Limits	15	15	Subsidized
	Senior outside City Limits	7	7	Subsidized
	Multifamily inside City Limits	17	38	Duplexes, triplexes, and condos
	Residential Subtotal	1,071	1,092	
Commercial	Multifamily inside City Limits	62	440	Apartments
	Multifamily outside City Limits	1	8	Apartments
	Inside City Limits	205	0	Businesses
	Outside City Limits	24	0	Businesses
	Commercial Subtotal	292	448	
	Total	1,363	1,540	

3.1.2 Population

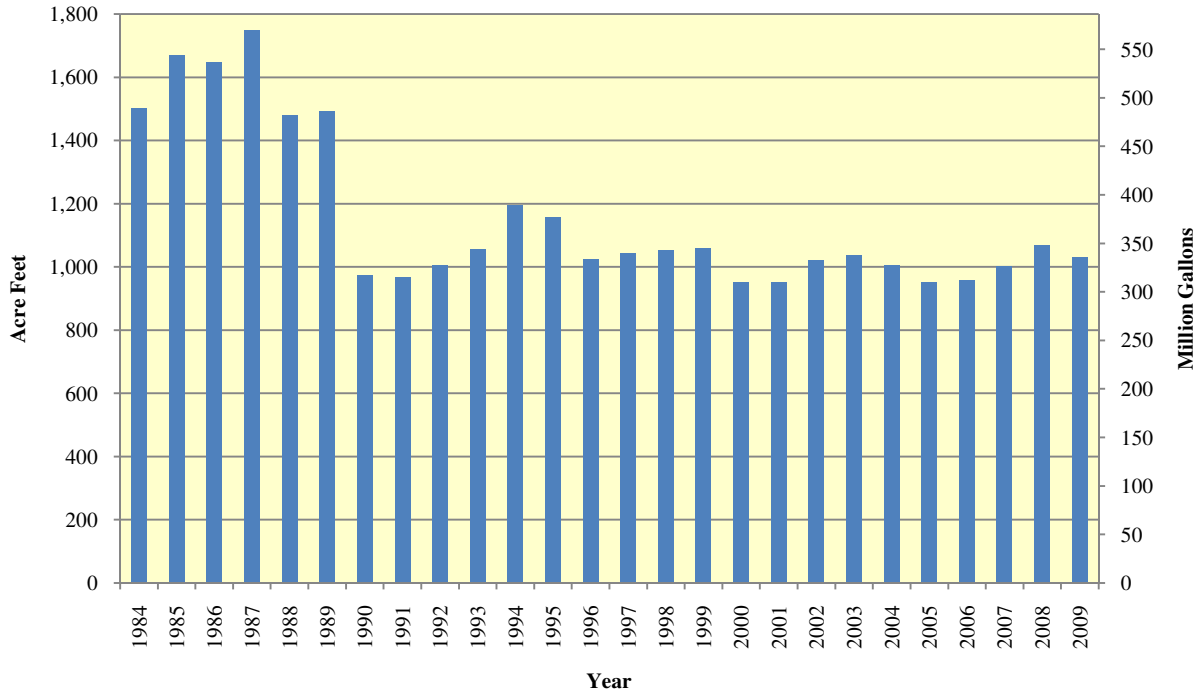
The City's existing water service area shown on **Figure 1A** includes homes and businesses both inside and outside City limits. The Washington State Office of Financial Management (OFM) estimates the current population within City Limits at 2,300. The following calculations estimate the total water service area population.

Population within City limits	2,300
Dwelling units within City Limits	1,173
Average occupancy per DU	2.0
Dwelling units outside City Limits	360
Estimated residents outside City Limits	720
Estimated total current water service pop.	3,020

3.1.3 Historical Source Production

The Figure following shows the trends in annual water production over the past two decades. The City perfected its highest quantity of water rights in the mid 1980s; refer to **Table 5-4** in **Section 5.3**. In the late 1980s annual system demand decreased by approximately 30% when the City began metering all services. The Figure illustrates the dramatic affect metering of services can have on system demand.

Figure A Historical Source Production



3.1.4 Current Source Production and System Demands

The Table following shows system production and demand for the past three years.

Table 3-2 Existing Source Production and System Demands

Description	Units	2007	2008	2009	Average
Annual	MG	324	342	331	332
	ac-ft	994	1,050	1,016	1,020
ADD	gpd	887,671	936,986	906,849	910,502
	gpm	616	651	630	632
MDD (1)	gpd	1,956,000	2,140,000	2,330,000	2,142,000
	gpm	1,358	1,486	1,618	1,488
PHD (2)	gpm	2,294	2,508	2,729	2,510

(1) *Based on actual MDD recorded by system Operator. The City's average ADD:MDD peaking factor for 2007-2009 is approximately 2.35.*

(2) *PHD values calculated using Equation 5-1 from DOH 2009 Water System Design Manual (N = 2,981 ERUs). The system Operator reports that City PHD varies between 2,000-2,300 gpm; the Operator bases his estimate of PHD on reservoir levels, well pump operation, and water treatment plant operation.*

3.1.5 Customer Water Use and Seasonal Consumption Patterns

The City meters all connections to the water system. Each customer receives a monthly bill that reflects the customer's consumption during the billing period. The following Table contains the City's historical water use organized by customer class as reported in the City's 2002 Water System Plan.

Table 3-3 Historical Water Use by Customer Class

Customer Class	1998		1999		2000		Average	
	(MG)	(percent)	(MG)	(percent)	(MG)	(percent)	(MG)	(percent)
Residential	133	39%	151	44%	129	42%	131	40%
Commercial	159	46%	149	43%	136	44%	148	45%
Unaccounted (1)	51	15%	44	13%	46	15%	47	14%
Total Produced	343	100%	344	100%	311	100%	326	100%

The City upgraded its water billing system in 2007; the first full year recorded in the new billing system was 2008. The Table following contains the City's current water use organized by customer class.

Table 3-4 Current Water Use by Customer Class

Customer Class	2008		2009		Average	
	(MG)	(percent)	(MG)	(percent)	(MG)	(percent)
Residential	87	25%	119	36%	103	31%
Commercial	245	72%	200	61%	223	66%
Unaccounted (1)	10	3%	12	4%	11	3%
Total Produced	342	100%	331	100%	337	100%

(1) *Also see **Section 9** for a discussion of the City's unaccounted/non-revenue/distribution system leakage.*

The water use data contained in **Tables 3-4** and **3-5** indicates that the City's water use patterns have changed significantly over the last decade; in particular, the ratio of residential to commercial water use has decreased from a 40/45 split in 1998-2000 to a 31/66 split in 2008-2009. The possibility exists that during the City's billing system upgrade in 2007 a number of users previously classified as residential in the 1998-2000 data were reclassified as commercial in the 2008-2009 data. However, the City has been unable to confirm this possibility. The City attributes the apparent changes in residential and commercial consumption patterns to increases in water rates and differing demand elasticity between the residential and commercial customer classes.

The City's total water production has not increased over the last ten years, which shows that the City as a whole has not increased water usage. The City has reduced the unaccounted for portion of water from an average of 14% in 1998-2000 to an average of 3% in 2008-2009; the City meets the distribution system leakage (DSL) standard of less than 10% set forth in WAC 246-290-820 (refer also to discussion in **Section 9**). Decreasing unaccounted for water has allowed the City to add connections without increasing total system water production.

The rate of consumption within customer classes changes seasonally throughout the year. The City has two main customer classes: residential and commercial. The City reads commercial meters every month and residential meters five months per year (May through September) which

provides insight into the summer/winter consumption ratio. The Table following shows the estimated percentage use by each customer class by season.

Table 3-5 Seasonal Consumption Patterns

Season	Residential	Commercial
Summer	75%	65%
Winter	25%	35%
Total	100%	100%

3.1.6 Equivalent Residential Units

The Washington State Department of Health (DOH) defines an equivalent residential unit (ERU) as the amount of water consumed by a typical full-time single family residence. Calculating the amount of water consumed by a typical full time single family residence requires a system to possess accurate water volume sales records for a one year period for single family connections.

The Table following contains the City's historical ERU daily consumption as reported in the City's 2002 WSP.

Table 3-6 Historical ERU Daily Water Use

Year	Daily ERU Consumption (gpd)
1998	357
1999	423
2000	385
Average	389

The following calculations show the City's water use ERU for 2008 and 2009:

2008
Volume sold to residential customers: 87 MG (Average of 2008 & 2009, see **Table 3-4**)
Number of residential connections: 1,071 (see **Table 3-1**)
Average annual use per residential connection: 87 MG / 1,071 residential connections ≈ 81,200 gal
Average daily use per residential connection: 81,200 gal / 365 days ≈ 222 gal

2009
Volume sold to residential customers: 119 MG (Average of 2008 & 2009, see **Table 3-4**)
Number of residential connections: 1,071 (see **Table 3-1**)
Average annual use per residential connection: 119 MG / 1,071 residential connections ≈ 111,000 gal
Average daily use per residential connection: 111,000 gal / 365 days ≈ 304 gal

As shown in **Table 3-6** and the preceding calculations, the City's water use ERU has fluctuated between 222 gpd and 423 gpd. The 2008-2009 ERU values suggest that the City has decreased its average use per household since 1998-2000. However, due to the previously discussed change in the City's billing system in 2007, comparing the 1998-2000 data to the 2008-2009 data may not be like comparing apples and oranges.

For the purpose of this WSP, the City chooses to use the water use ERU of **304 gpd** calculated from the 2009 data. The following calculations estimate the total number of ERUs currently served by Leavenworth:

Commercial ERUs	
2009 commercial metered volume:	200 MG
Average daily commercial metered volume:	200 MG / 365 days ≈ 548,000 gpd
Number of Commercial ERUs:	548,000 gpd / 304 gpd/ERU = 1,802 ERUs
Unaccounted for ERUs	
2009 unaccounted for volume:	12 MG
Average daily unaccounted for volume:	12 MG / 365 days ≈ 32,900 gpd
Number of unaccounted for ERUs:	32,900 gpd / 304 gpd/ERU = 108 ERUs
Residential ERUs	1,071
Commercial ERUs	1,802
Unaccounted for ERUs	+ 108
Total ERUs	2,981

3.2 Demand Projections

3.2.1 Projected Land Use

The City's UGA extends mostly to the north of City Limits. **Figures 1A** and **1B** show planned land use (land use shown in **Figures 1A** and **1B** was current as of April 2010; refer to the current City and County Comprehensive Plans for current land use and zoning).

3.2.2 Projected Population and ERUs

The Washington State Office of Financial Management (OFM) Forecasting Division develops official State and local population estimates for use in the allocation of certain State revenues and for use in growth management and other planning functions. The OFM is the State agency responsible for administering the US Census Bureau State Data Center Program in Washington State. The OFM projects population changes for all counties in the State. In 2007 OFM undertook its most recent update of the county population projections. The following table contains the population projections published by the OFM for Chelan County.

Table 3-7 OFM Projected Population for Chelan County

Projection Series	2007 Population	2010 Population	2016 Population	2030 Population	Average Annual Growth Rate [1]	
					2010-2016	2016-2030
Low	69,200	70,174	73,752	80,009	0.83%	0.58%
Medium	69,200	75,093	81,011	93,523	1.27%	1.03%
High	69,200	80,050	88,296	107,177	1.65%	1.39%

(1) *These values are calculated from the Chelan County population projections published by the OFM.*

As shown in the preceding table, the population of Chelan County projected by OFM works out to annual growth rates ranging from 0.58% to 1.65% depending on time frame and projection series. It is important to note that the population projections in the preceding Table are for the purposes of this Plan only and do not reflect those population projections which were agreed upon by Chelan County and its incorporated cities via interlocal agreement and a lengthy political process to aid in distribution of OFM population projections pursuant to the requirements of the Growth Management Act. The date in this table is only shown to provide basic information on typical annual growth rates.

In most systems, population growth correlates directly with water demand growth. However, Leavenworth's population and water system connections have grown steadily over the last 20 years, but the City has managed to limit the growth of annual system water production through conservation (refer to **Figure A**). Due to the lack of obvious correlation in recent years between system population growth and total system water production, the City chooses to project water demand growth based on the judgment of City Staff and its Engineering Consultant. The City projects water demand growth to occur at 1.2% annually. At 1.2% annual growth, water system demand will increase by approximately 7.4% (from present demands) for the 6-year planning period and 26.9% (from present demands) for the 20-year planning period.

Water mains generally have a service life of approximately 50 years. Unlike other components of water system infrastructure (wells, reservoirs, booster stations, etc.) systems generally cannot add transmission capacity incrementally as a system grows. Sizing transmission and distribution system improvements for a 20-year projection can in some cases lead to the need for additional transmission capacity long before a particular water main has served its useful life. For this reason, the City has chosen to estimate build-out demands for the Future Service Area to aid in sizing transmission and distribution system improvements; the build-out demand estimate looks only at water use equivalent residential units (ERUs) and does not incorporate population projections in any way. In 2008 Leavenworth performed a buildable lands analysis in conjunction with a Water Distribution System and Wastewater Collection System Master Plan and a potential UGA boundary revision application. The buildable lands analysis included the UGA and land outside the existing UGA that may eventually become part of the UGA (see Future Service Area on **Figure 1A**). The Master Plan estimates the demands the system will experience when the existing UGA and some potential UGA expansion areas reach build-out. For the purposes of this Water System Plan the build-out demands are referred to as ultimate demands. The Table following contains the City's projected ERUs for established planning horizons.

Table 3-8 Projected Total System ERUs

Time Frame	ERUs
Current (1)	2,981
6-year (2)	3,202
20-year (2)	3,784
Ultimate (3)	7,852

(1) *Refer to **Section 3.1.6** for assumptions governing present ERU calculation.*
(2) *Water use ERUs assumed to increase at 1.2% annually. Refer to **Section 3.2.2** for growth rate rationale.*
(3) *The ultimate ERU number contained in this Table comes from the City's Water Distribution System and Wastewater Collection System Master Plan; the Master Plan contains an estimate of system ERUs required for the development of the current UGA and its potential expansion area north of the existing UGA (refer to discussion in preceding paragraph).*

3.2.3 Distribution of Projected Growth ERUs

Addition of new customers and water demand does not occur uniformly throughout City pressure zones. This Section distributes projected growth to the existing and future pressure zones. The following table shows the assumed distribution of growth to system pressure zones based on discussions with the City staff, land available for development, and existing UGA boundary and potential UGA additions.

Table 3-9 Pressure Zones ERU Growth Distribution

Pressure Zone	Current ERUs (1)	Present to 6-year		6-year to 20-year		Ultimate ERUs (2)
		Percent of Growth	ERUs (1)	Percent of Growth	ERUs (1)	
Zone 1 (Main Zone)	2,911	55%	3,032	25%	3,178	6,232
Zone 2 (existing Ski Hill)	70	45%	170	40%	403	923
Zone 3 (future upper Ski Hill)	-	0%	-	25%	145	545
Zone 4 (future top Ski Hill)	-	0%	-	10%	58	152
Total System	2,981	100%	3,202	100%	3,784	7,852

(1) *Current, 6-yr, and 20-yr ERU distribution estimated based on land availability, zoning, and the professional judgments of the City's staff and Engineering Consultant. All ERUs listed include unaccounted/non-revenue/leakage ERUs.*

(2) *Refer to discussion in **Section 3.2.2**; ERU figures developed based on land capacity analysis in the City's Water Distribution System and Wastewater Collection System Master Plan.*

Growth projected in Zone 1 will manifest itself as infill inside City Limits and, to a limited extent, infill along East Leavenworth Rd and Icicle Rd; refer to **Section 2.6** for details pertaining to City policies for additional connections outside of the UGA and RSA but inside of the water service area.

3.2.4 Projected Water Demand

The following Table contains projected water demand for the established planning horizons based on the growth projections developed in preceding Sections.

Table 3-10 Projected Water Demand

Zone	Attribute	Existing [1]	6-year [2]	20-year [2]	Ultimate [3]
Zone 1 (main zone)	ERUs	2,911	3,032	3,178	6,232
	Annual (MG)	323	336	353	751
	ADD (gpm)	615	640	671	1,428
	MDD (gpm) [4]	1,444	1,504	1,577	3,071
	PHD (gpm) [5]	2,440	2,536	2,652	5,042
Zone 2 (existing Ski Hill)	ERUs	70	170	403	923
	Annual (MG)	8	19	45	111
	ADD (gpm)	15	36	85	212
	MDD (gpm) [4]	35	84	200	455
	PHD (gpm) [5]	117	224	440	856
Zone 3 (future upper Ski Hill)	ERUs	-	-	145	545
	Annual (MG)	-	-	16	66
	ADD (gpm)	-	-	31	125
	MDD (gpm) [4]	-	-	72	269
	PHD (gpm) [5]	-	-	199	559
Zone 4 (future top Ski Hill)	ERUs	-	-	58	152
	Annual (MG)	-	-	6	18
	ADD (gpm)	-	-	12	35
	MDD (gpm) [4]	-	-	29	75
	PHD (gpm) [5]	-	-	102	205
Total System	ERUs	2,981	3,202	3,784	7,852
	Annual (MG)	332	355	420	946
	ADD (gpm)	632	676	799	1,799
	MDD (gpm) [4]	1,488	1,589	1,877	3,868
	PHD (gpm) [5]	2,510	2,671	3,133	6,661

(1) *Refer to **Section 3.1.4** for source of existing demand figures.*
(2) *Refer to **Section 3.2.2** for 6-year and 20-year growth percentages.*
(3) *Refer to discussion in **Section 3.2.2** on ultimate demands; also refer to the City's Water Distribution System and Sewer Collection System Master Plan for calculation of UGA and UGA expansion area demands.*
(4) *Existing, 6-year, and 20-year reflect an ADD:MDD peaking factor of 2.35; also see note 3.*
(5) *Existing, 6-year and 20-year PHD calculated using Equation 5-1 from the 2009 DOH WSDM; also see note 3.*

3.3 Topography

The City's water system currently consists of two pressure zones. The UGA encompasses a large portion of the Ski Hill area to the north of downtown. The Ski Hill area spans approximately 200 vertical feet. The planning data in preceding Sections includes two additional pressure zones which will provide service to the area of land not serviceable by the City's existing pressure zones. Please refer to **Figure 2** for system topography and approximate pressure zone boundary contours.

4.0 DESIGN STANDARDS

Each water utility must establish system design standards appropriate to meet its customers' needs and expectations. While a utility has some discretion in setting performance and design criteria, all criteria must meet the minimum standards set by the Washington State DOH for public water supplies. Many water systems in the State of Washington use one or more of the following standards as the basis for facilities evaluation and design.

- Washington State Department of Health Water System Design Manual
- Recommended Standards for Water Works ("10 State Standards")
- System owner requirements and preferences
- Local fire protection authority input
- Washington Surveying & Rating Bureau (regarding fire flow)
- Engineering judgment
- Industry practice

Washington Administrative Codes (WAC's) pertaining to public water systems administered by Washington State Department of Health (DOH) and Ecology (DOE) comprise the regulatory criteria applicable to this water system (WAC 246-290)

The Sections following define the City's system design standards.

4.1 Sources of Supply Requirements

DOH Water System Design Manual recommends systems develop source capacity that enables the system to replenish depleted fire suppression storage within a 72-hr period while concurrently supplying the max day demand of the system. 10 State Standards recommends a minimum of two sources and total source capacity at least equal to the system maximum day demand with the largest source out of service.

The City selects the following supply capacity requirement:

- Supply facilities shall have sufficient capacity to meet the system max day demand.

4.2 Booster Station Requirements

4.2.1 Open System Booster Stations

An open system pressure zone pumps water to a reservoir open to the atmosphere. The level of the reservoir being filled typically controls the operation of the booster pumps that fill it. Open system booster stations shall be designed in accordance with DOH criteria as outlined in Chapter 10 of the Water System Design Manual (WSDM). The following summarizes the WSDM criteria:

- Equalizing storage or additional booster pump capacity must be provided to ensure the Peak Hour Demand (PHD) of the zone can be met
- Max Day Demand (MDD) of the booster zone must be met with all pumps in service
- Average Day Demand (ADD) of the booster zone must be met with the largest capacity pump out of service

4.2.2 Closed System Booster Stations

A closed system pressure zone pumps to a distribution system that is closed to the atmosphere; some closed zones utilize pressure tanks, and/or variable speed pumps, and/or PRVs to meet system demands without over pressurization. Closed system booster stations shall be designed in accordance with DOH criteria as outlined in Chapter 10 of the DOH WSDM. The following summarizes the WSDM criteria:

- Provide PHD at minimum 40 psi service pressure (DOH requires 30 psi; however, the City requires 40 psi minimum normal service pressure) with the largest pump out of service
- Provide MDD + fire flow rate at minimum 20 psi residual pressure with the largest capacity pump out of service
- Auxiliary power generator that activates automatically in the event of a power outage

4.3 Storage Requirements

As required by WAC 246-290-235, City storage facilities shall be designed with sufficient capacity to meet the requirements of the following storage components as defined in the DOH WSDM:

- Dead Storage
- Operational Storage
- Equalizing Storage
- Standby Storage
- Fire Suppression Storage

The City may, at its discretion, apply the alternate design concept as described in the DOH WSDM and further detailed in Sections following.

4.3.1 Dead Storage (DS)

Dead storage is the portion of a reservoir below which some customers in the system will experience pressures less than the minimum requirement. Standpipes typically have a portion of the reservoir intentionally designed as dead storage.

Conversely, if a system's source (well or booster pump) does not have sufficient capacity to fill a reservoir above a certain elevation, that portion of the reservoir cannot provide storage to the system and technically qualifies as dead storage.

4.3.2 Operational Storage (OS)

Operational storage is the volume in a reservoir used during normal operation of the system; it is the storage volume used between turning the supply pumps on and off. In general, systems control the operation of supply sources with level sensors or floats in the reservoirs they fill. Using OS allows a reasonable amount of time between pump start/stop which protects the motors from heat damage that can result from excessive cycling of the pump. The system uses OS when supply sources are off. Systems that utilize variable speed pumps can eliminate OS by setting up the pumps to maintain a full reservoir.

4.3.3 Equalizing Storage (ES)

Equalizing storage is the quantity of storage required to meet peak demands that exceed supply capacity. The following equation from the DOH WSDM calculates the volume of required ES:

ES = (PHD-Q) x 150 minutes

Where ***ES*** *= equalizing storage in gallons*

PHD *= peak hour demand in gpm*

Q *= source capacity in gpm*

4.3.4 Standby Storage (SB)

The purpose of SB is to provide a measure of reliability should sources fail or when unusual conditions impose higher demands than anticipated. The DOH WSDM provides separate equations for calculating required SB volume for systems served by one source and for systems served by multiple sources as described below.

- **Water Systems With A Single Source**

  The required SB volume for systems served by a single source of supply is two times the system's ADD for the design year to be available to all service connections at minimum service pressure of 20 psi.

  SB = (2 days) (ADD) (N)

  Where ***SB =*** *is the total standby storage in a single source system in gallons*

  ADD *= Average day demand, gpd/ERU*

  N *= Number of ERUs*

- **Water Systems with Multiple Sources**

  The required SB volume for systems served by multiple sources must be available to all service connections at a minimum service pressure of 20 psi and is based upon the following equation.

$$SB = (2 \text{ days})(ADD)(N) - (1{,}440 \text{ min})(Q_S - Q_L)$$

Where ***SB*** *= the total standby storage in a multiple source system in gallons (in no case can volume be less than 200 gal per ERU)*

ADD *= Average day demand, gpd/ERU*

N *= Number of ERUs*

Q_S *= Sum of all available source, gpm*

Q_L *= Capacity of largest source, gpm*

SB storage is intended to satisfy the requirements imposed by the system customers for unusual situations; DOH requires that the SB volume be not less than 200 gallons/ERU.

A further reduction in required SB volume can be achieved by providing automatic backup power at the sources of supply. To be considered equivalent to gravity storage all sources used in the SB calculation must be equipped with automatic backup power (see **Section 4.3.6**)

4.3.5 Fire Suppression Storage (FS)

FS is the quantity of storage needed to meet required firefighting flows. If a public water system provides fire flow, it is required to construct and maintain facilities, including storage reservoirs, capable of delivering fire flow while maintaining a minimum pressure of 20 psi at all service connections within the distribution system [WAC 246-290-221(5)].

The volume of FS required for each pressure zone is the product of the maximum fire flow rate and duration established as City criteria; this may or may not be the same fire flow rate and duration required by the local fire protection authority or County Fire Marshal for individual structures within the City. For water systems located in areas governed under the Public Water System Coordination Act of 1977 (PWSCA), Chapter 70.116 RCW, minimum flow rates and duration that must apply for residential, commercial, and industrial developments are specified in the Water System Coordination Act regulations, WAC 246-293-640. Greater FS requirements for individual structures may be specified by the local fire protection authority, County Fire Marshal, and/or locally adopted Coordinated Water System Plan; however, the City is not obligated to provide fire flow above and beyond City criteria established in this Water System Plan.

4.3.5.1 Nesting of Fire Suppression Storage and Standby Storage

A water system may elect to "nest" the SB and FS storage volumes [WAC 246-290-235(4)]. If a purveyor chooses to nest SB and FS, the larger of either SB or FS is used as the total volume required. Provided that such practice is not prohibited by:

- Adopted Coordinated Water System Plan
- Local Ordinance
- Local Fire Protection Authority

The City elects to nest the SB and FS storage volumes in storage calculations as allowed by the WAC. The City consulted Chelan County Fire District 3 (CCFD 3) on this decision; refer to **Appendix A** for documentation of CCFD 3 involvement.

4.3.6 Storage Alternate Design Concept

The DOH WSDM provides criteria for reservoir design and storage volume. During the capital facilities planning process, systems typically apply these criteria to determine whether existing storage volume meets the needs of the system and satisfies regulatory criteria.

The WSDM provides an "Alternate Design Concept" (Section 9.1.3 of the WSDM) which outlines circumstances under which systems may reduce or in some cases eliminate the standby and fire storage component requirements. Systems can substitute source capacity for storage volume provided certain requirements are satisfied.

Water systems substituting source capacity for storage volumes need to consider and provide appropriate justification for varying from the following:

- Exclude capacity of the largest producing source of supply from the calculations
- Each source of supply used in the calculations be equipped with on-site backup power facilities, promptly started by an automatic transfer switch upon loss of utility power.
- Incorporate provisions into the system design for pump protection during low demand periods.

The City elects to utilize the storage alternate design concept at its discretion where it is deemed cost effective and in the City's best interest to do so.

4.4 Fire Flow Criteria

The City recognizes that for individual structures (existing and future) the International Fire Code, Local Fire District, and the recommendations of the Washington Surveying and Rating Bureau may differ from the City's fire flow rate and duration criteria. However, the City feels that the fire flow criteria established herein provide a reasonable level of fire protection for the land use types within the City; the City will be working further with appropriate entities to further refine fire flow criteria in the near future. The adopted fire flows may not currently be available in all areas of every pressure zone.

As development occurs, the City requires developers to upgrade existing facilities and install new facilities with sufficient capacity to meet the City's established fire flow criteria for the development type in the area proposed for development. The City requires developers to consult the City to determine the infrastructure upgrades a proposed development necessitates. Developers requesting water service must install the system upgrades needed to provide required fire flow; the improvements necessitated and implemented by development must follow the improvements laid out in this Water System Plan.

In general, the City sets the following fire flow criteria for each development type:

The City will supply up to the following rates and durations:

- Single Family Residential: 1,500 gpm for 1 hour
- Multi-family Residential: 2,500 gpm for 2 hours
- Schools: 2,500 gpm for 2 hours
- Commercial: 2,500 gpm for 2 hours (general, tourist., and light industrial)
- Downtown: 3,500 gpm for 3 hours (central)

For new structures, the City may require water system facilities capable of supplying a higher fire flow than shown above if Chelan County, the International Fire Code, the local Fire District, or the WSRB requires it.

4.4.1 Fire Flow Rate and Duration Criteria by Pressure Zone

The City provides fire flow rates and durations for each pressure zone based on development types (as described in preceding sections). The City sets the largest fire flow criteria in each pressure zone based on existing structures and planned development types; some existing structures require greater fire flow than the City criteria established herein. The City plans to refine fire flow criteria in the future. The Table following shows the largest fire flow rate and duration criteria for each pressure zone.

Table 4-1 Fire Flow Rate and Duration Criteria by Pressure Zone

Pressure Zone	Fire Flow		Development Type or Structure Dictating Highest Fire Flow for Pressure Zone
	Rate (gpm)	Duration (hrs)	
Zone 1 (main zone)	3,500	3	Downtown area and structures
Zone 2 (existing Ski Hill)	2,500	2	Multi-family development
Zone 3 (future Ski Hill upper)	1,500	1	Single family residential
Zone 4 (future Ski Hill top)	1,500	1	Single family residential

In accordance with the DOH Water System Design Manual, the system shall meet all fire flow rates while concurrently supplying the system MDD with the largest source offline, with OS, ES, and FS depleted, while maintaining a minimum pressure of 20 psi throughout the system with pipeline flow velocities not to exceed 10 fps.

4.5 Distribution System Requirements

4.5.1 System Pressure

DOH establishes minimum service pressures for public water systems. During normal conditions, minimum pressures within the distribution system shall be maintained at or above 30 psi at the customer meter. During fire conditions (MDD, FS depleted, largest source out of service) systems must maintain a minimum pressure of 20 psi at all customer meters. Although DOH does not dictate restrictions on maximum distribution system pressure, the City endeavors to provide service pressure between 40 psi and 80 psi at the customer meter whenever possible. In some cases topography may dictate that areas of the distribution system have pressure exceeding 80 psi. In areas where system pressure exceeds 80 psi, the City recommends that

customers install an individual pressure regulator, as required by most municipal building codes and the *Uniform Plumbing Code.*

4.5.2 Pipe Sizes

DOH requires that distribution system mains supplying fire flow have a minimum diameter of 6 inches. However, the City requires a minimum diameter of 8 inch for all new mains installed that supply fire flow unless otherwise justified by a hydraulic analysis.

4.5.3 Valve and Hydrant Spacing

City valve spacing requirements vary by project specifics; however, the City does not allow valve spacing to exceed 1,000 ft between valves. The local Fire District dictates hydrant spacing for specific projects.

4.5.4 Construction Standards

The City's municipal code adopts the Washington State Department of Transportation (WSDOT) Standard Specifications with the APWA Amendments to Division One as the City's construction standard [refer to **Appendix D** for City's Municipal Code 14.14.090(5)(a. and b.)]. The WSDOT Standard Specifications are available online at WSDOT's website. The City will provide a hard copy for DOH review if requested.

The City utilizes the following review procedures to ensure conformance with the City's water system facilities standards and Water System Plan when individuals, developers, or outside entities propose water system modifications/extensions:

- The Public Works Director reviews proposed plans and specs for general conformance with City standards and Water System Plan.
- If needed, the Public Works Director forwards plans and specs to the City's Engineering Consultant for input on conformance with the City's standards and Water System Plan.
- The City informs the submitter on changes necessary to bring the proposed plans and specs into conformance with the City's standards and Water System Plan.

5.0 SYSTEM ANALYSIS

5.1 Reported System Problems

A Water System Plan provides a detailed engineering analysis of a water system. However, this analysis is incomplete without input from the system's operator(s) and any other individuals or entities that have intimate knowledge of the day to day operations and problems of the system. The following Sections outline comments, concerns, and/or complaints raised by those individuals and/or entities with close working knowledge of the system.

5.1.1 Comments from City Staff

City Staff report the following issues with the water system:

- The Water Treatment Plant (WTP) Operator reports that the lack of a booster pump for the WTP lab facilities tends to increase difficulty of operation.

Refer to **Section 5.2.3** for additional issues related to the WTP.

5.2 Supply

The City supplies its water system from both surface water and ground water sources. The water treatment plant withdraws surface water from Icicle Creek and the wells withdraw ground water from an aquifer.

5.2.1 Supply Facilities Capacity

The pump in Well #1 has a capacity of 1,300 gpm and the pump in Well #2 has a capacity of 750 gpm.

The WTP's capacity varies based on a number of factors which include:

- During spring high silt load necessitates frequent filter backwashing which requires operator attention; this presents a limitation because the City does not Staff the WTP 24 hours per day.
- Seasonal variations in raw water temperature affect the maximum flow rate at which the WTP can provide satisfactory treatment. The WTP can effectively treat 2.0 MGD under cold water conditions and 2.45 MGD under warm water conditions.
- The WTP Operator reports the raw water intake pipe has a maximum hydraulic capacity of 2.45 MGD

Based on operating history and facility testing documented by the WTP Operator, it appears that during peak demand periods in the summer months, the WTP operates under a low silt load and with warm raw water temperature. For the purposes of this Water System Plan, all calculations assume a maximum WTP capacity of 2.45 MGD.

The City's quantity of supply criterion calls for the City to have sufficient capacity to meet the MDD of the system. The Table following compares existing source capacity with current and projected system demands.

Table 5-1 Supply Facilities Capacity Evaluation

Attribute	Current		6-year		20-year		Ultimate	
	(gpm)	(MGD)	(gpm)	(MGD)	(gpm)	(MGD)	(gpm)	(MGD)
Total Existing Source Capacity [1]	3,750	5.40	3,750	5.40	3,750	5.40	3,750	5.40
Max Day Demand (MDD) [2]	1,488	2.14	1,589	2.29	1,877	2.70	3,868	5.57
Surplus (Deficiency)	2,262	3.26	2,161	3.11	1,873	2.70	(118)	(0.17)

(1) *Wells #1 and #2 have a combined capacity of 2,050 gpm (2.95 MGD) and the WTP has a capacity of 1,700 gpm (2.45 MGD). These capacities assume constant operation (24/7).*

(2) *Refer to **Section 3** for development of current and projected demands.*

As shown in the preceding table, Leavenworth has adequate supply facilities capacity to meet current, 6-year, and 20-year MDD with the largest producing supply facility (either Well #1 or the WTP) offline. Supply facility redundancy will decrease as the City approaches ultimate demand levels at some point beyond the 20-year planning horizon.

At present, it appears Leavenworth will not require an expansion of supply facilities during the 20-year planning period to meet supply quantity criteria; however, the City may consider adding pumping capacity to the existing well field in order to increase supply redundancy and perfect unused instantaneous groundwater rights; refer to further discussion of Ground Water Permit G4-29958 in the water rights analysis.

5.2.2 Condition of Wells & Pumps

The City has experienced occasional problems with the wells including chlorine corrosion causing pipe failures in the pump house; none of the problems pose a regular threat to reliability. The City's wells and pumps are relatively new (early 1990s) and are in good condition. The City has updated the electrical controls for the wells.

5.2.3 Water Treatment Plant

The WTP Operator has identified the following issues pertaining to the WTP.

1. Fish screen on raw water intake pipe does not meet current standards.
2. During periods of high sediment loading in Icicle Creek (primarily during spring runoff), WTP filters require backwashing at 8-10 hour intervals.
3. When the water plant is off-line, there is a lack of sufficient potable water at the plant for filter washing and other domestic uses.
4. There is no backup power (i.e., the WTP cannot operate during power outages).
5. Office/Lab is too small and is in a very noisy location.
6. Lack of indoor chemical storage area.
7. No fencing exists around the WTP which is near a public trail.

5.2.4 Disinfection

The WTP provides continuous disinfection via a flow paced chlorine injection system and chlorine contact basin. The WTP Operator believes that replacing the existing flow paced chlorine disinfection system with a system controlled by the chlorine residual level in the chlorine contact basin would improve consistency of chlorine residuals in the system.

The City provides disinfection at Wells #1 and #2 via a gas chlorine injection system. It appears the wells' disinfection system does not require improvement at this time.

5.2.5 Water Quality and Treatment

5.2.5.1 Compliance with Existing Regulations

DOH generates a Water Quality Monitoring Report (WQMR) for water systems on an annual basis; the WQMR summarizes the system's water quality sampling requirements for the year. **Appendix B** contains a copy of the City's 2010 WQMR. The Table following summarizes the City's water quality monitoring requirements.

Table 5-2 Monitoring History and Requirements as Reported by DOH

Contaminant	Last Sampled	Next Sample Due	Comments
Asbestos	S01 – 2009 S03 – 2009	Distribution System – 2010	
Bacteriological (coliform)	Three Samples Monthly	Three Samples Monthly	Refer to the City's Coliform Monitoring Plan
Dioxin			State Waiver through 2010
Endothall			State Waiver through 2010
EDB (soil fumigants)	S01 – 1998 S03 – 2001		State Waiver through 2010
Glyphosphate			State Waiver through 2010
Gross Alpha		S01 – 2008-2010 S03 – 2008-2010	
Herbicides, Insecticides	S01 – 2009 S03 – 2003	SO1 – 2008-2010 SO3 – waived 2010	SO1 – one sample ever three year compliance period SO3 – waived through 2010
Inorganic Chemicals (IOC)	S01-2009 S03 - 2007	SO1 – 2010 SO3 – 2002-2010	SO1 – one sample every year SO3 – one complete IOC sample between 2002-2010 All constituents within acceptable ranges
Lead & Copper	2009	2010	10 distribution samples required every year Samples have been within permissible limits
Nitrates (part of IOC)	S01 – 2009 S03 – 2009	SO1 – 2010 SO3 – 2010	SO1 – one sample every year SO3 – one sample every year
Pesticides	S01 – 2009 S03 – 2007	S01 – 2010 S03 – waived 2010	S01 – one sample between 2008-2010 S03 – waived through 2010
Diquat			Statie Waiver through 2010
Volatile Organic Chemicals (VOC)	S01 – 2010 S03 - 2007	SO1 – 2011 SO3 – 2008-2010	SO1 – one sample every year SO3 – one sample between 2008-2010 All constituents within acceptable ranges
Radionuclide	S01 – 2007 S03 – 2005	SO1 – every 4 yrs SO3 – every 4 yrs	
Halo-Acetic Acids (HAA5)	Distribution System – 2009	2010	Refer to the City's Disinfection Byproducts Monitoring Plan
Trihalomethane (THM)	Distribution System – 2009	2010	Refer to the City's Disinfection Byproducts Monitoring Plan

It appears the City's water quality sampling meets existing regulatory requirements.

5.2.5.2 Expected Future Regulations

The Environmental Protection Agency (EPA) finalized their Groundwater Rule in October 2006. The rule builds upon the Total Coliform Rule. The Groundwater Rule requirements went into effect December 1, 2009. The Table following provides an overview of the Groundwater Rule.

Table 5-3 Groundwater Rule Overview

Requirement	Comments
Sanitary survey by DOH every 3 years	May be every 5 years if certain conditions are met
Determination of hydrogeologic sensitivity	Gravel wells without hydrogeologic barrier are defined as sensitive setting (this is the case for Leavenworth's two wells)
Triggered source water monitoring: • Test source water for coliform within 24 hours of distribution system hit • Monthly source monitoring for coliform of sources in hydrogeologically sensitive settings	-
If the above steps indicate a fecally contaminated source or one with significant deficiencies that can act as a potential pathway for contamination, the system must do one of the following: • eliminate the source of the contamination or correct the significant deficiency • provide alternate source water • provide treatment which achieves at least 99.99% removal or inactivation of viruses and monitoring to verify same	-

For those sources which are found to be contaminated and which cannot eliminate the source of contamination or provide alternate source water, treatment requires 4-log inactivation/removal which, at water temperature of 50F and pH of 6-9 results in a required CT of 6. Minimum residual entering distribution system is 0.2 mg/L. With Leavenworth's ±900' of 24" main, meeting a CT of 6 would require a chlorine residual of about 0.6 mg/L at the end of the 24" transmission main which is the way the system is currently operated. Thus, while it is not expected that the Groundwater Rule will require Leavenworth to provide 4-log inactivation treatment, the system has the ability to do so without significant modifications.

5.3 Water Rights

The water rights information contained herein in is based on available records, including those provided by the Washington State Department of Ecology (DOE). This Water System Plan does not constitute legal analysis or interpretation by the City nor Varela & Associates of the rights or quantities reported herein.

In 2008 the City, assisted by water rights attorney Thomas Pors, conducted a water rights assessment and discovered errors in the Department of Ecology's previous assessments of the City's water rights. This Section describes the City's water rights as presented in the City's 2008 Amendment of the 2002 Water System Plan. The 2008 Amendment sought to clarify the scope and quantity of the City's water rights, but has not been finally accepted or rejected by DOH due a disagreement between the City and Department of Ecology. That disagreement is the subject of a declaratory judgment action pending in Chelan County Superior Court. The final resolution of that case will prompt an amendment to this section of the City's water system plan and **Tables 5-5** and **5-6**, if necessary.

The City has a combination of interruptible and uninterruptible surface and ground water rights. The interruptible rights depend on in stream flows in Icicle Creek and the Wenatchee River for their availability; the uninterruptible rights are independent of instream flow levels in Icicle Creek and the Wenatchee River.

The City's most senior water right is Adjudicated Certificate No. 4 from the Icicle Creek Adjudication, issued by the Chelan County Superior Court on October 28, 1929 in the amount of 1.52 cfs for municipal supply year round with a priority date of 1912. No annual quantity was specified, but a continuous diversion of 1.52 cfs is equivalent to 1,100 acre-feet annually.

Ground Water Certificate No. 437-A, with a priority date of March 14, 1949, authorizes Leavenworth to withdraw 1,000 gpm, 1,100 acre-feet per year from an infiltration gallery near the Wenatchee River, It was issued as a "non-additive" for annual quantity based on language in the original Report of Findings dated May 2, 1949 describing the City's existing Icicle Creek right (Certificate No. 4) "which is not to be used when well is proved and operating." See Department of Ecology Water Resources Program Policy POL-1040, dated 03-09-06. Thus, as of the issuance of Certificate 437-A, the City had total water rights of 1,000 gpm, 1,100 acre-feet. In 1990 Ecology approved a change application for Certificate 437-A, changing the place of use to the "service area of the City of Leavenworth" and adding a point of withdrawal for a new well in the SE1/4, NE ¼ of Section 14, T. 24N, R17 E.

Surface Water Certificate 8105, with a priority date of June 20, 1960, authorizes 1.50 cubic feet per second from an infiltration gallery adjacent to Icicle Creek for municipal supply. The application for this water right (Application No. 16124) clearly intended the diversion to be continuous, because it included 1085.5 acre-feet per year as the annual quantity of the applicant's intended use, continually, for municipal supply. The permit for this water right does not set forth any annual limitation or indicate any restriction of the water right to service a particular population or number of connections. Consistent with then-prevailing practices by the State Supervisor of Water Resources, the certificate was issued for the full instantaneous quantity of 1.50 cfs on April 25, 1961, less than 5 months after the permit. There was no limitation or condition in the certificate relating to annual quantity, nor any conditions relating to population or connection limits. An application to change the point of diversion for this water right to a point upstream for the intake to the City's water treatment plant was approved by the Department of Ecology on January 12, 1990. Ecology's Findings of Fact and Order regarding this decision (Docket No. DE 90-C114) did not in any way limit the annual quantity of this water right, and allowed the point of diversion change for the full instantaneous quantity of 1.50 cfs.

It is readily apparent that Certificate 8105 was issued based on a prior administrative policy of issuing certificates once works for diverting or withdrawing and distributing water for municipal supply purposes were constructed, rather than after the water had been put to actual beneficial use. In the 2003 Municipal Water Law, the Legislature described these so-called "pumps & pipes" certificates as "rights in good standing." With respect to such certificates, RCW 90.03.330(2 and 3) provide:

> (2) Except as provided for the issuance of certificates under RCW 90.03.240 and for the issuance of certificates following the approval of a change, transfer, or amendment under RCW 90.03.380 or 90.44.100,

> the department shall not revoke or diminish a certificate for a surface or ground water right for municipal water supply purposes as defined in RCW 90.03.015 unless the certificate was issued with ministerial errors or was obtained through misrepresentation. The department may adjust such a certificate under this subsection if ministerial errors are discovered, but only to the extent necessary to correct the ministerial errors. The department may diminish the right represented by such a certificate if the certificate was obtained through a misrepresentation on the part of the applicant or permit holder, but only to the extent of the misrepresentation. The authority provided by this subsection does not include revoking, diminishing, or adjusting a certificate based on any change in policy regarding the issuance of such certificates that has occurred since the certificate was issued. This subsection may not be construed as providing any authority to the department to revoke, diminish, or adjust any other water right.
>
> (3) This subsection applies to the water right represented by a water right certificate issued prior to September 9, 2003, for municipal water supply purposes as defined in RCW 90.03.015 where the certificate was issued based on an administrative policy for issuing such certificates once works for diverting or withdrawing and distributing water for municipal supply purposes were constructed rather than after the water had been placed to actual beneficial use. Such a water right is a right in good standing.

Under this section, it is clear that the Department of Ecology has no authority to revoke or diminish Certificate 8105 since the effective date of the Municipal Water Law on September 9, 2003. Neither did the Department of Ecology have such authority prior to the Municipal Water Law, because other than the 1990 change application, which did not affect the quantity of this water right, the Department did not take any official action with respect to Certificate 8105 or provide notice to the City or an opportunity to be heard or appeal any such action. The Department of Ecology can only take actions within the limits of its statutory authority, and within those limits it must take action by written order subject to appeal to the Pollution Control Hearings Board. Ecology has no statutory authority to determine or adjudicate the validity of water rights, that being the exclusive province of the courts pursuant to RCW 90.03.110, et seq. *Rettkowski v. Ecology*, 122 Wn.2d 219, 858 P.2d 232 (1993). Ecology has limited authority to make "tentative determinations" regarding the scope and validity of water rights for which applicants seek changes pursuant to RCW 90.03.380 or RCW 90.44.100, but that authority is not relevant in the context of quantifying Certificate 8105. Because the Department of Ecology did not take any legally authorized action specifically revoking or diminishing the quantity of Certificate 8105, the full annual quantity of 1085.95 acre-feet of that water right is still "in good standing" and available for the City to beneficially use for growth in its service area.

In 1995, the Department of Ecology made a characterization of the quantity of Certificate 8105 in two contemporaneous decisions involving two different water rights (see discussion of Ground Water Permit G4-29958 and Surface Water Permit S4-28122). The 1995 Reports of Examination were issued following a stipulation and Agreed Order of Dismissal in City of Leavenworth V. Ecology, PCHB No. 93-149, in which the City and Ecology agreed that the City's existing water rights, including Certificate 8105 were not the subject of nor affected by that appeal. Ecology's characterization of Certificate 8105 in the 1995 Reports of Examination exceeded Ecology's legal authority and is unenforceable. Ecology had no authority to adjudicate the scope and quantity of Certificate 8105, nor did they have authority to tentatively determine the quantity of Certificate 8105 in the context of Applications G4-29958 or S4-28122. Based on the advice of its legal counsel, the City is now disregarding the extraneous *ultra vires* language in the reports of examination for G4-29958 and S4-28122 with respect to the annual quantity of Certificate 8105, and amending this Plan accordingly.

Ground Water Permit G4-29958, with a priority date of April 14, 1989, was issued on August 11, 1995 for the City's well field in the NE ¼ of Section 14, T24N, R17E, in the amount of 2,000 gpm, 900 acre-feet, interruptible when the flows of Icicle Creek fall below the minimum flows set in WAC Chapter 173-545. All but 90 acre-feet of this annual quantity was issued as supplemental (non-additive) to existing rights, and that 90 acre-feet included the same 90 acre-feet of primary (additive) water rights issued under Surface Water Permit S4-28122. The 90 acre-feet of primary (additive) water rights was granted based on Ecology's assessment of the City's existing water rights, which as indicated above was erroneous. Specifically, the Report of Examination dated June 10, 1993 acknowledged that Certificate 8105 was issued without an annual volume limitation, but rather than interpret the upper limit of the quantity of Certificate 8105 as a continuous withdrawal for municipal purposes, the author of this report of examination calculated a "reasonable quantity" for Certificate 8105 "based upon the per capita demand used for Certificate 427-A and multiplying by the projected 2,500 population for 1980." The report of examination then characterized Certificate 8105 as having only 275 acre-feet and the total of the City's existing water rights as only 1375 acre-feet. Based on advice from the City's legal counsel, this characterization of the City's existing water rights is being disregarded. On February 11, 2008, the City sent a request to the Department of Ecology for an extension of the development schedule for completion of construction for Permit G4-29958 to June 1, 2011 in order to have time to design and construct facilities to increase well field capacity. That extension request was granted by the Department of Ecology on August 29, 2008.

Surface Water Permit S4-28122, with a priority date of January 28, 1983, was issued on August 11, 1995 for 3.18 cfs, 636 acre-feet, interruptible when the flows of Icicle Creek fall below the minimum flows set in WAC Chapter 173-545. The intent of this water right was to increase the City's diversion from Icicle Creek to equal the capacity of its water treatment plant. All but 90 acre-feet of this annual quantity was issued as supplemental (non-additive) to existing rights, and that 90 acre-feet included the same 90 acre-feet of primary (additive) water rights issued under Ground Water Permit G4-29958.

The Department of Ecology intended to limit the amount of additional primary water rights from applications G4-29958 and S4-28812 based on its calculation of the City's existing water rights compared to future demand requirements for a population of 3,823 by 2011. Because Ecology erred in the Reports of Examination for these applications in its calculation of the City's existing water rights, by undercounting the City's uninterruptible inchoate right under Certificate 8105, it is likely that Ecology would not have granted the City 90 additional acre-feet of primary (additive) water rights had it correctly accounted for all 2185.95 acre-feet of the City's existing water rights. Therefore, City is not including this 90 acre-feet in the total annual quantity calculation in **Tables 5-5** and **5-6**.

The Department of Ecology was mistaken concerning the annual quantity of water rights already perfected by the City in the mid-1980s, which led to errors in Ecology's Reports of Examination for applications G4-29958 and S4-28812 and errors by the City in its 2001-02 Water System Plan. **Table 5-4** summarizes the annual quantity of water rights beneficially used and perfected by the City from 1984 through 1993. The maximum annual quantity of water produced and beneficially used by the City during this period, 1,748 acre-feet in 1987, represents the City's perfected total annual quantity of water rights. The difference between this quantity and 2185.95

acre-feet per year is an inchoate but valid water right in good standing that is available for future growth demands in the City's water service area.

Table 5-4 Historical System Production Data Summary

Year	Infiltration Gallery [2] (MG)	Wells [3] (MG)	WTP [3] (MG)	Total Production (MG)	Total Production (ac-ft) [1]	Notes
1984	39.7	-	449.4	489.1	1,501	WTP production for 1984 -1989 is taken from operations data summarized and provided by City staff. Total system production figures for 1984-1989 are taken from the City's 1988 and 1991 Water System Plans. This infiltration gallery totals are calculated by subtracting WTP production from total production reported in the 1988 and 1991 WSPs.
1985	75.9	-	468.0	543.9	1,669	
1986	129.5	-	407.1	536.6	1,647	
1987	84.3	-	485.1	569.4	1,748	
1988	143.2	-	338.6	481.8	1,479	
1989	114.6	-	370.9	485.5	1,490	
1990	-	110.6	206.2	316.8	972	WTP, well and total production figures for 1990 - 2009 are taken from operations data summarized in the water production table prepared by City staff dated 7/27/10 (see Note 3). Production for 1992, 1993 and 1995 was estimated by water system staff due to incomplete available data. The City installed water service meters throughout its water service area during 1989 and 1990, which corresponds with a significant reduction in system water demand reflected in the data for 1989 and 1990.
1991	-	71.1	243.7	314.8	966	
1992	-	89.0	176.7	327	1,004	
1993	-	80.1	236.5	344	1,056	
1994	-	110.7	278.0	388.7	1,193	
1995	-	164.5	168.9	377	1,157	
1996	-	189.0	144.0	333.0	1,022	
1997	-	214.0	126.0	340.0	1,043	
1998	-	180.2	162.3	342.5	1,051	
1999	-	196.7	147.8	344.5	1,057	
2000	-	107.7	202.4	310.1	952	
2001	-	82.0	227.3	309.3	949	
2002	-	125.3	207.1	332.4	1,020	
2003	-	138.2	199.4	337.6	1,036	
2004	-	190.1	137.2	327.3	1,005	
2005	-	170.9	138.4	309.3	949	
2006	-	193.9	117.6	311.5	956	
2007	-	244.2	82.3	326.5	1,002	
2008	-	305.4	42.5	347.9	1,068	
2009	-	261.1	74.2	335.3	1,029	

(1) *Acre-feet values calculated in this table are rounded to the nearest acre-foot*
(2) *The City stopped using the infiltration gallery (sometimes referred to as the collector well) and put two new wells online in 1990*
(3) *Water treatment plant and well data summarized and provided by the City is based on original operation records for the WTP and wells.*

The Table following summarizes available information regarding the City's water rights.

Table 5-5 Summary of Available Water Rights Information

Type of Right	Point of Diversion	Cert. No.	Year	Instantaneous (Q_i) Interruptible	Instantaneous (Q_i) Uninterruptible	Annual (Q_a)	Notes
Surface Water Rights	Icicle Creek WTP SE¼, SE¼ S28, T24N, R17E	Cert #4	1912	-	1.52 cfs 682 gpm 0.98 MGD	1,100 ac-ft	(1), (2), (4)
		8105	1960	-	1.5 cfs 673 gpm 0.97 MGD	1,085.95 ac-ft	(6)
		S4-28122	1983	3.18 cfs 1,427 gpm 2.06 MGD	-	90 ac ft	(3)
	Total Surface Water Rights			3.18 cfs 1427 gpm 2.06 MGD	3.02 cfs 1,355 gpm 1.95 MGD	-	-
Ground Water Rights	Well Field SW¼, SE¼, NE¼ S14, T24N, R17E	437-A	1949	-	2.23 cfs 1,000 gpm 1.44 MGD	1,100 ac-ft	(4)
		G4-29958	1989	4.46 cfs 2,000 gpm 2.88 MGD	-	90 ac-ft	(3)
	Total Ground Water Rights			4.46 cfs 2,000 gpm 2.88 MGD	2.23 cfs 1,000 gpm 1.44 MGD	-	-
Total Water Rights				7.64 cfs 3,427 gpm 4.94 MGD	5.25 cfs 2,355 gpm 3.39 MGD	2,185.95 ac-ft	(3), (5)

(1) *This right has been adjudicated by the Chelan County Superior Court in 1929 and confirmed the City's right. No annual quantity is specified, but a continuous withdrawal rate of 1.52 cfs equals 1,100 acre-feet annually.*

(2) *The water right indicates that the point of diversion is within the NE¼ SE¼ of S28 T24N R17E. However, the City's diversion to the WTP is in the SE¼ SE¼ of the same section. A change application has been filed with DOE to correct this.*

(3) *A total of 90 ac-ft/yr of new water right was granted between G4-29958 and S4-28122. The Reports of Examination for these applications incorrectly assessed the City's existing water rights as indicated in **Section 5.2.5**. The ROEs granted an additional 90 acre-feet annually of primary (additive) water right based on the erroneous calculation that the City had only 1,375 acre-feet of existing water rights. The additional 90 acre-feet of primary (additive) water rights may not be available as a result of changing the City's assessment of existing water rights for Certificate 8105 to 1085.5 acre-feet, and it is therefore not included in the City's total annual quantity.*

(4) *Issued as "non-additive" for annual quantity based on language in the original Report of Findings. By Ecology's Findings of Fact and Report of Decision dated January 12, 1990, the City's request to add a point of withdrawal and change the place of use to Well #1 (from the old infiltration gallery) was approved , but a superseding certificate had not been issued as of the writing of this Water System Plan.*

(5) ***Table 5-2** does not list the City's surface water right (Wenatchee River) at the golf course (#9707 for 0.54 cfs and 106 ac-ft/yr). This water is pumped by the golf course independent of the City's drinking water sources and is not routed through the distribution system. The City owns the water right and the land but the golf course is separately operated in a long-term lease arrangement. Though it is not integrated into the City's distribution system, Certificate 9707 meets the definition of "municipal water supply purposes" under RCW 90.03.015(4).*

(6) *Point of diversion changed in 1993 to match intake location for water treatment plant*

Table 5-6 Comparison of Water Rights with Existing and Projected Demands

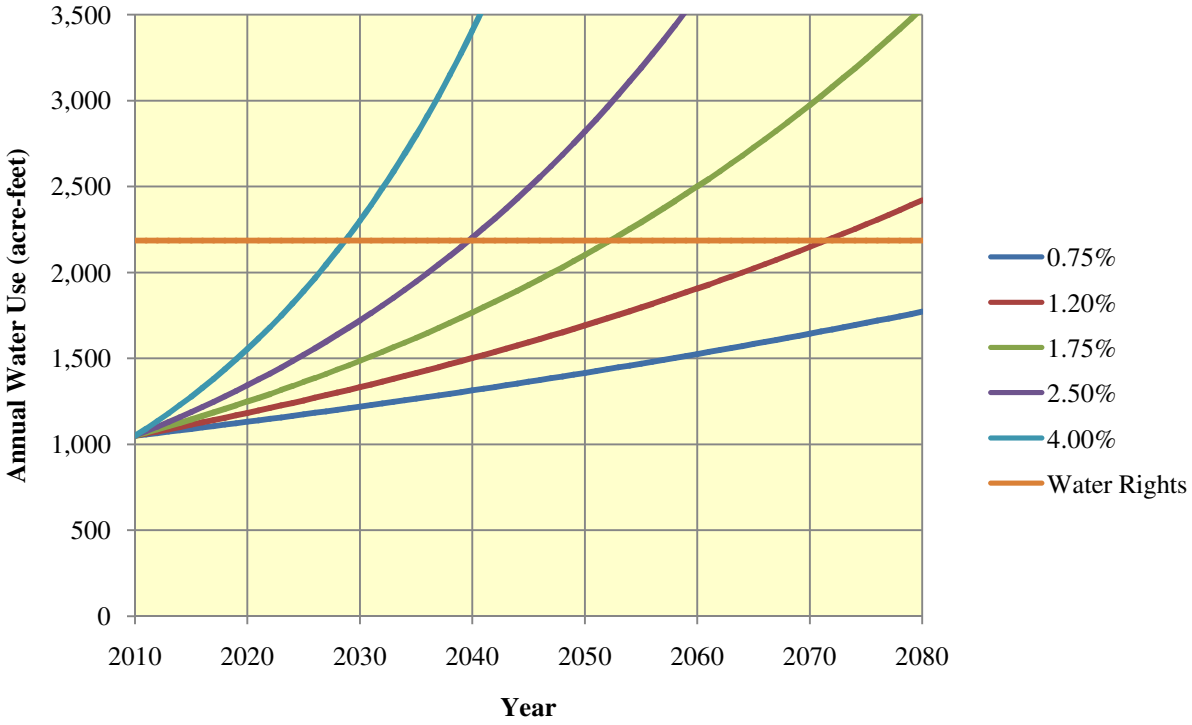
Surface or Ground Water	Permit, Certificate or Claim #	Name of Right Holder or Claimant	Priority Date	Source Number	Primary or Suppl.	Water Rights		Water Use		Water Right Status (Excess/Deficiency)	
						Max Instant. Flow Rate (gpm)	Max Annual Volume (ac-ft/yr)	Max Instant. Flow Rate (gpm)	Max Annual Volume (ac-ft/yr)	Max Instant. Flow Rate (gpm)	Max Annual Volume (ac-ft/yr)
Surface (1)	Cert. #4	City of Leavenworth	1912	S01 WTP	Primary	682 continuous	not specified	1,500 (4)	(3)	1,282 (2)	(3)
	8105		1960		Primary	673 continuous	1,085.95				
	S4-28122		1983		Both	1,427 interruptible	90 (6)				
	Total Surface Water Rights					1,355 continuous 1,427 interruptible 2,782 total	(3)				
Ground (1)	437-A	City of Leavenworth	1949	S03 Well Field	Primary	1,000 continuous	1,100	2,050 (5)	(3)	950 (2)	(3)
	G4-29958		1989		Both	2,000 interruptible	90				
	Total Ground Water Rights					1,000 continuous 2,000 interruptible 3,000 total	(3)				
Both	Present Adequacy of Water Rights					2,355 total continuous 2,428 total interruptible 4,782 total	2185.95 (6)	1,618 (8)	1,050 (7)	3,164 737	1,135.95
	Projected 20-year Water Rights Adequacy							1,877 (8)	1,289 (9)	2,905 478	896.95
	Projected Ultimate Water Rights Adequacy							3,868 (8)	2,903	914 (10) -1,513 (11)	-717.05 (12)

(1) *Refer to the preceding table for specific information regarding these water rights*
(2) *Excess based on combined interruptible & uninterruptible*
(3) *Annual limit for surface water and groundwater are combined shown below*
(4) *In the absence of completely reliable influent flow meter data, 1,500 gpm is used based on historic plant operation according to the operator*
(5) *Reflects capacity of existing well pumps*
(6) *See discussion in text of **Section 5.2.5** regarding water right annual quantities*
(7) *This figure equals total volume produced in 2008 of 342 MG (refer to **Table 3-2** – highest of last three years) converted to ac-ft*
(8) *These figures are current and projected max day demand (refer to **Tables 3-2** and **3-10**); this assumes that the system will meet peak hour demand with equalizing storage*
(9) *Projected 20-year annual demand of 420 MG converted to ac-ft, refer to **Table 3-10**.*
(10) *This figure includes interruptible water rights and represents years in which water withdrawals are not restricted (i.e., interrupted) due to minimum stream flows*
(11) *This figure includes only uninterruptible water rights and demonstrates that the City does not have adequate water rights on an instantaneous basis to meet projected instantaneous demands*
(12) *At present, the City lacks sufficient annual quantity of water rights to serve projected Ultimate demand.*

Conclusions

- The City has adequate annual and instantaneous water rights for present and projected 20-year demand; the City can meet projected instantaneous demand with uninterruptible water rights (keeping interruptible water rights in reserve).
- The City does not have adequate water rights to meet projected ultimate annual demands.
- The City has inadequate uninterruptible water rights to meet projected ultimate instantaneous demands; however, interruptible water rights will meet projected ultimate instantaneous demands.
- This Water System Plan projects the annual growth rate of City water demand at 1.2%. The following Figure illustrates the affect growth rate will have in determining how long the City's annual water rights remain adequate.

Figure B Affect of Growth Rate on Projected Water Rights Adequacy



5.4 Booster Zones

The City currently operates one booster station. The sections following assess the adequacy of City booster station facilities based on the criteria defined in **Section 4.2**.

5.4.1 Zone 2 (Existing Ski Hill)

The Zone 2 (existing Ski Hill) booster station pumps to the 700,000 gal Zone 2 reservoir; Zone 2 is an open system. Approximately 60 single family homes and a few multi-family connections receive service from Zone 2.

5.4.1.1 Zone 2 Booster Station Capacity Assessment

The Zone 2 booster station consists of two identical 10 HP pumps with individual capacity of 200 gpm and combined capacity of 400 gpm. The water level in the Zone 2 reservoir turns the pumps on and off. Based on the demand projections developed in **Section 3.2.4** the existing pumps have adequate capacity to meet existing and projected 20-year max day demand of Zone 2. The existing pumps also have adequate capacity to meet present and projected 20-year average day demand of Zone 2 with the largest pump out of service.

However, as growth occurs in the Ski Hill area, the City will eventually need additional booster stations to serve areas above elevation 1,300. The future booster stations (Zone 3 and Zone 4) will rely on Zone 2 for supply. Hence, the City may need additional pumping capacity in the Zone 2 booster when it constructs additional pressure zones for the Ski Hill area.

5.4.1.2 Zone 2 Storage Capacity Assessment

The 700,000 gallon Zone 2 reservoir provides gravity storage to Zone 2. The table following contains current and projected storage volume requirements for Zone 2 (all storage components are calculated per the criteria and equations defined in **Section 4.3** and demands from **Table 3-10**).

Table 5-7 Zone 2 Storage Capacity Assessment

Storage Component	Present (gal)	6-year (gal)	20-year (gal)
Operational (1)	97,800	97,800	97,800
Equalizing	0	0	6,000
Standby (2)	14,000	34,000	80,600
Fire Suppression (3)	300,000	300,000	300,000
Dead Storage	0	0	0
Total Required	411,800	431,800	484,400
Total Required (SB + FS nested)	397,800	397,800	403,800
Existing Storage	700,000	700,000	700,000
Surplus (Deficit)	288,200	268,200	215,600
Surplus (Deficit) (SB +FS nested)	302,200	302,200	296,200

(1) *Assumes top 3.25' of existing 23.25' tall 700,000 gal Zone 2 reservoir*
(2) *Single booster pump capacity exceeds twice ADD; hence, 200 gal/ERU minimum*
(3) *Multi-family development in Zone 2 necessitates the 2,500 gpm for 2 hrs fire flow requirement.*

As shown in the preceding table, Zone 2 has adequate storage to meet present and projected 20-year storage needs. Two pressure reducing valves (PRV) between Zone 2 and Zone 1 make the Zone 2 reservoir available to Zone 1 in the event that Zone 1 pressure in the vicinity of the PRVs drops below a set point; the City has chosen the PRVs' set points such that the valves only operate in emergency situations (rather than acting as equalizing storage during normal peak demands).

5.4.1.3 Zone 2 Distribution Capacity Assessment

The Zone 2 distribution system consists primarily of 8" and 12" mains with the exception of the 16 inch main from Bergestrasse to the reservoir. The City intends Zone 2 to serve the portion of Ski Hill between elevations 1,200 to 1,300. The zone can theoretically serve connections up to elevation 1,340 and still meet the DOH 30 psi minimum pressure criterion. However, the City will eventually implement Zone 3 to serve connections between elevations 1,300 to 1,400.

The hydraulic model indicates that existing mains can supply current and 20-yr PHD to service connections between elevation 1,200 to 1,300 with service pressures meeting the City's 40 psi goal. The hydraulic model predicts that all existing service nodes in the Zone 2 meet or exceed the 1,000 gpm residential fire flow requirement; where applicable, Zone 2 also meets the 2,500 gpm multi-family fire flow requirement. Distribution capacity meets City criteria and appears adequate for meeting current and projected 20-year demands.

5.5 Storage

This Section contains the analysis of Zone 1 (main zone) storage needs. Refer to **Section 5.4** for Zones 2-4 storage analyses.

5.5.1 Zone 1 (Main Zone) Storage Capacity Assessment

Zone 1 has 800,000 gallons of storage available from the Icicle reservoir; Zone 1 also benefits from storage in Zone 2 due to PRVs between the Zones (refer to **Section 5.4.1.2**). The table following contains current and projected storage volume requirements for Zone 1 (all storage components are calculated per the criteria and equations defined in **Section 4.3** and demands from **Table 3-10**).

Table 5-8 Zone 1 Storage Capacity Assessment

Storage Component	Present (gal)	6-year (gal)	20-year (gal)
Operational (1)	108,100	108,100	108,100
Equalizing	0	0	0
Standby (2)	582,200	606,400	635,600
Fire Suppression (3)	630,000	630,000	630,000
Dead Storage	0	0	0
Total Required	1,320,300	1,344,500	1,373,700
Total Required (SB + FS nested)	738,100	738,100	743,700
Existing Storage (4)	1,100,000	1,100,000	1,100,000
Surplus (Deficit)	(220,300)	(244,500)	(273,700)
Surplus (Deficit) (SB +FS nested)	361,900	361,900	356,300

(1) *Assumes top 2.5' of existing 18.5' tall 800,000 gal Zone 1 reservoir*
(2) *Source capacity (excluding largest producing source) exceeds twice ADD; hence, 200 gal/ERU minimum*
(3) *Downtown commercial area in Zone 1 necessitates the 3,500 gpm for 3 hrs fire flow requirement*
(4) *Includes 800,000 gal Icicle reservoir and 300,000 gal of SB/FS storage available in Zone 2 reservoir via PRVs between Zone 2 and Zone 1 (**refer to Section 5.4.1.2** for Zone 2 storage calculations)*

As shown in the preceding Table, Zone 1 has adequate storage to meet present and projected 20-year storage needs provided the City nests the standby and fire storage components. Two pressure reducing valves (PRV) between Zone 2 and Zone 1 make the Zone 2 reservoir available to Zone 1 in the event that Zone 1 pressure in the vicinity of the PRVs drops below a set point; the City has chosen the PRVs' set points such that the valves only operate in emergency situations (rather than acting as equalizing storage during normal peak demands).

5.5.2 Condition of Existing Reservoirs

The City fully demolished and reconstructed the Zone 1 (Icicle) reservoir in 2008; the City chose a cast in place concrete reservoir reconstruction that requires virtually no maintenance. The Icicle reservoir is in excellent condition.

The Zone 2 (Ski Hill) steel reservoir received a full coating (inside and out) when constructed in 2005. The Zone 2 reservoir is in good condition.

5.6 Distribution System

This Section evaluates the adequacy of the City's distribution system facilities under current and projected demands. **Section 4.5** outlines the criteria for evaluating the distribution system.

The City's Water Distribution System and Sewer Collection System Master Plan contains analyses to determine the City's transmission needs when the future service area reaches build-out (herein referred to as ultimate demands). This Water System Plan integrates the results of that analysis and in some cases substitutes the ultimate improvement sizing in lieu of 20-year improvement sizing to increase the likelihood that distribution system improvements live out their full useful service life.

5.6.1 Hydraulic Model Setup

The hydraulic model utilizes WaterCAD 7.0 by Haestad Methods as the analysis environment.

Hydraulic model node elevation data comes from a variety of sources and may not share a consistent datum. Design surveys of the City's Zone 1 (icicle) and Zone 2 (Ski Hill) reservoirs provide the basis of elevation for calculating theoretical pressure zone boundaries. The City intends the hydraulic analysis to assess local distribution system performance within preset pressure zone elevation boundaries. Due to the uncertainty associated with area topography, pressure zone boundaries shown on the Figures are approximate.

Reservoir water levels for the various scenarios were set in accordance with DOH requirements:

- Equalizing storage depleted for peak hour scenarios
- Fire/standby storage depleted for max day scenarios
- The largest single source of supply (WTP for Zone 1 and one booster pump for Zone 2) neglected for max day (fire flow) scenarios
- Refer to **Appendix E** for a table of boundary conditions for the various scenarios

The following sources provided input in distributing demand and growth to the hydraulic model: customer water use records, aerial photography, judgments of City staff and engineering consultant, and the City's Water Distribution System and Sewer Collection System Master Plan. Refer to the City's Master Plan for details on Future Service Area build-out (ultimate) demands distribution.

The City plans to regularly update the system hydraulic model to reflect additions, replacements, and/or changes to the distribution system. During the intervening years between Water System Plan Updates the City will use the model to design planned capital improvements as system growth occurs. The hydraulic model helps the City understand the system's capacity and limitations. **Appendix E** contains a copy of the hydraulic model node map and sample outputs.

5.6.2 Hydraulic Model Findings

The City has numerous supply scenarios under which the water system can operate (wells only, WTP only, a combination of wells and WTP). The City generally operates the WTP as the lead source at a constant flow rate and uses the wells to equalize peak demands throughout the day. However, due to all three sources geographic locations southwest of the City, the various possible combinations of sources only marginally affect distribution system pressures. Water supplied by the WTP and wells flows to the City through mains along Icicle Rd and East Leavenworth Rd; The Icicle Rd main conveys approximately 80% of the City's supply, while the East Leavenworth Rd main conveys approximately 20%. The Icicle reservoir tends to provide a constant hydraulic grade line (HGL) for Zone 1.

The table following summarizes pressures estimated by the hydraulic model under static, max day, and peak hour conditions for current and projected demands with the distribution system as it currently exists.

Table 5-9 Estimated Water System Service Pressures (Existing Distribution System)

General Area	Predicted Pressure (psi)				
		Current		20-year	
	Static	Max Day	Peak Hour	Max Day	Peak Hour
Northwest residential (Pine Rd & Ski Hill Dr)	55-60	40-45	35-40	40-45	30-35
West residential (West & Mine St)	55-60	45-50	40-45	45-50	35-40
West residential (Park Ave & Mountain View Dr)	40-45	30-35	25-30	30-35	25-30
High school (Titus Rd / Chumstick Highway)	70-75	60-65	50-60	55-60	40-50
Highway 2 & Icicle Rd	65-70	55-60	60-65	55-60	60-65
Downtown	70-80	60-70	50-60	60-65	50-60
Safeway (Hwy 2 & Riverbend Dr)	65-70	55-60	50-55	55-60	45-50
East Leavenworth Rd & Dye Rd	80-85	70-75	60-65	65-70	55-60
East Leavenworth Rd & Dempsey Rd	85-90	85-90	85-90	80-85	80-85
East Leavenworth Rd & Icicle Rd (1)	80-85	80-85	90-95	80-85	90-95
Icicle Rd at wells (1)	80-85	85-90	95-100	95-100	95-100
Icicle Rd & Fish Hatchery Rd (1)	75-80	80-85	90-95	80-85	90-95

(1) *Nodes in the vicinity of the WTP and wells experience some pressure fluctuation depending on which sources of supply operate. Max Day scenarios assume the WTP offline and both wells online; Peak Hour scenarios assume both the WTP and wells online. With existing transmission capacity the capacity of the WTP substantially decreases when both wells operate.*

As shown in the preceding Table, the majority of the system meets the City's minimum pressure goal of 40 psi during current and 20-year PHD with the exception of the west residential area in the vicinity of Mountain View Dr; it appears some services in this area may not currently meet the DOH required 30 psi minimum pressure during existing PHD. Zone 2 will eventually serve the Mountain View Dr vicinity because it sits above elevation 1,200; hence the low pressure when served from Zone 1.

Under 20-year PHD the area near Pine Rd and Ski Hill Dr near the Zone 2 booster station will experience pressure in the 30-35 psi range which meets the DOH requirement, but does not meet the City goal of 40 psi.

The hydraulic model estimates available fire flow throughout the system. The Table following summarizes estimated available fire flow. Estimated flows assume max day demand conditions with the existing distribution system and maintaining 20 psi at all services.

Table 5-10 Model Estimated Available Fire Flows (Existing Distribution System)

General Area	Criteria (gpm)	Predicted Available Fire Flow with 20 psi Residual			
		Current (gpm)	Meets Criteria?	20-year (gpm)	Meets Criteria?
Northwest residential (Pine Rd & Ski Hill Dr)	1,500	>4,000	Yes	>4,000	Yes
West residential (West St & Mine St)	1,500	900-1,100	No	900-1,100	No
West residential (Park Ave & Mountain View Dr)	2,500 (1)	900-1,100	No	900-1,000	No
High school (Titus Rd / Chumstick Highway)	2,500	3,000-3,300	Yes	2,700-3,300	No
Highway 2 & Icicle Rd	2,500	>4,000	Yes	>4,000	Yes
Downtown	3,500	1,200-3,500	No	1,200-3,500	No
Safeway (Highway 2 & Riverbend Dr)	2,500	1,000-1,100	No	900-1,000	No
East Leavenworth Rd & Dye Rd	1,500	1,200-1300	No	1,100-1,200	No
East Leavenworth Rd & Dempsey Rd	1,500	1,500-1,600	Yes	1,400-1,500	No
East Leavenworth Rd & Icicle Rd (1)	1,500	2,500-3,000	Yes	2,500-2,800	Yes
Icicle Rd at wells (1)	1,500	>4,000	Yes	>4,000	Yes
Icicle Rd & Fish Hatchery Rd (1)	1,500	2,500-2,800	Yes	2,500-2,700	Yes

(1) *The City's land use allows for multi-family development in this area.*

As shown in the preceding Table, several areas in the City do not meet fire flow criteria presently; several more areas will not meet criteria under 20-year demands. The multi-family area near Mountain View Dr has substantial fire flow deficiency. The east end of Town near Safeway does not meet the City's commercial fire flow requirement. A portion of East Leavenworth Rd falls slightly short of the residential fire flow criteria. Recent improvements to the downtown area in the vicinity of the hospital have improved fire flows in downtown (some areas currently meet the 3,500 gpm criteria); however, downtown will require more improvements to allow the full central business district to meet fire flow criteria under present and 20-year demands.

5.6.3 Conclusions of Hydraulic Analysis

According to the system Operator and the hydraulic model, the system experiences satisfactory service pressure and pressure variations under average present day demand conditions; likewise, service pressures and pressure variations are generally within acceptable limits during present MDD and PHD. The existing system has several areas that do not meet fire flow criteria; these deficiencies will increase if system growth continues to occur without major transmission improvements. Likewise, system service pressures will continue to decrease as system growth occurs unless the City implements transmission main improvements.

The Leavenworth distribution system lacks a continuous backbone trunk water main adequately sized to convey water through and/or around the distribution system for delivery to the smaller diameter local distribution lines and to the future growth areas on the north side of the system. The system presently relies on smaller diameter mains to convey water through the grid. These

mains act as both local distribution and transmission mains. A trunk water main would provide high capacity transmission through and/or around the perimeter of the distribution system and utilize existing smaller diameter mains for distribution and service. A trunk main would also provide transmission capacity for fire protection, reduce pressure fluctuations throughout the system, and provide the ability to serve future growth in areas to the north.

With existing distribution system capacity the main zone HGL does not provide adequate pressure during peak demands to customers connected above elevation 1,200. Future improvements to the Zone 1 distribution system could theoretically allow connections in Zone 1 above elevation 1,200; however, connecting services above elevation 1,200 to Zone 2 will provide them with higher service pressures.

In general, the existing transmission and distribution system meets current non-emergency demands, but does not meet fire flow requirements in certain areas. As demands increase in the future, the system will strain to meet pressure requirements in some areas and fire flow deficiencies will increase. As discussed previously, the lack of a trunk transmission main in and/or around the City contributes to the identified deficiencies. In addition, a few localized distribution grid inadequacies restrict fire flows in some areas.

5.6.4 Water Treatment Plant Transmission Main Hydraulics

Water from the WTP flows to the City through approximately 12,600 LF of 16” main on Icicle Rd which branches into 12” and 10” mains on Icicle Rd and East Leavenworth Rd respectively. The 12” main on Icicle Rd runs approximately 10,000 LF until it reaches the edge of the City at Highway 2. The 10” main in East Leavenworth Rd runs approximately 16,000 LF at which point it increases to 12” for approximately 2,200 LF where it tees into Highway 2 near Safeway at the east end of the City. Water travels roughly four miles along the Icicle Rd route and six miles along the East Leavenworth Rd route. The existing transmission capacity between the WTP and the City limits the gravity flow capacity of the WTP to approximately 2.4 MGD although the Operator does not operate above 2.0 MGD due to filter backwash frequency.

The 12” rough old steel main between the wells and the City substantially limits transmission from the WTP and wells. The City cannot operate both the wells and WTP simultaneously at full capacity due in part to this transmission limitation. Using pumps at the WTP (rather than relying solely on gravity) would allow the City to fully utilize existing sources, but would elevate pressures along Icicle Rd and East Leavenworth Rd; at present, the WTP piping and finished water pumps are not set up to provide the additional head required.

Due to the fact that the wells and Icicle reservoir are located relatively close to the central part of the City on Icicle Rd, the East Leavenworth Rd main is a secondary transmission route carrying a smaller portion of the water from WTP than does the Icicle Rd main. For this reason, its relatively small size (10”) does not present an immediate problem although when, at some future point it is replaced due to age, it should be upsized. If the City wishes to consider a site for additional storage in the vicinity of East Leavenworth Rd and Dye Rd, then the 10” main will need to be replaced with something significantly larger.

5.6.5 Residences near Water Treatment Plant

The City serves approximately 20 connections near the WTP. These connections are mostly vacation homes occupied seasonally. These connections receive service pressure that does not meet DOH's 30 psi minimum requirement. Some of these connections utilize individual booster pumps (refer to **Section 6.8.1**). The City has served these connections for over a decade and does not receive complaints from customers on the level of service provided. Due to the small number of connections and the lack of discontent on the part of the customers, the City does not plan to modify service to these connections.

5.6.6 Old River Crossing

The City suspects the old 10" steel main that crosses the Wenatchee River from East Leavenworth Rd to the vicinity of Division St. may be leaking. The City has closed the valves at both ends of the river crossing and no longer uses the main. This WSP and the improvements developed herein assume that this river crossing will be abandoned. The river crossing main plays a relatively minor role in meeting system peak hour demands (PHD).

5.6.7 Condition of Distribution System

Aside from the pipe size and capacity issues discussed previously, the principle concerns with the existing pipe system relate to the age and condition of the pipe. The age and condition of City mains varies substantially.

The City believes the 16" Icicle Rd transmission main will not present an unmanageable maintenance problem in the near term. However, in addition to limiting the available capacity of the WTP and wells (see preceding discussion), the 12" steel main on Icicle Rd is old and will eventually need replaced.

The City installed the 10" steel transmission main on East Leavenworth Rd in the 1930's. City personnel report that the 10" steel main has heavy internal encrustation, and that pinhole leaks occur periodically; installation of a polyphosphate system substantially reduced the frequency of pinhole leaks. Neglecting capacity concerns, the City may need to consider replacement of this main due to excessive maintenance requirements; the older the main gets, the more it will leak. The City replaced a portion of the main on East Leavenworth Rd near Highway 2 with 12" ductile iron during a Chelan County road project. The Icicle Rd transmission main is newer than the 10" steel main in East Leavenworth Rd. As maintenance requirements become excessive over time, the City will eventually need to replace the 10" steel main in East Leavenworth Rd; it is unclear whether maintenance or hydraulic issues (discussed previously) will first prompt the City to replace the 10" main.

The City serves the Icicle Valley area with numerous individual privately owned service lines tapped directly to the Icicle and East Leavenworth Rd transmission mains. In some cases the City has extended water service to additional residences by connection to the end of an existing service pipe. Service pipe size, material, and installation quality varies widely in this area. The City has limited control of these services by way of shut-offs (where available) at the transmission main, and at meter boxes. In many cases long runs of privately owned service pipe

exist between the transmission main and a city meter. This area has a few fire hydrants, but due to the limited distribution system, the transmission mains on Icicle Rd and East Leavenworth Rd provide the only meaningful access to fire flow in the area.

In the Duncan Orchards area east of the City (at the northerly end of East Leavenworth Rd), the existing water distribution system consists of a combination of individual service extensions and developer installed PVC pipe of varying sizes. The City owns none of these pipes. Few fire hydrants exist in this area.

During the meter installation project completed in 1990, crews observed corrosion and encrustation of old iron services; the buildup did not appear excessive. In no case did the internal encrustation render the line unusable. Many older service lines utilize a "seamed" galvanized iron pipe. Leaks that occur on "seamed" galvanized service lines usually occur along the pipe seam.

City Staff report that the system has adequate valving in most areas with the exception of several stretches on the Icicle Rd and East Leavenworth Rd transmission mains. Fire hydrants generally have adequate valving; City Staff estimate approximately 20% of fire hydrants have no shut-off on the hydrant lead. In the early 1990s, City crews encountered a wood stave hydrant lead, indicating the possibility that others may exist in the system.

In general, the City Limits have good fire hydrant coverage. The service area south of the City along the Icicle Rd and East Leavenworth Rd transmission mains has sparse hydrant coverage due to the lack of distribution capacity extending out from the transmission mains; the lack of transmission capacity and distribution mains limit the fire flow that could be withdrawn from hydrants on East Leavenworth Rd. In order to reduce demand for urban services in this area outside the UGA the City will only install a fire hydrant in this area when the City has determined that a hydrant serves the best interests of the City. Applicants for hydrants in this area are responsible for all costs associated with its installation.

The City's 2002 WSP reported average annual unaccounted for/non-revenue/distribution system leakage of approximately 15% (100 gpm on average). The City attributed the unaccounted for/non-revenue/distribution system leakage to a combination of meter inaccuracies, leakage, water used but not recorded for flushing/hydrant testing/street washing, unauthorized unmetered uses, backwashing at the WTP and reservoir overflows. Since 2002, the City has found and repaired some large leaks, discovered some previously unrecorded City meters, and generally worked to reduce unauthorized or unrecorded uses. This has reduced the City's unaccounted for/non-revenue/distribution system leakage to approximately 3-4% annually.

5.7 Control System

The City has the capability to automatically control the WTP and wells based on the level of the Icicle reservoir. The City generally operates the WTP at a constant flow rate rather than varying the flow rate with the reservoir level. The operator sets the WTP flow rate at approximately the average day demand flow rate (adjusted seasonally based on operator experience) and then the

wells equalize peak demands in excess of the WTP flow rate. The WTP serves as the lead source and the wells function as needed to meet demand.

Phone lines transmit communication between the Icicle reservoir level sensor and the WTP and wells. City staff report that existing controls provide adequate flexibility to manage the system's sources of supply.

5.8 Overall Water System Reliability

Leavenworth has a certain amount of supply redundancy due to its three sources of supply. However, various system characteristics could threaten reliability under certain circumstances as shown in the Table following.

Table 5-11 Water System Reliability

Reliability Vulnerability	Effect on Water System
Interruptible Water Rights	Nearly half of the City's existing instantaneous water rights are subject to interruption depending on the flow in Icicle Creek and/or the Wenatchee River. In the past this has not presented a problem; however, as demand increase with growth, water rights interruption could pose a threat to water system reliability.
Loss of Electrical Power	The City has equipped the wells with a backup power generator. At present, the wells have sufficient capacity to meet system demands. The WTP cannot function without electrical power. Under most conceivable situations, customers would not lose water service during a power interruption.
WTP or Well Out of Service	• Current ADD – minimal effect because the City has three independent sources, each of which has capacity exceeding current ADD (standby storage is also available) • Current MDD – minimal effect because any two of the City's three sources has capacity exceeding current MDD (standby storage is also available) • 20-year ADD – minimal effect because any two of the City's three sources has sufficient capacity to meet 20-year ADD (standby storage is also available) • 20-year MDD – minimal effect provided two sources do not go down simultaneously; any two sources will meet projected 20-year MDD (standby storage is also available)
Main Break	Minimal effect because the distribution system is well looped in most areas and generally has adequate valves to isolate sections of main requiring repair

5.9 Summary of System Deficiencies

The Table following summarizes the deficiencies identified in this Section.

Table 5-12 Summary of Water System Deficiencies

Area of System	System Component	Description of Deficiency(ies)
Supply	Quantity of Supply	No deficiency identified or anticipated
	Wells & Pumps	No deficiency identified or anticipated
	Water Treatment Plant	• Fish screen on raw water intake pipe does not meet current standards. • During periods of high sediment loading in Icicle Creek (primarily during spring runoff), WTP filters require backwashing at 8-10 hour intervals. • When the water plant is off-line, there is a lack of sufficient potable water at the plant for filter washing and other domestic uses. • There is no backup power (i.e., the WTP cannot operate during power outages). • Office/Lab is too small and is in a very noisy location. • Lack of indoor chemical storage area. • No fencing exists around the backwash pond area which is near a public trail.
	Disinfection	No deficiency identified or anticipated
	Water Quality Testing	No deficiency identified or anticipated
Water Rights	Quantity of Rights	The City has adequate rights to meet projected 20-year demand; the City does not have adequate rights to meet projected ultimate demands.
	Litigation with DOE	The City is currently suing DOE over the annual quantity of Certificate 8105.
Booster Zones	Zone 2 (existing Ski Hill)	No booster pump, storage, or distribution system deficiencies identified or anticipated; however when the City implements additional booster zones to serve the Ski Hill area, additional booster pump capacity may become necessary.
	Future Zones	Will need additional pressure zones to serve Ski Hill Area above elevation 1,300
Storage	Zone 1 (Main Zone)	No deficiency identified or anticipated
Distribution	PHD Pressure	Some areas do not meet City minimum pressure goal (40 psi) under current and projected 20-year PHD • West residential area in the vicinity of Mountain View Dr • Northwest residential area in the vicinity of Pine Rd and Ski Hill Dr (existing Zone 2 booster station)
	MDD Fire Flow	Several areas do not meet City fire flow criteria under either current or projected demands: • West residential (West St & Mine St) • West residential (Park Ave & Mountain View Dr) • Downtown • Safeway (Highway 2 & Riverbend Dr) • East Leavenworth Rd & Dye Rd • East Leavenworth Rd & Dempsey Rd
Control System	Adequacy of Control	No deficiency identified or anticipated
Reliability	Threats to System	No unmanageable threats to reliability identified or anticipated

6.0 IMPROVEMENTS

6.1 Introduction

This section identifies a system improvement or a range of system improvement alternatives for each deficiency listed in **Section 5**. Where applicable, **Figure 3** shows the geographical location of system improvements.

The cost estimates included in this section represent planning level estimates based on preliminary evaluations and assumptions; the cost estimates provide a basis for comparing alternatives and allow the City to approximate financing needs for preparation of a capital improvements plan (CIP). Estimated costs were derived from other similar projects in eastern Washington in the past 10 years; cost have been modified depending on actual project design specifics, the cost of labor and materials, and market conditions at the time of project implementation.

When the City prepares to implement the capital projects identified herein, the City will prepare a more detailed evaluation and cost estimate in a preliminary engineering report. In some cases DOH may require a Project Report in accordance with WAC 246-290-110 to address project specifics prior to project approval. In most cases, DOH does not require a Project Report for distribution system improvements identified in a WSP. However, for a new reservoir, pressure zone, or WTP upgrades, DOH would likely require the City to define in greater detail the improvement(s) identified in this WSP in the form of a Project Report.

6.2 Supply

The supply analysis indicates that the City will not need supply capacity improvements during the 20-year planning period provided system water demand grows at the rate projected. However, the City may consider adding pumping capacity to the existing well field in order to increase supply redundancy and perfect unused instantaneous groundwater rights. The City may also consider eventually expand capacity of the WTP to provide additional supply redundancy. As the City approaches ultimate demand levels, an expansion of supply facilities will become necessary. The City's 2002 WSP explored several alternatives that will apply to expanding supply capacity regardless of when the City chooses to expand supply capacity; this WSP carries forward and updates the supply alternatives considered in the 2002 WSP.

6.2.1 Supply Capacity Expansion Alternatives

6.2.1.1 Alternative 1: Expand Well Field Capacity

The City has several options for expanding the pumping capacity of the existing well field:

- Increase the pumping rates of Wells 1 and 2 by replacing the pumps
- Install a pump in existing unused 8" test well at well field site

- Construct new well at well field site

Adding pumping capacity to the well field would increase the City's supply redundancy and perfect unused instantaneous groundwater rights. The City's groundwater permit G4-29958 allows an instantaneous withdrawal rate of 3,000 gpm; existing Wells 1 and 2 perfect approximately 2,000 gpm of the 3,000 gpm allowed. The City could install groundwater pumping facilities with capacity exceeding 3,000 gpm; however any capacity in excess of 3,000 gpm would be considered strictly for facility redundancy and could not legally be used.

6.2.1.2 Alternative 2: Increase Capacity of the Existing Water Treatment Plant

The City could modify or replace the limiting unit processes at the existing WTP. Existing facilities allow the WTP to produce up to 2.45 MGD (with intense Operator attention). The intake pipe reportedly limits plant capacity. However, other facility components would also require upgrading to significantly expand capacity of the WTP. Several documents pertaining to the WTP (1996 Comprehensive Performance Evaluation of the WTP, 1999 letter report titled Achieving Optimized Performance Goals and Treatment Capability from a Small Water Treatment Facility, and communication with Bob Hegg of Process Applications) identify the limiting unit processes.

- Filter capacity limited to 2.75 MGD (1996 Process Applications report estimates likely filter capacity of approximately 2.75 MGD based on a 4 gpm/ft^2 loading rate. The evaluation team believed the assumed maximum loading to be appropriate for direct filtration plants although it could possibly be loaded at a higher rate
- Reaction basin capacity limited to approximately 2.45 MGD
- Lack of redundancy for the various WTP components
- WTP requires high level of attention and work by operating staff to treat 2.45 MGD due to frequent filter backwashing requirement. Expanding capacity of the existing WTP might require staffing of the facility around the clock.

Due to these limitations it may not prove practical or economical to increase the capacity of the existing WTP. Bob Hegg of Process Applications agrees with this assessment.

6.2.1.3 Alternative 3: Replacement of WTP

The City could replace the WTP at the existing site or a new location.

6.2.1.4 Supply Capacity Expansion Alternatives – Summary & Conclusions

The Table following summarizes supply capacity alternatives.

Table 6-1 Summary of Considerations for Future Supply Expansion Alternatives

Alternative	Advantages	Disadvantages	Key Issues
1. Additional Wells	• Allows incremental increases in capacity • Most likely the lowest cost alternative • Creates minimal additional O&M	• City residents prefer surface water taste to groundwater	• Site availability • Aquifer characteristics • Resolving past well/pumping problems • Consistency with City's water rights
2. WTP Expansion	• Makes use of existing facilities • Would retain a preferred (surface) water source	• May be significantly more expensive than drilling additional wells • May not be feasible/economical	• May be enough unit processes requiring replacement that a new WTP would be preferred • Consistency with City's water rights
3. WTP Replacement	• Existing WTP deficiencies would be resolved by new plant construction • New WTP would reduce O&M related to surface water treatment • Would retain a preferred (surface) water source	• Significantly more expensive than drilling additional well(s)	• Site adequacy (i.e.constructability while keeping existing facility in service) • Consistency with City's water rights

The following bullets summarize observations relating to the preceding table of future supply expansion alternatives.

- The WTP has existing deficiencies unrelated to capacity (refer to **Section 5.2.3**). As the WTP ages, the list of deficiencies will likely grow longer. Unforeseeable regulatory changes could also add to the list of plant deficiencies. Due to these facts, retrofitting and/or expanding the existing facility may not prove cost effective.
- Most water systems (and DOH) prefer groundwater sources to surface water sources because groundwater sources generally do not require treatment (aside from chlorination) which usually decreases O&M costs and water quality variability.
- From a cost standpoint (both capital and operational), groundwater supply will cost less than surface water treatment, assuming that adequate groundwater supply can be developed.
- The fact that the City has an existing WTP consistently producing high quality water offsets (although not totally diminishes) the fact that producing groundwater generally cost less than treating surface water.
- All supply alternatives must be consistent with the City's water rights.

In light of the preceding considerations the City plans to expand pumping capacity of the existing well field to perfect all or a portion of the remaining instantaneous water right under ground water permit G4-29958 (refer to discussions in **Sections 5.3 and 6.2.1.1**). The City plans to evaluate several alternatives for expanding the capacity of the well field. This evaluation may require pump testing existing wells to assess the capacity of the aquifer; due to this fact, the alternatives comparison cannot be included in this Water System Plan. For the purposes of this Water System Plan the City plans a preliminary project budget of $300,000 for expanding the pumping capacity of the well field.

6.2.2 Water Treatment Plant

6.2.2.1 Improvement Alternatives Overview

The following Table contains the WTP issues identified in **Section 5.2.3** and a conceptual overview of the improvement alternatives. Issues where the City considered multiple improvements, the Table indicates the City's chosen alternative. The Sections following **Table 6-2** contain detailed descriptions of the selected WTP improvements along with cost estimates.

Table 6-2 Summary of WTP Problems and Improvement Alternatives

Problem	Improvement Alternatives	Advantages and Disadvantages	Key Issues
1. Fish screen on raw water intake pipe does not meet current standards.	Screen that prevents fish passage and provides pre-screening to reduce sediment load		• Screen ideally will prevent fish passage, provide pre-screening, be self cleaning, and meet the requirements of WDFW for velocity and size • Screen ideally will not be susceptible to freezing or result in high head loss
2. During periods of high sediment loading in Icicle Creek (primarily spring run off), WTP filters must be backwashed at 8-10 hour intervals	Make O&M adjustments, no capital improvements - shutdown WTP during spring runoff and perform annual plant maintenance Based on the advantages and disadvantages of this and the other alternatives, the City has selected this alternative for dealing with high sediment loading	Advantages • No capital costs • During high turbidity periods, demand is low enough that wells can meet system demand • No new unit process Disadvantages • Intermittent filter operation may not be practical (reduced treatment effectiveness, etc.) • As system demand grows, wells may not have sufficient capacity to supply system without WTP. • Does not address turbidity due to landslides, rainstorms or other unforeseeable events (as opposed to predictable spring runoff)	
	VAF2000 prefilter – compact mechanical prefilter with automatic backwash; City personnel initially identified this alternative and have done some pilot testing. VAF2000 is manufactured by the Valve and Filter Corp.	Advantages • Would increase filter run times between backwash • Compact size • Automatic backwash Disadvantages • Water from intake would need to be pumped through prefilter (no pumping currently required) • Additional backwash water would be created which would contribute the already overloaded backwash process, thus increasing backwash improvement costs • Prefilter backwash may not settle as readily as coagulated/flocculated water from sand filters • Requires a separate unit process to operate • Backwash water counts against water right	• Additional treatment of prefilter backwash water (in addition to settling) may be required to meet NPDES permit requirements since this water would not see a coagulant as is currently the case • Additional backwash water would be added to the already overloaded backwash water system. However, this additional backwash water should be offset at least partially by a reduction in required frequency of backwashing the sand filters. • Where to locate this equipment (including pumps, building, etc.) • Costs would include filters, pumps, electrical, building to house this equipment, piping modifications • May not be as simple or inexpensive as advertised by filter manufacturer • Desired/required control and automation features

Problem	Improvement Alternatives	Advantages and Disadvantages	Key Issues
(continued from previous page) 2. During periods of high sediment loading in Icicle Creek (primarily spring run off), WTP filters must be backwashed at 8-10 hour intervals	Clarification/sedimentation – either conventional process (i.e., separate flocculation and clarification), or solids contact process (flocculation and clarification combined), requires new basin	Advantages • Would increase filter run times between backwash • Would reduce total backwash water volume Disadvantages • Requires separate basin, limited site availability • Substantial cost but would reduce backwash improvement costs • Requires a separate unit process to operate • Likely most costly alternative; also most significant process change	• Addition of a clarifier represents a significant process modification and would impact routine O&M requirements • Uncertainty of available room while still leaving space for future plant modification or replacement – depending on type may require an area as small as 50'x50' to as large as 100'x100' • Costs would include concrete basin and related equipment (settled solids removal) and significant piping revisions if existing coagulation equipment and flocculation basin is to be used.
	Infiltration gallery – existing intake replaced by well screen installed horizontally below water level adjacent to Icicle Cr., backfill with a uniformly graded fine gravel	Advantages • Would increase filter run times between backwash • Would eliminate much of the sediment at the source which would eliminate sediment handling at downstream processes • Would resolve intake screen problems (fish, freezing) • Would reduce backwash water volume • Additional O&M requirements would be minimal as compared to the other alternatives, no new unit process Disadvantages • Not certain if existing terrain is suitable (rock, etc.) • Due to possible headloss across the screen, pumping water from the infiltration gallery may be required.	• Site feasibility • Consistency of groundwater levels adjacent to Creek over the course of the year • Costs would involve excavation and screen installation, potentially pumping equipment and related electrical, piping modifications
3. When the water plant is off-line, there is a lack of sufficient potable water at the plant for filter washing and other domestic uses	Utilize existing chemical storage tank onsite (3,000 gallon) – related improvements would include piping and pumping equipment to reservoir The City selects this alternative for implementation	Advantages • Lower capital expense • Utilizes existing double walled insulated and heated chemical storage tank Disadvantages • Volume of chemical storage tank is relatively small	• Whether the existing chemical storage tank should be preserved or converted to the water storage reservoir
	Construct storage of a size suitable for plant needs (10K-30K gallons) – related improvements would include piping and pumping equipment to reservoir	Advantages • Larger volume available Disadvantages • Significant capital expense	• Location of new tank

Problem	Improvement Alternatives	Advantages and Disadvantages	Key Issues
4. There is no backup power, therefore, the WTP cannot operate during power outages.	Provide backup power generator at WTP	Advantages • Continued plant operation during power outages Disadvantages • Backup power does not provide complete source reliability. That is, the WTP may be off-line for a number of other reasons	• Water reservoir is intended to provide water during source outages. If this is acceptable relative to the expected power outage duration, backup power for WTP is not necessary • Wells already have backup power; additional supply redundancy reliability may not be justifiable
5. Smaller than ideal lab area in a very noisy location	Construct larger lab by adding onto existing office area	Advantages • Reduce potential for long term operator hearing loss Disadvantages • Limited area available	• Building footprint has been field approximated. Building expansion may require a pier type foundation due to site topography
6. Lack of indoor chemical storage area	Construct indoor chemical storage area	See comments at right	• City has at least temporarily solved this problem by storing chemicals at the well site in the pump house • Available area is limited. This improvement must be coordinated with other improvements which affect site layout • City must decide how pressing this problem is. Solutions are not simple or convenient. May be best addressed in conjunction with future WTP replacement.
7. No fencing around WTP which is near a public trailhead	Fence around the WTP	Advantages • Secure the WTP perimeter	-

6.2.2.2 Improvement Alternatives Development

The following Sections describe the WTP improvement alternatives considered and the estimated cost.

1. Raw Water Intake Fish Screen

The City's raw water intake screen does not meet current Department of Fish and Wildlife (DFW) requirements. However, the City has secondary screens at the screen house that accomplish the same level of screening required by DFW. The City's WTP Operator has discussed this with DFW and it appears DFW plans no enforcement action. If and when the City decides to modify the existing raw water intake screen (or if compelled by DFW at some later date) the City will use the following process:

- DFW will provide the City with specific criteria and requirements for the screen.
- The City and its engineer will perform an evaluation if multiple alternatives exist that will achieve the desired outcome (feasibility, cost, pros and cons of each alternative).
- After selecting an alternative, the City will submit the proposed solution to DFW and the National Marine Fisheries Service (NMFS) for review and concurrence with the City's decision.
- The City will then investigate the permits associated with the proposed solution and begin the application process. At this time the City cannot predict which permits will apply. JARPA, SEPA and NEPA may or may not be required depending on the selected alternative.
- Either in conjunction with or following the permit process, the City will begin design of the facilities and construction will follow thereafter.

The City chooses to delay action on the raw water intake screen indefinitely. If compelled by DFW, the City will modify the WTP intake screen. The City plans to explore funding sources to determine whether grant money exists that does not carry with it a prohibitive administrative effort.

2. High Sediment Loading

The City takes the WTP offline during the spring runoff when raw water turbidity reaches its peak; while offline the Operator performs routine maintenance on the WTP facilities. The wells supply the system during this period; the Operator reports that the capacity of the City's wells significantly exceeds demand during spring runoff. Several alternatives exist that would allow the City to operate the WTP through the spring runoff period, but they require significant additions and/or modifications to the WTP. At this time, the City does not feel the benefits of operating the WTP through high sediment loading justify the cost of such an upgrade. The City plans to continue to operate the WTP as described previously.

3. On-Site Water Storage

The City will utilize an existing 3,000 gallon chemical storage reservoir and install a booster pumping system to provide water for cleaning the plant (filters or chlorine contact chamber) when the plant is offline as well as to provide for domestic needs (toilets, etc.). The following table estimates the cost of the system.

Table 6-3 On-Site Water Storage

Description	Est. Cost
Modifications to existing chemical storage tank (allowance)	$5,000
Trenching for additional pipes	$5,000
Site piping modifications, pressure tank, pumps, minor electrical, installation	$15,000
Subtotal	$30,000
Taxes (8.1%)	2,400
Engineering – design, inspection, construction admin (15%)	4,500
Contingencies (20%)	6,000
Total (rounded to nearest $5,000)	45,000

4. Backup Power

The City installed a backup power generator for the wells which supplies the City with water during a power outage. A preliminary analysis indicates the WTP would require approximately a 75KW generator based on the following assumptions: need to operate the following major system components plus an allotment for smaller system components not specifically called out (lighting, etc.): 20 HP pump to distribution system, two 5 HP vacuum pumps, 5 HP wash pump, 1.5 HP service pump, inlet/outlet valves, chemical feed pumps, chlorination and water quality monitoring equipment. Assuming a diesel generator with in-base fuel tank, weatherproof outdoor enclosure, exhaust silencer, automatic transfer switch, and electrical panel modifications, the estimated cost is $80,000 including tax, contingency and engineering.

At this time, the City feels that the supply redundancy provided by the backup generator at the City's wells site adequately protects against interruptions in water service due to power failure. The City may consider backup power for the WTP if/when the City renovates or expands the WTP.

5. Small, Noisy Lab

A building extension will be constructed to the west of the existing lab building measuring approximately 15' x 20'. To work around the steeply sloped back side of the existing building, a pier type foundation may be required for part or all of the building. Such a foundation may necessitate a wood frame building rather than matching the existing concrete block. The estimated cost including tax, contingency and engineering is $60,000.

6. Lack of Indoor Storage Chemical Storage Facility

The City currently stores chemicals at the well houses and transports them to the WTP as needed. This inconvenience does not significantly disrupt operation of the WTP. The City plans to delay construction of indoor chemical storage at the WTP site indefinitely. If/when the City expands/renovates the WTP, the City will construct indoor chemical storage facilities.

7. Fencing around WTP Perimeter

Total distance is approximately 1,000 LF which at $15/LF plus a gate and miscellaneous appurtenances results in an estimated cost of approximately $20,000.

6.3 Water Rights

The water rights analysis indicates the City will not need additional water rights within the 20-year planning horizon. However, the City will eventually need additional water rights to meet

projected ultimate system demands. The following Table contains possible solutions to the City's eventual water rights shortfall. The Table ranks the alternatives in order of probable feasibility taking into account the current regulatory environment. The City may need to implement more than one alternative to meet ultimate water rights needs.

Table 6-4 Preliminary Alternatives for Addressing Ultimate Water Rights Needs

Rank of Feasibility	Description	Comments/Key Issues
1	Buy existing water rights	• Feasibility dependent on a willing seller and ability to transfer rights • Could be expensive
2	Increase conservation	• Existing residential usage is low; it is unclear whether the City can significantly reduce consumption through conservation. • Commercial conservation potential exists where existing buildings have not been retrofitted with low use plumbing fixtures and where large base water allotments exist. • A conservation oriented rate structure may encourage conservation; this would involve implementing a rate structure with a small base volume allotment, high overage rates, and adding customer water use history to monthly water bills.
3	Restrict future growth (moratorium on new connections)	• Significant political and economic issues accompany this approach.
4	Reuse wastewater	• Very high initial and on-going costs
5	Obtain additional water rights from the State	• Highly unlikely in the current regulatory environment • The City's pending litigation against Ecology prevents considered analysis of this option at this time. The City expects to refine the description of alternatives in future plans.

The City will reassess the adequacy of water rights every six years in conjunction with updating its WSP. The City will implement one or a combination of the alternatives from the preceding Table when system growth makes it necessary.

6.4 Booster Zones

The analysis of the existing Ski Hill booster zone (Zone 2) indicates the zone will not require improvements within the 20-year planning horizon. However, the City will need additional booster zones to serve the Ski Hill area above elevation 1,300. The following Sections outline the City's plan for additional booster zones.

6.4.1 Existing and Future Pressure Zones

The City intends Zone 1 to serve connections up to elevation 1,200. In most cases service from Zone 1 to connections at or below elevation 1,200 results in static pressures of at least 50 psi and pressures during PHD of at least 40 psi. At present, Zone 1 serves the Mountain View Dr area which has connections as high as elevation 1,230. Eventually the City will connect the Mountain View Dr area to Zone 2.

The City plans for existing Zone 2 to serve connections up to elevation 1,300. The City may eventually wish to provide service to the highest portion of the UGA in the northwest corner above elevation 1,300 and possibly as high as 1,440; this will require two additional booster zones. The table following contains the details of the City's pressure zone plans.

Table 6-5 Existing and Future Pressure Zone Details

Attribute	Zone 1 (existing)	Zone 2 (existing)	Zone 3 (proposed)	Zone 4 (proposed)[1]
Existing Highest Service Elevation	1,230	1,330	-	-
Planned Highest Service Elevation	1,200	1,300	1,400	≈ 1,440
Planned System HGL [1]	1,341	1,424	1,520	1,620

[1] *Zones 1, 2, and 3 the system HGL is an existing or planned reservoir overflow elevation; Zone 4 will most likely be a closed booster system and not have a reservoir.*

6.4.2 Zone 2 (Existing Ski Hill)

As the City adds pressure zones to serve the Ski Hill area, the new zones will withdraw water from Zone 2. The growth in Zone 2 and the additional demands of new booster stations will eventually necessitate an upgrade of the Zone 2 booster pumps. The City designed the Zone 2 booster station such that the building and piping will support larger booster pumps than currently exist. The Zone 2 booster station will eventually need capacity to simultaneously supply Zone 2 20-year MDD (200 gpm), Zone 3 20-year MDD (72 gpm) and Zone 4 20-year PHD (102 gpm). As growth dictates during the 20-year planning period, the City plans to eventually upgrade the pumping capacity of the Zone 2 booster station with a minimum of two pumps each with capacity of 375 gpm. System growth will ultimately dictate the timing of expanding the Zone 2 booster station pumping capacity. The City estimates the total cost of the upgrade at $20,000.

The Zone 2 booster station may require additional expansion beyond the 20-year planning period. The City plans to address booster pump capacity expansion incrementally as necessitated by growth within and beyond the 20-year planning period.

6.4.3 Zone 3 (Future Upper Ski Hill)

The City plans the following improvements to serve customers in the Ski Hill area between elevations 1,300 and 1,400.

As growth pressures dictate, the City will construct a booster station that withdraws from Zone 2 and supplies Zone 3. **Table 3-10** contains projected demands for Zones 1, 2, 3, and 4.

The Zone 3 booster station will need to supply the 20-year MDD of Zone 3 (72 gpm) plus the 20-year PHD of Zone 4 (102 gpm). In the interest of redundancy, the City plans to initially construct the booster with two pumps, each capable of supplying 180 gpm (assume a combined capacity of 340 gpm). The City will construct the booster station such that the building, piping, and electrical systems will allow eventual expansion to meet ultimate demands for Zone 3; ultimate capacity of the Zone 3 booster will include the ultimate MDD of Zone 3 (269 gpm) and the ultimate PHD of Zone 4 (205 gpm). The City plans a ultimate capacity for the Zone 3 booster of at least two pumps each capable of 475 gpm (assume combined capacity of 900 gpm).

The City plans to construct a reservoir to provide reliability for Zone 3. The reservoir will have an approximate overflow elevation of 1,520. The City will make the Zone 3 reservoir available to Zone 2 and Zone 1 via pressure reducing valves located at the Zone 2/3 boundary. The

following calculations estimate the required volume for the Zone 3 reservoir based on ultimate demands and ultimate Zone 3 booster capacity:

Operational Storage = 40,000 gal (allowance)
Equalizing Storage = [(559 gpm + 205 gpm) – (900 gpm)] x (150 min) = 0 gal
Standby Storage = (200 gpd/ERU) x (545 ERUs) = 109,000 gal (DOH minimum)
Fire Storage = (1,500 gpm) x (60 min) = 90,000 gal

Assume nesting of fire and standby storage
Required Storage = 40,000 gal + 109,000 gal ≈ 150,000 gal

Zone 3 will need a transmission main to connect the Zone 3 booster to the Zone 3 reservoir. For planning purposes, the City assumes that sufficient property exists at (or can be acquired adjacent to) the existing Ski Hill reservoir site to allow construction of the Zone 3 booster station. **Figure 3** shows the assumed location and layout of Zone 3 facilities.

The Table following estimates the cost of constructing the Zone 3 facilities.

Table 6-6 Estimated Cost of Future Zone 3 Facilities

Item Description	Estimated Cost
Booster Station	
Site grading and access road	$10,000
Building (assume 18' x 25' CMU block)	90,000
Site and building piping (PRV & limit switch, fittings)	50,000
Pumps, electrical, and controls	50,000
Property acquisition (if required)	20,000
Booster Station Subtotal	220,000
Reservoir	
Ground level steel 350,000 gal reservoir (1)	300,000
Telemetry system tied into SCADA	20,000
Site piping	40,000
Property acquisition (if required)	25,000
Gravel access road (2)	15,000
Reservoir Subtotal	400,000
Transmission/Distribution Improvements	
≈ 1,000 LF of 12" main from booster to reservoir	88,000
Subtotal (rounded to the nearest $10,000)	710,000
Taxes (8.1%)	57,510
Engineering – design, inspection, construction admin (20%)	142,000
Contingencies (20%)	142,000
Total (rounded to nearest $100,000)	$1,100,000

(1) *Includes site work, excavation, foundation, and fencing*
(2) *Assume 1,000 LF, with 6" crushed rock, 12 ft wide, and $10/SY*

Growth in the Ski Hill area will dictate the timing of Zone 3 implementation. At this point the City cannot predict whether the Zone 3 improvements will become necessary during the 6-year or 20-year planning horizon.

6.4.4 Zone 4 (Future Top Ski Hill)

The City plans the following improvements to serve customers in the Ski Hill area from elevation 1,500 to approximately 1,550.

As growth pressures dictate, the City will construct a booster station that withdraws from future Zone 3 and supplies Zone 4. **Table 3-10** contains projected demands for Zones 1, 2, 3, and 4.

Because the City's Master Plan projects a relatively modest population for Zone 4, the City plans to serve the area using a closed pressure zone (no gravity reservoir). The Zone 4 booster station will need to supply the PHD of Zone 4 with the largest booster pump out of service (also excluding a fire pump); the booster will also need capacity to supply MDD plus fire flow.

Water systems usually fulfill the requirements of a closed system booster station with two pumps capable of the zone PHD and an additional fire pump capable of supplying the fire flow rate for the zone. However, some systems use different pump configurations to fulfill the closed system requirements (e.g. a three pump arrangement where three equally sized pumps have a combined capacity that meets MDD plus fire flow of the zone). Due to uncertainty associated with when growth will prompt implementation of Zone 4, the City will determine the initial capacity and pumping arrangement for the Zone 4 booster station at the time of implementation. The Zone 4 booster station building, piping, and electrical systems will have sufficient capacity to meet projected ultimate Zone 4 PHD (205 gpm) with the largest booster pump out of service (also excluding a fire pump if used) and it will have capacity to meet Zone 4 MDD (75 gpm) plus fire flow (1,500 gpm).

The City assumes that sufficient property exists at or can be acquired adjacent to the existing Ski Hill reservoir site to allow construction of the Zone 4 booster station. **Figure 3** shows the assumed location and layout of Zone 4 facilities.

The Table following estimates the cost of constructing the Zone 4 facilities.

Table 6-7 Estimated Cost of Future Zone 4 Facilities

Item Description	Estimated Cost
Booster Station	
Site grading and access road	$10,000
Building (assume 18' x 25' CMU block)	90,000
Site and building piping	50,000
Pumps, electrical, and controls	50,000
Backup power generator and automatic transfer switch	50,000
Property acquisition (if required)	20,000
Subtotal (rounded to the nearest $10,000)	270,000
Taxes (8.1%)	21,870
Engineering – design, inspection, construction admin (20%)	54,000
Contingencies (20%)	54,000
Total (rounded to nearest $50,000)	$400,000

Growth in the Ski Hill area will dictate the timing of Zone 4 implementation. At this point the City cannot predict whether the Zone 4 improvements will become necessary during the 6-year or 20-year planning horizon.

6.5 Storage

The storage analysis indicates the main zone has adequate storage to meet 20-year needs. The City will add storage when growth causes the City to implement Zone 3 to serve the upper Ski Hill area; **Section 6.4.3** contains the storage improvements associate with Zone 3.

6.6 Distribution System

6.6.1 Estimated Unit Costs of Distribution System Improvements

The Table following lists the estimated cost of construction for water mains with and without the cost of asphalt replacement. The Table does not include tax, contingencies, and engineering; subsequent tables for specific improvement projects include these items.

Table 6-8 Estimated Distribution System Unit Costs

Diameter (in)	Cost per LF ($)						
	Main and Install (1)	Valves, Fittings, Restraints (2)	Fire Hydrants (3)	Service Connections (4)	Asphalt Replacement (5)	Total for Construction without asphalt	Total for Construction with asphalt
8	41	8	10	20	20	75	95
10	48	10	10	20	20	84	104
12	52	10	10	20	20	88	108
14	64	13	10	20	20	103	123
16	77	15	10	20	20	118	138
18	87	17	10	20	20	130	150
20	100	20	10	20	20	146	166
24	126	25	10	20	20	177	197

(1) *Based on recent bid tabulations and pipe material costs – assumes PVC C900/905 mains.*
(2) *Assume 20% of cost of main and install*
(3) *Assume one hydrant every 500 ft*
(4) *Assume one service every 100 ft*
(5) *Assume 8' wide restoration*

The distribution system unit costs contained in the preceding Table provide the basis for planning level cost estimates throughout **Section 6**

6.6.2 Addressing Existing Distribution System Deficiencies

The hydraulic analysis of water system facilities identified some deficiencies with the City's distribution system relating to meeting minimum pressure goal of 40 psi under PHD and meeting fire flow criteria under MDD. When considering improvements to address distribution system deficiencies, the City feels it prudent to plan for facilities to meet projected ultimate demands because water mains generally have service lives of 50 years or more (rather than the 20-year planning period generally used for WSPs).

The City's 2008 Water Distribution System and Sewer Collection System Master Plan lays out the water system facilities needed to serve the City's projected ultimate demands. The City plans to address the system deficiencies identified in this WSP by implementing the Master Plan

improvements. The table following contains the distribution system deficiencies and associated Master Plan improvement.

Table 6-9 Distribution System Improvements

Type	Locale of Deficiency	Associated Improvement	Master Plan Improvement Designation [1]
PHD Pressure	• West residential area in the vicinity of Mountain View Dr	• Connect this area to Zone 2.	3 & 4
	• Northwest residential area in the vicinity of Pine Rd and Ski Hill Dr (existing Zone 2 booster station)	• Replace and upsize transmission main from well field and Icicle reservoir (see **Figure 3** for sizes and location)	1B
MDD Fire Flow	• West residential (West St & Mine St)	• Connect these areas to Zone 2	3 & 4
	• West residential (Park Ave & Mountain View Dr)		
	• Downtown	• Provide parallel 12" mains on Front St and Commercial St from 8th St to 14th St • Replace and upsize East Leavenworth Rd transmission main (see **Figure 3** for sizes and location)	2
	• Safeway (Highway 2 & Riverbend Dr)		
	• East Leavenworth Rd & Dye Rd		1C & 1D
	• East Leavenworth Rd & Dempsey Rd		
	• Chumstick Highway & County Shop Rd	• PRV from Titus Rd in Zone 2 to provide supplemental fire flow to Chumstick Highway area.	5

[1] *Refer to **Tables 6-10** and **6-11** for descriptions of the Master Plan improvements, prioritization and planning level cost estimates. Refer to **Figure 3** for location of improvements.*

The City plans to address the distribution system deficiencies identified in the preceding table in the context of implementing the City's Master Plan for the water system. The Section following reiterates the improvements identified in the City's Master Plan and lays out the City's implementation plan.

6.7 Master Plan for Improvements

The City's 2008 Water Distribution System and Sewer Collection System Master Plan lays out the water system facilities needed to serve the City's Future Service Area at build-out. The schematic layout of improvements shown on **Figure 3** illustrates the minimum looping and transmission required within the system to meet the minimum criteria defined herein. In some cases, actual layout and pipe alignments can vary from those shown on **Figure 3**; however, variation from the schematic must satisfy the looping and total transmission capacity intended by **Figure 3**.

As the City begins to implement the improvements identified herein, more detailed evaluations and cost estimates should be prepared during pre-design of specific projects. In some cases DOH may require a Project Report per WAC 246-290-110 to address project specifics for DOH review and approval; projects such as reservoirs and booster stations will most likely require a Project Report.

6.7.1 Master Plan Improvements Schedule

Each Master Plan improvement has a schedule trigger that makes the improvement necessary to meet the City's water system level of service criteria. The Table following summarizes the Master Plan improvements and provides a general description of the various schedule triggers for

the improvements which will help the City determine phasing of improvements projects (refer to **Figure 3** for corresponding schematic map of improvements):

Table 6-10 Master Plan Improvements

Category	Improvement Designation	Location	Purpose & Description	Schedule Trigger
Supply Transmission	1A	Icicle Rd	Main upgrades on Icicle Rd from East Leavenworth Rd to well T-main to prevent excessive pressures when WTP operates: • Replace 5,800 LF of existing 12" main with 16" from East Leavenworth Rd to the connection with the 24" well field transmission main	• If/when the City upgrades the capacity of the water treatment plant (WTP) this transmission upgrade will prevent excessive pressures on Icicle Rd and East Leavenworth Road when the WTP operates • Maintenance and/or reliability issues due to failures or leakage in this key aging main may also affect prioritization and timing.
	1B	Icicle Rd	Main upgrades from well field T-main to Commercial St & Mill St to allow the City to fully utilize existing supply capacity of wells & WTP: • Replace 3,400 LF of existing 12" main with 18" from connection with the 24" well transmission main to the Icicle reservoir • Replace 2,000 LF of existing 12" main with 20" from Icicle reservoir to Commercial St & Mill St	• The City needs these main upgrades to address current PHD deficiencies (refer to **Table 6-9)** • The upgrades increase the City's ability to fully utilize the existing supply capacity of the wells and WTP. • Maintenance and/or reliability issues due to failures or leakage in this key aging main may also affect prioritization and timing.
	1C	East Leavenworth Rd	Replace aging, deteriorated steel main in East Leavenworth Rd: • Replace 12,000 LF of existing 10" main with 12" (or 16" if future storage to be constructed near Dye Rd) from Icicle Rd to Dye Rd	• The City will need these improvements when maintenance of the existing steel main becomes burdensome or if the City constructs storage at the east end of town. Coordinating this improvement with County road projects would allow the City to save money on asphalt restoration
	1D	East Leavenworth Rd	Higher priority section of East Leavenworth Rd main replacement due to leakage and poor condition: • Replace 3,800 LF of existing 10" main with 12" (or 16" if future storage to be constructed near Dye Rd)	• Replace failing pipe as soon as practical
	1E	River Crossing	City has closed river crossing valves due to pipe leakage; abandon 10" steel river crossing by physically disconnecting from system and abandoning to prevent accidental re-activation by inadvertent opening of valves	• Physically disconnect river crossing and abandon as soon as practical
Downtown Transmission	2	Commercial St	Main upgrades mostly along Commercial St and Front St to provide fire flow to downtown and transmission to east end of system: • Replace 1,400 LF from Mill St to 3rd St with 18" • Replace 1,600 LF from 3rd St to 8th St with 16" or 18" • Install 2,350 LF of 12" from 8th St to 14th St	• The system needs these improvements to address existing fire flow deficiencies in the downtown area and in the Safeway area (refer to **Table 6-9**) • Maintenance and/or reliability issues due to failures or leakage in this key aging main may also affect prioritization and timing.
		Front St	• Install 2,350 LF of 12" from 8th St to 14th St	
Zone 1 Transmission to Zone 2 Booster Station	3	Ski Hill Dr	Main upgrades from the future downtown trunk main to the Pine St / Ski Hill Dr area to bolster suction pressures at Ski Hill booster station #1: • These improvements stiffen transmission capacity to the Zone 2 booster station; the existing system appears to have adequate capacity for the existing pumps • Replace approximately 3,300 LF of main with 12" from future downtown transmission main to Zone 2 booster station	• The rate of growth in Zones 2, 3, and 4 will determine when it becomes necessary to upgrade transmission capacity to the Zone 2 booster station when growth in Zones 2, 3, and 4 prompt an upgrade of the Zone 2 booster station pumps • The existing pumps in the Zone 2 booster station have capacity of approximately 400 gpm (0.576 MGD); with an assumed MDD ERU of 710 gpd/ERU it has capacity to serve approximately 810 ERUs.

Category	Improvement Designation	Location	Purpose & Description	Schedule Trigger
continued from previous page	*continued from previous page*	Pine St	• Install 1,400 LF of 12" main from Central Ave to Burke Ave to finish Pine St loop	*continued from previous page* • Once the population of Zones 2, 3, and 4 exceed approximately 810 ERUs, the Zone 1 transmission improvements to Ski Hill Dr will become necessary to allow larger pumps at the Zone 2 booster. Assuming approximately 40 new ERUs in Zones 2, 3, and 4 per year will allow approximately 20 years of growth.
Pressure Zones (present and future)	4	Zone 2	• Upgrade Ski Hill booster station #1 to 900 gpm capacity • 12" main needed from Ski Hill Dr to Titus Rd in order to provide fire protection to multi-family development • When Mountain View Dr area is eventually connected to Zone 2 a 14" main is required part way and 12" the rest of the way in order to provide fire protection to multi-family development • In general, 8" looped mains are sufficient to provide service to customers within Zone 2 (except in the areas discussed above).	• These upgrades become necessary as development in the pressure zone begins to request water service. • Time frames will depend on which areas request water service first. • **Figure 3** shows schematic layout of mains and looping necessary to meet minimum criteria in all pressure zones; actual layout at implementation may vary from that show on **Figure 3**
		Zone 3	• Construct Ski Hill Booster Station #2 with approximate capacity of 340 gpm • Construct Ski Hill Reservoir #2 at approximate HGL of 1,520 • In general, 8" looped mains are sufficient to provide service to customers within Zone 3 (no multi-family fire flow provided in Zone 3)	
		Zone 4	• Construct Ski Hill Booster Station #4 with approximate capacity of 210 gpm for normal supply and 1,600 gpm fire pump supply • In general, 8" looped or 10" dead end mains are sufficient to provide service to customers within Zone 4 (no multi-family fire flow provided in Zone 4)	
Pressure Reducing Stations	5	Zone 1 / Zone 2	• Pressure reducing valves between zones make the storage of upper zones available to lower zones • Two PRVs already exist (Ski Hill Dr and Titus Rd); the system needs connecting main and third PRV that connects to the Chumstick Highway near Cottage Creek development at pressure zone boundary (elev 1,200) and a minimum HGL setting of 1,270. This provides fire protection along the Chumstick Hwy and augments downtown & riverbend fire flows	• These improvements are needed to address current deficiencies (refer to **Table 6-9**) • The PRV between Zone 2 and Zone 1 for Chumstick Highway is needed currently to make Zone 2 fire storage available to Zone 1 for fire suppression.
	6	Zone 2 / Zone 3	• Install PRVs in Ski Hill Dr and Titus Rd at pressure zone boundary (elev 1,300) and a minimum HGL setting of 1,370	• Needed when the City constructs storage for Zone 3 and for interim fire protection before full distribution grid is constructed
Supply Transmission	7	Icicle Rd	• Replace deteriorated 16" main in and along Icicle Rd. from WTP to East Leavenworth Rd. with 18" main.	• Maintenance issues will determine the timing of this improvement
Distribution System	-	System Wide	• Small diameter mains restrict distribution sytem • Replace existing 4" mains with 8" mains	• As necessary due to maintenance issues or as development requires.

6.7.2 Organization and Timing of Master Plan Improvements

The preceding Table summarizes the City's water system Master Plan; **Figure 3** shows the layout of the City's Master Plan facilities. The City will only need to implement portions of the Master Plan improvements during the 20-year planning period considered in this WSP; the remainder of the Master Plan improvements will be implemented beyond the 20-year horizon. The Table following contains the City's organization of the Master Plan improvements.

Table 6-11 Organization and Planning Level Cost Estimate of Master Plan Improvements

Group	Category	Improvement Designation [1] (see **Figure 3**)	Location	Improvement	Approximate Cost [2]
Improvements Required to meet Current Deficiencies and Critical Deteriorating Mains	Supply Transmission	**1B**	Icicle Rd	• 3,400 LF of 18" main from connection with the 24" well t-main to Icicle reservoir	$600,000
				• 2,000 LF of 20" main from Icicle reservoir to Commercial St & Mill St	$460,000
	Downtown Transmission	**2**	Commercial St	• 1,400 LF of 18" main from Mill St to 3rd St	$290,000
				• 1,600 LF of 16" or 18" main from 3rd St to 8th St	$300,000 or $330,000
				• 2,350 LF of 12" main from 8th St to 14th St	$350,000
			Front St	• 2,350 LF of 12" main from 8th St to 14th St	$350,000
	Supply Transmission	**1D**	East Leavenworth Rd	• 3,800 LF of 12" or 16" main in vicinity of Dye Rd	$460,000 or $620,000
	Mains and PRV	**5**	Zone 1 / Zone 2	• Mains and PRV connecting Zone 2 to Zone 1 at Chumstick Highway	$700,000
				Subtotal	**$3.51–3.70M**
Improvements Required when Existing Facilities Deteriorate or to Meet Regulatory Requirements	Supply Transmission	**1E**	River Crossing	• Abandon 10" steel river crossing by physically disconnecting and abandoning.	$10,000
		1C	East Leavenworth Rd	• Replace 12,000 LF of existing 10" main with 12" (or 16" if future storage to be constructed near Dye Rd) from Icicle Rd to Dye Rd	$1,500,000 or $2,000,000
		7	Icicle Rd	• Replace 12,400 LF of deteriorated 16" main in and along Icicle Rd from WTP to East Leavenworth Rd with 18" main.	$2,200,000
	Distribution System	N/A	System Wide	• Replace existing 4" mains with 8" mains	$1,200,000
				Subtotal	**$4.91-5.41M**
Improvements Needed Solely to Serve Growth	Supply Transmission	**1A**	Icicle Rd	• Replace 5,800 LF of existing 12" main with 16" from East Leavenworth Rd to the connection with the 24" well field transmission main	$950,000
	Zone 1 Transmission to Zone 2 Booster Station	**3**	Ski Hill Dr	• Replace approximately 3,300 LF of main with 12" from future downtown transmission main to Zone 2 booster station	$490,000
			Pine St	• Install 1,400 LF of 12" main from Central Ave to Burke Ave; finish Pine St loop	$210,000
	Pressure Zones (present and future)	**4**	Zone 2	• Upgrade Ski Hill booster station #1 to 900 gpm capacity • Distribution grid (assumed funded by development)	$20,000
			Zone 3	• Construct Ski Hill Booster Station #2 with approximate capacity of 340 gpm • Construct Ski Hill Reservoir #2 at approximate HGL of 1,520 • Distribution grid (assume funded by development)	$1,100,000
			Zone 4	• Construct Ski Hill booster station #4 with approximate capacity of 210 gpm for normal supply and 1,600 gpm fire pump supply • Distribution grid (assume funded by development)	$400,000
	PRV Stations	**6**	Zone 2 / Zone 3	• Install PRVs on Ski Hill Dr and Titus Rd at Zone 2/3 boundary	$80,000
				Subtotal	**$3.25M**
				Total Master Plan Improvements	**$11-12M**

(1) *Refer to **Table 6-10** for additional information on improvements and to **Figure 3** for location of improvements.*
(2) *Including taxes, engineering, and contingencies; refer to preceding Sections for cost estimates and **Appendix F** for detailed cost estimates for distribution system improvements.*

As shown in the **Table 6-9**, the City does not need to implement all Master Plan improvements to meet current and 20-year system deficiencies. System growth and regulatory/maintenance needs of existing facilities will determine the implementation schedule for many of the Master Plan improvements. The Tables following estimate the improved performance of the water system after implementing the Master Plan improvements identified in **Table 6-9** and detailed in **Tables 6-10** and **6-11**.

Table 6-12 Estimated Water System Pressures with Distribution System Improvements

General Area	Static Pressure (psi)	Predicted Peak Hour Pressure (psi)			
		Current		20-year	
		w/o Imp.	w/ Imp.	w/o Imp.	w/ Imp.
Northwest residential (Pine Rd & Ski Hill Dr)	55-60	35-40	50-55	30-35	50-55
West residential (West & Mine St) (1)	55-60	40-45	90-95	35-40	90-95
West residential (Park Ave & Mountain View Dr) (1)	40-45	25-30	80-85	25-30	80-85
High school (Titus Rd / Chumstick Highway)	70-75	50-60	70-80	40-50	70-80
Highway 2 & Icicle Rd	65-70	60-65	65-70	60-65	65-70
Downtown	70-80	50-60	75-85	50-60	75-85
Safeway (Hwy 2 & Riverbend Dr)	65-70	50-55	60-70	45-50	60-70
East Leavenworth Rd & Dye Rd	80-85	60-65	75-80	55-60	75-80
East Leavenworth Rd & Dempsey Rd	85-90	85-90	90-95	80-85	90-95
East Leavenworth Rd & Icicle Rd	80-85	90-95	85-90	90-95	80-90
Icicle Rd at wells (2)	80-85	95-100	85-90	95-100	85-90
Icicle Rd & Fish Hatchery Rd (2)	75-80	90-95	85-90	90-95	85-90

(1) *At present Zone 1 serves these areas; eventually the City will connect these areas to Zone 2. The improvement pressures assume the City has connected these areas to Zone 2.*

(2) *Nodes in the vicinity of the WTP and wells experience some pressure fluctuation depending on which sources of supply operate. Max Day scenarios assume the WTP offline and both wells online; Peak Hour scenarios assume both the WTP and wells online. With existing transmission capacity the capacity of the WTP substantially decreases when both wells operate.*

Table 6-13 Estimated Available Fire Flows with Distribution System Improvements

General Area	Criteria (gpm)	Predicted Available Fire Flow with 20 psi Residual			
		Current (gpm)		20-year (gpm)	
		w/o Imp.	w/ Imp.	w/o Imp.	w/ Imp.
Northwest residential (Pine Rd & Ski Hill Dr)	1,500	>4,000	>4,000	>4,000	>4,000
West residential (West St & Mine St)	1,500	900-1,100	2,500-3,000	900-1,100	2,500-3,000
West residential (Park Ave & Mountain View Dr)	2,500	900-1,100	2,500-3000	900-1,000	2,500-3,000
High school (Titus Rd / Chumstick Highway)	2,500	3,000-3,300	>4,000	2,700-3,300	>4,000
Highway 2 & Icicle Rd	2,500	>4,000	>4,000	>4,000	>4,000
Downtown	3,500	1,200-3,500	>4,000	1,200-3,500	>4,000
Safeway (Highway 2 & Riverbend Dr)	2,500	1,000-1,100	2,100-2,600	900-1,000	2,100-2,600
East Leavenworth Rd & Dye Rd	1,500	1,200-1300	>4,000	1,100-1,200	>4,000
East Leavenworth Rd & Dempsey Rd	1,500	1,500-1,600	2,400-2,500	1,400-1,500	2,400-2,500
East Leavenworth Rd & Icicle Rd	1,500	2,500-3,000	3,000-3,300	2,500-2,800	3,000-3,300
Icicle Rd at wells	1,500	>4,000	>4,000	>4,000	>4,000
Icicle Rd & Fish Hatchery Rd	1,500	2,500-2,800	>4,000	2,500-2,700	>4,000

As shown in the preceding Tables, as the City implements the improvements required to meet current deficiencies and critical deteriorating mains contained in **Table 6-11** (shaded red) will correct the service pressure and fire flow deficiencies identified in the system analysis.

6.8 Plan for Providing Service

6.8.1 Interim Management and Control of Individual Booster Pumps

As required by WAC 246-290-230(8) the City maintains management and control of two existing individual booster pumps located near the WTP. The City's management and control of the booster pumps includes the following:

- Annual inspection of booster pumps for proper plumbing and cross connection control; observation of pump operation and notifying the owner if problems are observed.
- Provision of troubleshooting assistance to owners (by phone or in some cases site visits) and assisting owners with locating reputable repair shops when the need arises.
- Ownership and costs associated with the operation, maintenance, and repair of the booster pumps remains the responsibility of the property owner.

6.9 Summary of Planned Improvements

Table 6-11 summarizes the City's Master Plan improvements and prioritization. **Table 7-1** in the Section following contains the City's 6-year and 20-year improvements implementation plan. **Section 7** discusses potential financing of improvements and **Section 8** discusses the City's operating budget.

7.0 IMPLEMENTATION

7.1 Introduction

This Section summarizes planned improvements and prioritization, describes financing alternatives, and presents this information in the form of a draft Capital Improvements Plan (CIP).

7.2 Improvement Implementation

As shown in **Table 7-2**, the majority of improvements planned for the 6-year horizon consist of distribution system upgrades. The improvements planned for implementation during the 6-year planning period address existing system deficiencies. In most cases development pressures will dictate the implementation schedule of improvements planned for the 20-year planning horizon.

7.3 Implementation Issues

7.3.1 WTP Improvements

Modifications to the WTP have potential to disrupt the City's ability to use it as a source. The Section following discuss issues the City will need to consider when implementing improvements to WTP facilities.

7.3.1.1 Onsite water storage system

Adding an onsite water storage system should not significantly disrupt the City's ability to utilize the WTP for supply. Depending on the sequence used for connecting the auxiliary water system to existing plumbing, the lab should not be without running water for more than a couple of hours unless complications occur.

7.3.1.2 New Lab

Expanding the existing lab will likely disrupt the City's ability to use the WTP as a source of supply. The City may lose the WTP for up to two months depending on the size and complexity of the addition to the existing lab. Because the WTP generally functions as the City's primary water supply, the City will time the construction of the lab expansion such that it occurs in either early spring or late fall so that system demand is not at peak levels.

7.3.1.3 Fencing of WTP Perimeter

Fencing of the WTP should not affect operation of the WTP.

7.3.2 Zone 2 Booster Pump Replacement

Replacing the booster pumps in the Zone 2 booster will require temporary interruption of booster pump operation. The City plans to make these modifications during low demand periods (October-February) when the Zone 2 reservoir can provide several days worth of storage.

7.3.3 Establishing Zone 3

If/When growth pressures warrant establishment of Zone 3 to serve new customers above elevation 1,300, the City will implement the Zone 3 improvements. The City will outline all pertinent details in a Project Report to DOH. Major details of the Project Report will include the following:

- Site of Reservoir – select site based on ability to acquire land, topography, accessibility, constructability, and ability to obtain lease or purchase agreement.
- Reservoir Construction Type – evaluate the advantages and disadvantages of available reservoir construction type alternatives (steel, concrete, etc.) based on the selected site. Select reservoir type.
- Site of Booster Station – select site based on ability to acquire land, topography, accessibility, constructability, and ability to obtain lease or purchase agreement.
- Transmission Main Route – select route such that main can function both as transmission and distribution main if possible.

7.3.4 Establishing Zone 4

If/When growth pressures warrant establishment of Zone 4 to serve new customers above elevation 1,400, the City will implement the Zone 4 improvements. The City will outline all pertinent details in a Project Report to DOH. Major details of the Project Report will include the following:

- Site of Booster Station – select site based on ability to acquire land, topography, accessibility, constructability, and ability to obtain lease or purchase agreement.
- Distribution Grid – mains will need sufficient capacity to supply residential fire flow.

7.3.5 Distribution System Improvements

The majority of high priority improvements consist of large diameter mains with the exception of the pressure reducing station between Titus Rd and the Chumstick Highway. Generally speaking, water main replacements and upgrades require careful planning to make service interruptions as brief as possible. Most of the medium-high priority main upgrades occur on busy thoroughfares or in the downtown area. Careful planning will help mitigate the disruption to traffic and businesses during these projects.

7.3.6 Permits/Approvals

Prior to implementation of the planned improvements, the Department of Health (DOH) must approve this Water System Plan and the Construction Documents for a specific project. In addition, DOH may require a Project Report (per WAC 246-290-110) for certain planned improvements such as for the establishment of future Zones 3 and 4. Depending on the source of funding for the proposed improvements, environmental reviews will also be needed.

7.4 Funding Sources

Financing presents the most significant hurdle for implementing improvements. While the City has reserve funds, outside funding will also be needed. The Sections following discuss potential funding sources for system improvements.

7.4.1 Capital Contributions

Capital contributions, variously known as "impact fees," "system development charges," "facility charges," or "connection charges" are one-time charges assessed against developers or individual new customers to recover all or a part of the cost of the additional system capacity constructed for their use or benefit (or to "buy in" to reserve capacity of existing facilities). Capital contributions improve financial equity because they require new customers to repay users who have invested in facilities through monthly service charges or fees and/or finance new facilities required to serve new customers.

Capital contributions are generally assessed against the developer. The Table following contains a breakdown of the City's capitalization fee schedule.

Table 7-1 System Connection Charges

Type	Size	Connection Charge		Meter Charge [1]
		Inside City	Outside City	
Residential	¾"	$820	$1,384	400
	1"	$846	$1,409	550
Commercial	¾"	$896	$1,467	400
	1"	$921	$1,498	550
	1 ½"	$1,348	$1,962	875
	2"	$1,627	$2,273	$1,300
	3"	$6,800	$7,961	-
	2"x6"	$11,960	$13,966	-

(1) *Prices shown are for outdoor meters. Indoor installations cost approximately 25% less.*

7.4.2 Reserve Funds

Most funding agencies want to see a financial commitment on the part of a system toward the project the funding agency is being asked to fund. A reserve fund allows a system to contribute funds to a project and demonstrate commitment to the project to funding agencies. The City currently has a reserve fund.

7.4.3 Developer Financing

The City has policies that require developers pay the cost of water system expansions needed to serve a new development.

7.4.4 Revenue Bonds

Revenue bonds issued by the City provide a means of borrowing funds to finance capital improvements to the water system. These bonds constitute a lien against the earnings of the

utility, in this case water revenues. The City may issue bonds for varying terms and interest rates depending on the needs of the City and the bond market at the time of issuance. Interest earned by bondholders is generally not taxable income, reducing the interest rate required by bond purchasers. Debt service is paid out of system revenues. The issuer is usually required to maintain utility rates at a sufficient level to pay the annual debt service plus 25% to 50%, which often goes into a reserve fund.

7.4.5 Local Improvement District (LID) Bonds

Using LID financing allows specifically benefited properties to pay for the improvements. A resolution or a petition of the majority of property owners can form an LID. Under certain circumstances where the jurisdiction declares the improvements necessary for the public health and safety (and with other criteria being met), an LID formed by System resolution is immune to protest; otherwise a 3/5 majority of property owners may prevent its formation by submission of a protest petition. Properties within the LID are assessed annually a total amount adequate to service bonds which are issued with the LID assessments as security. In essence, LID financing provides a method for developers and property owners to make appropriate capital contributions to new facilities required to support service to their properties.

The City could use LID financing for improvements benefiting presently served properties or newly developed properties. Disadvantages of LID financing in fully developed areas of the City include the significant time and costs associated with the formation and assessment determination process.

7.4.6 RD Loans and Grants

The Rural Development (RD) Water and Waste Disposal Direct Loans and Grants program is primarily a loan program, but provides grants if specific criteria are met, to prevent utility rates from becoming exceedingly high. RD uses several methods to arrive at the maximum feasible utility rate based on a review of the recipient's financial reports. Additionally, RD generally seeks to limit the ratio of grant to loan approximately at 25% grant with 75% loan. RD policy is that grant funds may be allocated when: 1) water system debt service exceeds 0.5% of median household income (MHI), 2) when rates would be too high relative to other similar system without grant funding, and 3) when RD has grant funds available.

Applications are accepted year round; grants are available until funds run out. It generally takes three to nine months to arrange this funding source. Loan security is normally a revenue bond ordinance, with loan repayment from utility rates, although repayment from taxes can also be used for RD loans. Loan interest rates vary and are based on federal standards (currently at 4.25%). Loan term is for the life of the facility, up to 40 years. RD requires that the utility user rates provide for an annual 10% reserve income in addition to annual debt service. Each loan agreement is individual to the applicant. RD loan funds are not available until project construction begins and the applicant must typically procure RD-approved interim financing.

Disadvantages of RD funding include significant administrative costs as compared to other funding programs and floodplain development restrictions.

7.4.7 Washington State Public Works Trust Fund

This State program administered by the Department of Commerce provides low interest loans for the repair, rehabilitation, and reconstruction of municipal infrastructure systems. PWTF offers three different loans, with varying criteria: 1) Planning Loan, 2) Pre-Construction Loan, and 3) Construction Loan.

7.4.7.1 Planning Loan

Applications are accepted throughout the year pending the availability of funds. Loans are available up to $100,000 per biennium/per jurisdiction, with interest rates that vary depending on the amount of local match and whether a jurisdiction qualifies as distressed. Eligible activities include development of capital improvement programs, updating GMA requirements, archaeological and historical reviews, and environmental reports.

7.4.7.2 Pre-Construction Loan

Applications are accepted throughout the year pending the availability of funds. Loans are available up to $1 million per biennium/per jurisdiction, with interest rates ranging from 0.5% – 2%, directly linked to the amount of local match. A minimum 5% local match is required and can be as high as 15%. The maximum loan term is 5 years, or 20 years with proof of secured construction funding. Project must be completed within 18 months of contract execution. Eligible activities include engineering design, environmental studies, land acquisition, and right-of-way delineation.

7.4.7.3 Construction Loan

Applications are due in March, with funding available the following spring. Loans are provided up to $7 million per biennium/per jurisdiction, with interest rates of 0.5% – 2.0%, directly linked to local match (minimum 5%). Threshold requirements include the adoption of a capital facilities plan that meets PWB standards for each eligible system, a project scope and schedule in compliance with said plan, and applicant must have a one-quarter of 1% Real Estate Excise Tax (REET) in place. Eligible activities include engineering, design, and construction. Projects must be complete 48 months after contract execution.

This federal program provides loans and grants to rural areas to construct, enlarge, extend, or otherwise improve rural water, sanitary sewage, solid waste disposal, and storm wastewater disposal facilities and related activities. Eligible applicants are those rural areas whose population is less than 10,000, where 75% of the median household income is less than 80% of the statewide MHI, can show a demonstrated effort and subsequent inability to finance the project through their own resources or commercial credit, and can demonstrate the financial feasibility of the project, as well as the ability to repay the loan.

Threshold requirements for submitting an application include an approved environmental assessment, a preliminary engineering report, and a financial feasibility and cost analysis.

This funding source is probably the best source of loan funds for municipal public works programs due to the low interest rates and minimal administrative costs.

7.4.8 Drinking Water State Revolving Fund (DWSRF)

The Washington State Department of Health (DOH) and the Public Works Board (PWB) jointly manage the DWSRF. DOH determines the eligibility and priority-ranks each project. PWB staff determines ability to proceed, environmental impact, and ability to repay the loan. CTED administers the DWSRF program. These federal loan funds are available primarily for projects that address Safe Drinking Water Act (SDWA) health standards that have been exceeded or to prevent future violations (i.e., water quality related projects), although some other projects, such as construction of new reservoirs, receive secondary consideration.

The maximum DWSRF loan available is $4 million. Interest rates are 0% - 1.5%. The usual loan term will be determined by the life of the facility being repaired, not to exceed twenty years. No local match is required but there is a 1% loan fee. Applications are due in May of each year, with funding available upon Board and EPA approval (assuming the application is successful). Minimum eligibility criteria include an approved and current water system plan or small water system management plan and construction of the project must be complete within 36 months after contract execution.

7.5 Capital Improvements Plan

The Table following presents the City's Capital Improvements Plan. The schedule for improvements is contingent upon the City's ability to acquire funding. If the City is unable to acquire grant and/or low interest loan funding for the projects identified herein, the City will reschedule those improvements following an analysis of the project(s). This analysis will include investigation of how to maximize potential funding combinations, phasing of the project to accomplish only the most necessary items first, review of alternate construction approaches or methodologies, and a variety of other approaches. It is likely that if an emergency arises that the City has not anticipated, the City will utilize reserve funds and bonding capacity (as determined necessary) to fund the project. If the emergency involves a private development need, the City may also choose to utilize approaches which include, but are not limited to, local improvement district financing and developer contributions.

Table 7-2 City of Leavenworth Capital Improvements Plan

Category	Component	Project	2011-2016	2017-2031
Supply	WTP	Onsite water storage and pump system for maintenance	45,000	
		Expand lab/office	60,000	
		Fence Perimeter of WTP	20,000	
		Renovate, replace, or abandon WTP		
	Wells	Expand pumping capacity of well field	300,000	
Booster Zones	Zone 2	Upgrade booster pump capacity in Zone 2 booster station		20,000
	Zone 3	New booster station, reservoir, and transmission main to serve Zone 3		1,100,000
	Zone 4	New closed system booster station to serve Zone 4		400,000
Distribution System	Supply Transmission	3,400 LF of 18" main on Icicle Rd from wells t-main to Icicle Reservoir	600,000	
		2,000 LF of 20" main from Icicle Reservoir to Commercial St & Mill St	460,000	
	Downtown Transmission	1,400 LF of 18" main on Commercial St from Mill St to 3rd St	290,000	
		1,600 LF of 18" main on Commercial St from 3rd St to 8th St (1)	330,000	
		2,350 LF of 12" main on Commercial St from 8th St to 14th St	350,000	
		2,350 LF of 12" main on Front St from 8th St to 14th St	350,000	
	Deteriorating Mains	1,400 LF of 16" main on East Leavenworth Rd (problem area) (2)	620,000	
		15,000 LF of 16" main on East Leavenworth Rd (2)		2,000,000
		12,400 LF of 18" main from WTP to East Leavenworth Rd		2,200,000
	PRV	PRV between Zone 2 (Titus Rd) and Zone 1 (Chumstick Hwy)	40,000	
Non-Capital Items	Water Rates	Water Rates Study		15,000
	WUE	Budget for Water Use Efficiency measures	1,000	1,000
		Total	3,466,000	5,736,000

(1) *The City's Master Plan indicates that either 16" or 18" main will meet the City's criteria; the CIP assumes the City installs 18" main.*

(2) *The City's Master Plan calls for 12" or 16" main depending on location of future storage; this CIP assumes the City will install the 16" main*

8.0 SYSTEM FINANCES

8.1 Revenue and Expenditure Overview

The following table presents an overview of the City's water system budget. The City's water and wastewater system finances are combined. However, because of detailed accounting, it is possible to separate out water system expenses. The following Table summarizes system expenses and revenues.

Table 8-1 Water System Budget Summary

	Category	2009 Actual	2010 Actual	2011 Budget
Expenditures	Legal Services	$51,167	$185,879	$75,000
	Salaries, wages, benefits & overtime	406,238	$398,385	$417,416
	Total Supplies (distribution system & WTP)	32,287	30,674	32,285
	Total Other Services & Charges	63,413	75,451	120,291
	WTP NPDES, testing	13,909	8,290	11,000
	Taxes	104,148	117,084	140,224
	Interfund rentals & leases	70,648	57,510	58,341
	Debt repayment	267,234	228,604	230,056
	Capital Expenses	27,939	53,663	45,000
	Other Financing/Transfers to Reserves	52,000	0	0
	Total	$1,088,983	$1,155,540	$1,129,613
Revenue	Intergovernmental (Grants/Loans/Non Rev)	$34,354	$0	$0
	Rates	937,224	961,155	1,002,240
	Taps	8,410	44,203	35,000
	Fines & Penalties (1)	8,958	7,674	8,500
	Misc. Revenues/Refunds (1)	118	9,738	15,500
	Transfers In from Reserves	25,000	121,378	0
	Investment interest (1)	1,831	2,771	719
	Total	$1,015,895	$1,146,919	$1,061,959
Balance	Surplus/Deficit (2)	-$73,088	-$8,621	-$67,654

(1) *Water/sewer revenues are combined – this number represents ½ the total for the given year.*
(2) *Refer to discuss below regarding the City's periodic use of existing water fund balance to cover non-recurring expenses.*

The operating budget noted above includes only revenue and expenses and does not reflect fund balance. In 2009 the City changed how it accounts for utilities' reserve funds after receiving a recommendation to do so from the State Auditor. The City split up the cumulative utilities reserve which held reserves for most of the City's utilities. Splitting up the cumulative reserve fund placed the reserves back in the funds for the individual utilities. The water and sewer utilities still share a common fund half of which is considered the water reserve because the historical transfers to reserves from water and sewer have been equal. As of December 31, 2010 the water/sewer fund had a balance of $276,463.40. In the preceding Table, the deficits for 2009 and 2010 and projected for 2011 use the existing water fund balance to make up the difference when expenditures exceed revenues. The deficits in these years are related to the legal services for water rights litigation (refer to **Section 5.3**) and in 2011 an additional expense of $25,000 for 50% of a utility rate study. In future years, as the water rights litigation comes to a close, the water revenues will again exceed expenses, in turn building back the fund balance. Water fund reserves may only be utilized by a vote of the Council.

The City also maintains a Water and Sewer Bond Reserve Fund for the purpose of covering debt payments if/when the water and sewer fund cannot make a debt payment; this fund contains an additional $264,048.

8.2 Water Rates

The following Sections summarize the City's water rates. The rates shown went into effect in December 2009.

8.2.1 Residential

Residential services are charged according to the following schedule. Residential meters are read monthly April through October in approximately the 3rd week of the month.

Inside City Limits

Base charge per month (includes base volume of 15,000 gallons)	$43.00

Outside City Limits

Base charge per month (includes base volume of 15,000 gallons)	$54.00

Overage Rates – All Residential Customers

15,001 - 50,000	$1.25 per 1,000 gallons
50,001 – 100,000	$1.50 per 1,000 gallons
100,001-150,000	$2.00 per 1,000 gallons
Above 150,001	$2.75 per 1,000 gallons

8.2.2 Commercial

Commercial rates are charged according to the following schedule. As with residential customers, the base charge per month includes the base volume of 15,000 gallons. Commercial meters are read monthly year round in approximately the 3rd week of the month.

Inside City Limits

¾" meter	$43.00
1" meter	$45.00
1½" meter	$55.00
2" meter	$57.00
3" meter	$177.00
2" x 6" fire service	$290.00

Outside City Limits

¾" meter	$54.00
1" meter	$56.00
1½" meter	$69.00
2" meter	$71.00
3" meter	$221.00
2" x 6" fire service	$363.00

Commercial Overage Rates

Commercial services inside the City are charged a straight $1.25 per 1,000 gallons for all water above 15,000 gallons. Commercial services outside the City are charged according to the following overage rate schedule.

15,001 - 100,000	$1.25 per 1,000 gallons
100,001 – 150,000	$2.00 per 1,000 gallons
Above 150,001	$2.75 per 1,000 gallons

8.2.3 Potential Zone 3 and 4 Connection Surcharges

If/When the City implements Zone 3, the new reservoir for that zone will be available to Zones 1 and 2 via PRV. As such, the reservoir benefits the entire system which justifies the rest of the system sharing in the cost. The Zone 3 booster station and t-main necessary to pump to this elevation benefit primarily future Zone 3 customers. Hence, new water system customers in Zone 3 should be responsible for booster station and t-main costs. Because these customers do not yet exist, the way to collect these costs would be in the form of a connection surcharge for new connections in Zone 3.

The Zone 4 booster station will only benefit Zone 4 customers. The City can justifiably collect connection charges from future residents of Zone 4 to recoup the cost of constructing the booster station to serve the area.

The City will develop a rationale for connection charges at a time close to project implementation when the actual cost of facilities can be better estimated.

8.2.4 Rate History

Water rates have steadily increased each year with 2006 through 2008 having a $1 increase in the base rate each year, which is reflective of about a 2 ½% increase. In 2010 a base rate increase of $2 is being implemented.

8.3 Description of Existing Debt

The City has five debts associated with its water system as described in the following table.

Table 8-2 Summary of Water System Related Debt

Description	Interest Rate	Annual Payment (2009)	Year Debt Will Be Retired
Water/Sewer Refunding Bond – water portion ≈ 50%	Avg 4.99%	$52,690(2009) (1) $6,091 (2010) $5,797 (2011)	2011
2003 (2002) DWSRF – Reservoir/Booster Station	1%	$91,821	2023
2009 (2004) DWSRF – West Reservoir /Telemetry	1%	$100,371	2025
2007 (2005) PWTF – West Reservoir / Telemetry	.5%	$28,019	2025
2009 PWTF – Downtown Roadway Rehab ≈ 25%	.5%	$0 (2009) $932 (2010) $46,875 (2011) (2)	2014

(1) *Because of loan/bond terms, annual payments decrease slightly in each year*
(2) *Because of loan terms, annual payments increase starting in 2011 and ending in 2014.*

8.4 Funding for Planned Improvements

As shown in **Table 6-11**, the City has $11-12M in water system infrastructure improvements that will eventually become necessary. The improvements identified in **Section 6.7.2** to address existing system deficiencies primarily involve constructing transmission mains. The improvements the City preliminarily plans to implement during the next six years will cost approximately $3.5M.

The ability of the City to construct improvements hinges on securing funding. The City may have to delay planned improvements if the City cannot secure funding on terms that maintain rate affordability.

The following table contains potential funding scenarios and associated rate effects. For water system work Rural Development offers the only likely source of grant funding available to the City. The Table estimates approximate rate impacts for several funding scenarios. Note that the City will not likely implement all planned improvements simultaneously; the following Table provides funding scenarios that will help the City plan how to phase proposed projects. The City could implement some projects on a pay as you go basis over several years rather than rolling several improvements into large projects.

Table 8-3 Potential Funding Scenarios and Resulting Rate Impacts

Summary of Rate Impacts [1]					
Description		First Priority [2]	Second Priority [3]	Third Priority [4]	Total
Total Cost of Improvements [5]		$ 3,700,000	$ 5,400,000	$ 3,300,000	$ 12,400,000
Increase in Monthly Bill per Rate ERU [6]	Scenario 1 - Revenue Bond (5.5%, 20-yr)	$20	$29	$18	$68
	Scenario 2 - RD Loan (3.0%, 30-yr)	$11	$16	$10	$36
	Scenario 3 - DWSRF (1.5%, 20-yr)	$11	$16	$10	$38
	Scenario 4 - RD 75:25 Loan/Grant (3.0%, 40-yr)	$7	$10	$6	$23
Existing Average Monthly Bill		$47	$47	$47	$47
Total Monthly Bill	Scenario 1 - Revenue Bond (5.5%, 20-yr)	$67	$76	$65	$115
	Scenario 2 - RD Loan (3.0%, 30-yr)	$58	$63	$57	$83
	Scenario 3 - DWSRF (1.5%, 20-yr)	$58	$63	$57	$85
	Scenario 4 - RD 75:25 Loan/Grant (3.0%, 40-yr)	$54	$57	$53	$70

(1) *The estimates do not include increases that may be needed for O&M costs (for example, for capital reserves, inflation, emergency reserves etc.).*
(2) *Improvements required to address current deficiencies and critical deteriorating mains; refer to **Table 6-11**.*
(3) *Improvements required when existing facilities deteriorate or to meet regulatory requirements; refer to **Table 6-11**.*
(4) *Improvements needed solely to serve growth; refer to **Table 6-11**.*
(5) *The total cost of improvements are planning level estimates for the purpose of evaluation and funding acquisition.*
(6) *Assumes existing in-city residential customers pay an average monthly bill of $47 and that the City currently receives approximately $900,000 in revenue from rates.*

The feasibility of the preceding funding scenarios depend on the maximum water rates the City believes its residents can afford, availability of funds in the identified programs, and success of the applications submitted to the various funding agencies.

9.0 WATER USE EFFICIENCY

WAC 246-290-810 requires that water system plans and small water system management programs must describe the municipal water supplier's existing Water Use Efficiency (WUE) Program. The municipal water supplier must continue existing levels of water use efficiency.

9.1 Metering Requirements

9.1.1 Source Meters

WAC 246-290-496(1) requires that systems measure the volume of water produced or purchased using a source meter or other meter installed upstream of the distribution system. The requirements of this section of the WAC do not apply to volumes of water delivered to a public water system through an emergency intertie; however, interties used as permanent or seasonal sources must have meters.

The City currently meters production at all City sources of supply (the WTP and well field).

9.1.2 Consumption Meters

WAC 246-290-496(2) requires systems to measure the volume of water delivered to consumers by installing meters on all direct service connections. Systems may serve certain clustered entities through a single meter (e.g. campgrounds, RV parks, mobile home parks, buildings with multiple units, and complexes with multiple buildings served as a single connection).

The City currently meters all service connections.

As required by WAC 246-290-496(3), the City selects, installs, operates, calibrates, and maintains customer service meters according to generally accepted industry standards and information from the manufacturer.

9.2 Data Collection

The Water Use Efficiency (WUE) Rule requires systems to collect production and consumption data on a regular basis and report that information in the annual performance report. Water production and consumption data has numerous uses including: calculating system leakage, forecasting demand, identifying areas for more efficient use of water, and evaluating the effectiveness of the WUE program.

9.2.1 Source and Service Meter Data

The City collects and records daily totals from all source meters; service meter data is collected and recorded on a monthly basis. The City uses this data to calculate distribution system losses. Refer to **Sections 3.1.4** and **3.1.5** for the City's source and service meter data.

9.3 Water Supply Characteristics

9.3.1 Surface Water Supply – Icicle Creek

The City's water treatment plant (WTP) withdraws water from Icicle Creek. The WTP is located on Icicle Creek approximately three miles south of town. During peak demand in summer irrigation season, the WTP treats approximately 2.0 MGD. Icicle Creek experiences heavy sediment loading during spring snow melt and runoff; the City typically shuts down the WTP during the peak sediment loads. The City's water rights constrain the instantaneous and annual quantities of water available for withdrawal (refer to water rights analysis in preceding Sections). The City foresees no significant changes it its planned use of this resource that would adversely impact the quantity and quality of water in Icicle Creek.

9.3.2 Ground Water Supply – Well Field

The City's well field withdraws water from a sand and gravel aquifer. Icicle Creek and the Wenatchee River recharge the aquifer. The wells are located adjacent to the City golf course south of town. The two wells have a combined capacity of 2,050 gpm. The City uses the wells year round to augment supply provided by the Icicle Creek surface water supply. The City's water rights constrain the instantaneous and annual quantities of water available for withdrawal (refer to water rights analysis in preceding Sections). The City foresees no significant changes in its planned use of this resource that would adversely impact the quantity and quality of water in the aquifer.

9.4 Current WUE Program

The City's existing WUE program seeks to gradually and permanently reduce average per-capita demand. Short-term voluntary or mandatory reductions in water use to overcome temporary water shortages associated with drought, transmission line failures, or emergency conditions are not considered elements of a WUE program. Rather, WUE program elements constitute a long-term voluntary reduction in customer demand through education, improved technology, and water rate structure.

As a part of the existing WUE program the City trains employees to perform water use efficiency oriented public outreach in the normal course of their duties.

9.4.1 Estimated Conservation Savings to Date

The City's 2002 WSP calculated the City's ERU usage at 389 gpd. As shown in **Section 3.1.6** the City has reduced ERU usage to 304 gpd. The City has saved approximately 85 gpd/ERU.

9.5 Goal Setting and the Public Forum

One of the most important steps in achieving efficient water use is setting goals that can be measured. The Water Use Efficiency Rule requires systems to set goals through a public process.

Involving the public allows water users to understand the characteristics and future needs of the City's system and to set a reasonable, attainable goal.

9.5.1 WUE Goals

The City has set the following WUE goals:

> Supply Side Goal: strive to continue water production within 3% of 342 MG/year, even with projected growth. Continue to address and minimize system's water loss. Update 20 year old metering system citywide, starting with replacing largest meters and largest water user's per meter size. Ongoing public education programs for increased awareness.
>
> Demand Side Goal: continue to keep water billed VS water produced difference equal to or less than 3%. Review current base rate of 15,000 gallons per customer and review annually the water rate structure. Support public education programs concerning WUE.

9.5.2 Public Forum for Establishing WUE Goal

The Water Use Efficiency Rule requires that systems allow customers and interested members of the public to participate in the goal setting process through a public forum. This allows the public an opportunity to provide input on the decisions and it helps customers to understand the need to use water more efficiently and how they can help achieve the WUE goal.

The City conducts public forums when establishing or revising the WUE goals in accordance with the requirements of WAC 246-290-830(4).

9.6 Evaluation of WUE Measures

9.6.1 Required Number of WUE Measures

The City serves approximately 1,363 connections. The Table following contains the number of measures systems of must either implement or evaluate for cost effectiveness based on the number of connections served. The City must either implement or evaluate for cost effectiveness at least five measures.

Table 9-1 Required Number of WUE Measures

Number of Connections	Less than 500	500 – 999	1,000 – 2,499	2,500 – 9,999	10,000 – 49,999	50,000 or more
Number of WUE Measures Required	1	4	5	6	9	12

9.6.2 WUE Measures Evaluated and Implemented

The following Sections list the five WUE measures evaluated by the City. Each section contains a description of the measure, whether or not the City chose to implement the measure, and an analysis of the measure's cost efficacy (if not implemented).

9.6.2.1 Measure #1: Customer Education

WAC 246-290-810(4)(f) requires systems to educate customers annually on water use efficiency; the City accomplishes this through placing educational material once per year in their quarterly news letter (The Leavenworth Courier). In addition to the customer education requirements of WAC 246-290-810(4)(f) the City will host a booth at a City Festival to further educate customers on merits of using water more efficiently. The City chooses to implement customer education to help achieve the WUE goal.

9.6.2.2 Measure #2: Customer Leaks

The City will attempt to use customer monthly meter reading data to identify water use patterns that suggest a customer leak may exist. The City will inform customers when their water use pattern suggests a leak may exist. The City chooses to implement customer leak information to help achieve the WUE goal.

9.6.2.3 Measure #3: Workshop for Landscape Professionals

The City will host (possibly in cooperation with neighboring water systems) a workshop for landscape professionals to promote water use efficient landscaping such as xeriscaping, drip irrigation, soil moisture sensors, rain sensors, etc. The City chooses to implement a workshop for landscape professionals to help achieve the WUE goal.

9.6.2.4 Measure #4: Xeriscape Promotion to Customers

The City will send out information to customers about local resale outlets for xeriscape products and local outdoor exhibits of xeriscaping. The City chooses to implement xeriscape promotion to customers to help achieve the WUE goal.

9.6.2.5 Measure #5: Shower Head Rebate

The City considered offering a fixed annual number of rebates to customers that purchase low flow shower heads. The following calculations estimate the amount of water saved by each shower head replaced:

Estimated average shower head flow rate: 4.0 gpm
Low flow shower head flow rate: 2.5 gpm
Estimated water savings per head replaced: 1.5 gpm
Estimated average length of shower: 8 mins
Estimated number of showers per shower head per day: 2
Estimated daily water savings: 24 gal
Estimated annual water savings: 8,760 gal

The City chooses to offer 10 rebates annually for $10 if customers purchase a low flow shower head and provides a sales receipt as proof of purchase. The City will award the rebates on a first come first served basis. This measure will cost $100 annually and will save approximately 87,600 gallons annually.

9.6.2.6 Budget for WUE Measures

The city estimates the selected WUE measures will cost approximately $1,000 annually.

9.6.2.7 Estimating Water Savings from WUE Measures

WUE measures #1, #2, #3, and #4 have difficult to quantify water savings potentials. Educating customers, helping them find leaks, encouraging WUE irrigation, and promoting xeriscaping will all likely have a positive effect in reducing customers' water use. However, due to the uncertainty associated with estimating the water savings potential of WUE measures #1-#4 the City chooses not to rely on the water savings reaped from these WUE measures when forecasting system demand. Water savings due to WUE measure #5 can be quantified using established values for common plumbing fixtures (see preceding section for calcs).

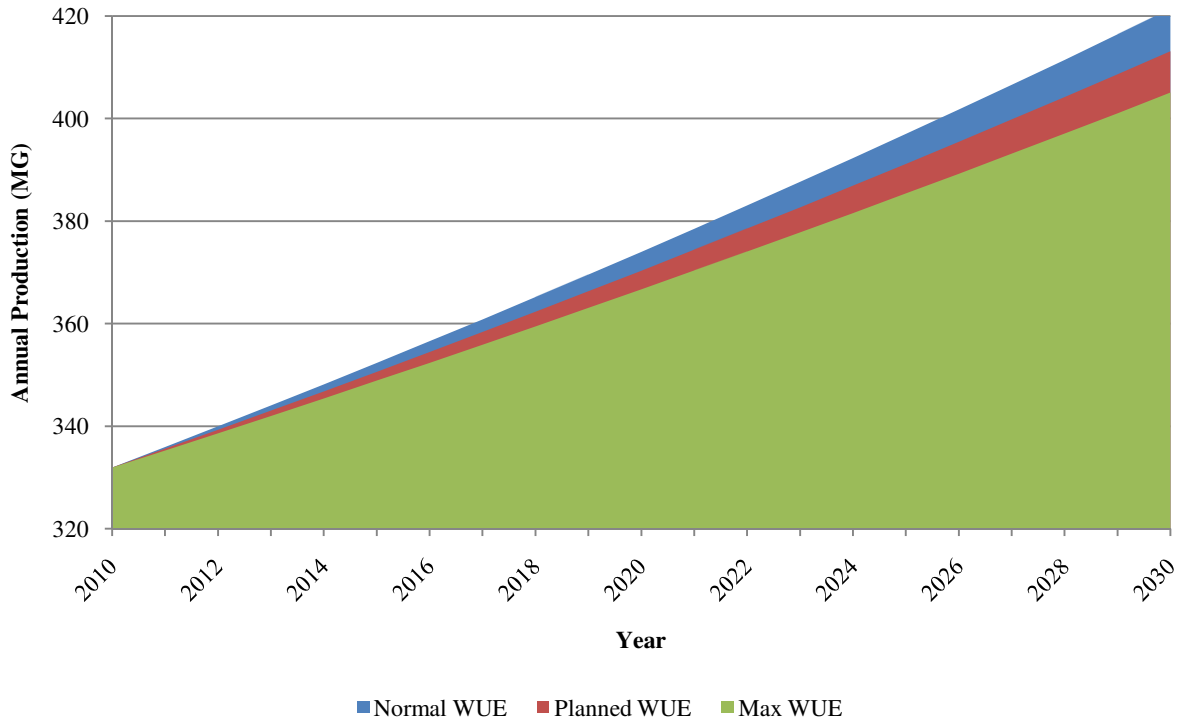
9.7 Evaluating Efficacy of WUE Measures

The City will monitor total system annual water use and average customer water use to determine whether WUE measures reduce actual water use. The number of rebates issued for low flow shower heads will also provide the City with insight into the amount of water the WUE program saves; each rebate issued theoretically carries with it a guaranteed savings (see preceding calculations).

9.8 Demand Forecasting – Projected Conservation

The Demand projections developed in **Section 3** do not take into account WUE efforts that might reduce future demand. The City projects total water use to increase 1.2% annually without WUE. With planned WUE measures the City believes it possible to reduce annual water use growth to 1.1%. If the City implemented all available WUE measures annual growth could conceivably reduce to 1.0%. The figure following illustrates potential water savings due to more efficient use of water.

Figure C Projected Water Use with WUE



The City plans to review water consumption annually to determine success of WUE efforts. The City also plans to review its WUE program annually to evaluate future water saving targets, and assess program benefits versus costs.

9.9 Distribution System Leakage Standard

The Water Use Efficiency Rule divides system water use into two categories: authorized consumption and distribution system leakage (DSL). DOH defines authorized consumption as the volume of water authorized for use by the water system. In addition to normal water sales metering records, systems can track and estimate other types of authorized water uses such as:

- Maintenance flushing of the water system
- Fire fighting and hydrant testing
- Cleaning of water tanks or reservoirs
- Street cleaning

DOH considers DSL all water use not authorized by a water system; this includes both apparent losses and real losses such as:

- Leakage
- Theft
- Meter inaccuracies
- Meter reading errors

- Data collection errors
- Calculation errors
- Water main breaks

The City calculates DSL by comparing source production meters with water sales from customer meters. **Table 3-4** contains the City's current calculated DSL; **Table 3-3** contains the City's historical DSL from the 2002 WSP. The City's DSL meets the standard of less than 10%.

9.10 Evaluation of Conservation Oriented Rate Structure

An inclining block type rate structure encourages conservation by directly linking a customer's increased consumption to higher water bills. Implementing an inclining block rate structure is relatively simple and inexpensive (to the water system) to implement. The City utilizes an inclining block rate structure for most of its customers (refer to **Section 8**); this encourages conservation. However, customers enjoy a large base allotment (15,000 gal) and rate blocks spaced at large intervals. Furthermore, the inclining block overage rates do not apply to commercial customers inside City Limits; these users pay a fixed overage rate. The following changes to the City's water rates structure would further orient the City's water rates towards conserving water:

- Reduce base volume allotment
- Reduce volume between rate blocks
- Apply inclining block overage rates to commercial customers inside City Limits.

Price elasticity of water demand describes the sensitivity of customer water use to changes in the price of water; it measures the responsiveness of water use to price change (e.g. for a system with a price elasticity of -0.3, a 10% increase in price will result in a 3% reduction in demand). In order to estimate the volume of water conserved by a rate increase a system must estimate the elasticity of water demand. The AWWA estimates that typical price elasticity values for systems consisting primarily of residential customers range from -0.1 to -0.3. At present, the City estimates demand elasticity to be approximately -0.1 (relatively inelastic). As such, the City would likely need to increase rates substantially (30-40%) to noticeably affect system demand. At present, the City feels that raising water rates 30-40% as a means to achieve WUE would place undue financial hardship on its customers.

9.11 Evaluation of Reclaimed Water Opportunities

Utilizing treated wastewater to satisfy non-potable water demands, such as irrigation of parks or golf courses, can reduce demand on a system's potable water supply. The Municipal Water Law requires systems with over 1,000 connections to evaluate opportunities for reclaimed water use when completing a Water System Plan.

9.11.1.1 Inventory of Large Water Users as Potential Reclaimed Water Users

The table following contains a list of the City's 20 largest water users:

Table 9-2 Inventory of Large Water Users

Rank	Customer Name	Potential Reclaimed Water User? (1)	Customer Address	2009 Water Use (gal)
1	City Of Leavenworth	Yes	1402 Commercial St	7,480,800
2	Enzian Inn	Yes	590 Hwy 2	5,195,500
3	Enzian Falls	Yes	311 Hwy 2 Irr	3,456,500
4	Icicle Junction	Yes	565 W Hwy 2 Irr	3,153,000
5	Cascade Medical Center	No	817 Commercial St	3,123,000
6	Sleeping Lady Retreat	No	7375 Icicle Rd	2,921,500
7	Cascade School District	No	10190 Chumstick Hwy	2,876,000
8	Cascade School District	Yes	225 Central Ave Irr	2,859,500
9	U.S. Fish Hatchery	No	12790 Fish Hatchery Rd	2,288,000
10	Boyd Management LLC	No	810 Hwy 2	2,271,500
11	Worldmark The Club	Yes	100 Enchantment Park Wy Irr	2,229,500
12	Der Ritterhof Motor Inn	No	190 W Hwy 2	2,147,500
13	LDS Church	Yes	10170 Titus Rd	2,134,000
14	Icicle Inn Best Western	No	505 W Hwy 2	2,105,000
15	Icicle Junction	No	565 W Hwy 2	1,615,500
16	Cascade School District	No	10195 Titus Rd	1,581,000
17	Bavarian Village Apts	No	330 Prospect St	1,557,000
18	Alpine Village Condos	No	525 Alpine Pl	1,545,000
19	Mountain Meadows	No	320 Park Ave	1,543,000
20	Village At Leavenworth	Yes	200 Joseph St Irr	1,446,000

(1) *Potential reclaimed water users in this table were not consulted on their desire to use reclaimed water. This list is purely for a rough estimate of irrigated area visible from an aerial photograph.*

As shown in the preceding table, several of the large water users in the City have the potential to use reclaimed water if it becomes available. Customers with large irrigated areas could potentially use reclaimed water.

9.11.2 Availability of Reclaimed Water

At present, the City does not have access to reclaimed water nor regulations requiring the use of reclaimed water. In the future the City would be willing to consider upgrading its waste water treatment plant to produce reclaimed water if the upgrades made financial sense. At present, the modest income available from selling reclaimed water does not justify the high cost of modifying the WWTP.

9.11.3 Financial and Operational Feasibility of Using Reclaimed Water

Providing reclaimed water for non-potable uses costs a lot of money. A partial list of the associated costs includes:

- Additional treatment facilities for the wastewater (as compared to what is otherwise required per the City's existing NPDES permit)
- Storage facilities for the reclaimed water
- Pumping facilities
- Transmission and distribution mains from the treatment, storage, and pumping site to the sites which would utilize the reclaimed water.

- Additional operational expenditures related to operating the expanded wastewater treatment facility and the reclaimed water storage, pumping, and transmission facilities.

Until a source of reclaimed water becomes available to the City it is difficult to quantify the capital cost to supply reclaimed water. In general, use of reclaimed water requires installation of distribution facilities from the source of reclaimed water to the point of use. Depending on the distance between the source of reclaimed water and point of use, costs will vary significantly and affect financial and operational feasibility.

9.12 Water Shortage Response Plan

The City utilizes two relatively secure sources of water supply (surface water and ground water). The City's WTP provides consistent, high quality water for approximately 11 months out of the year; the City takes the WTP offline during spring snow melt and runoff. City wells withdraw water from high quality aquifer that has consistently produced water without problems for decades. Therefore, in both the short term (e.g. power interruptions, redundancy, spills) and long term (e.g. aquifer capacity, redundancy), water shortages do not present a major concern to the City. Nevertheless, a catastrophic failure of one or more of the City's sources of the supply could require the City to respond to short or long term water shortages. The following paragraphs and Table lay out the City's plan for dealing with water shortages.

The likely duration of the water shortage, which sources are affected and the time of year the shortage occurs largely determine which response steps are required.

- Supply interruptions affecting only the wells or the WTP during non-summer months are not likely to have a severe effect since demand is significantly reduced. With the WTP offline the remaining sources can supply at least twice average day demand.
- Power outages no longer threaten the City's ability to supply water due to the backup power generators at the well field. In addition the City has storage that would allow the system to operate for short periods of time in the event of supply interruption.
- In the event that the existing sources' capacity was reduced due to dramatically reduced aquifer or Icicle Creek levels or for some other reason, a use reduction plan for customers is needed and is laid out in the following table.

Table 9-3 Water Shortage Response Plan

Stage 1 Minor Shortage Voluntary Measures 5% – 10% reduction goal	Stage 2 Moderate Shortage Mandatory Program 10% – 20% reduction goal	Stage 3 Severe Shortage Rationing Program 20% – 30% reduction goal
A. PUBLIC INFORMATION ACTIONS		
– Prepare & distribute water conservation materials (bill insert, etc.) – Prepare & disseminate technical conservation information to specific customer types – Coordinate media outreach program – Issue news releases to the media	– Continue public information program	– Continue public information program
B. GOVERNMENT ACTIONS		
– Increase enforcement of hydrant opening – Increase meter reading frequency & meter maintenance – Promote intensive leak detection & repair program – Draft & adopt ordinances banning water waste. A typical ordinance could require: ▪ No unfixed leaks; ▪ No hosing of paved surfaces; ▪ No fountains except those using re-circulated water; ▪ No water running onto streets; ▪ No watering during the middle of the day; and ▪ No irrigation runoff ▪ Draft & adopt ordinances allowing City to declare a water emergency and require fixed consumption allotments or % cutbacks (rationing)	– Reduce water usage for main flushing, street cleaning, public fountains, & park irrigation – Watering of parks, cemeteries, etc., restricted to nights or designated irrigation days	– All public water uses not required for health or safety prohibited unless using tank truck water supplies or reclaimed wastewater – Irrigation of public parks, cemeteries, etc., severely restricted – Pool covers required for all municipal pools – Main flushing allowed only for emergency purposes
C. USER RESTRICTIONS		
– Implement voluntary water use reductions (see A. Stage 1)	– Implement ordinance banning water waste (See B. Stage 1 above) – Adopt landscape irrigation restrictions incorporating one or more of the following: ▪ Time of day (e.g., 7 pm to 7 am) ▪ Weekly frequency (e.g., odd/even, time per week) ▪ Sprinkler bans (e.g., hand) – Commercial car washes should intensify voluntary use reductions – Golf course irrigation times and weekly watering limits reduced	– Implement ordinance allowing utilities to declare a water emergency & to require rationing (see B. Stage 1) – Car washing permitted only during specified watering hours of designated irrigation days – Times of day restrictions applied to commercial car washes – Golf course watering times & weekly watering limits reduced – Permissible watering hours & weekly frequency for landscaping irrigation further reduced
D. PENALTIES		
– None	– Warning – House call – Shut off and reconnection fee	– Fines
E. PRICING		
– None	– Impose surcharges	– Impose surcharges

The City Council has the necessary authority to implement the above measures at such time as they are required.

10.0 SOURCE WATER PROTECTION

The City's Wellhead Protection and Watershed Control Program contains the City's source water protection information. The City submitted the Wellhead Protection and Watershed Control Program under separate cover with the 2002 WSP; the City will provide an additional copy of the Program under separate cover for DOH review if required.

On May 11, 2011 the City performed an update of the potential contaminant sources list within the existing one, five, and ten year time of travel boundaries. Stan Adams and Tracy Valentine performed the update. The survey found no new potential sources of contamination.

11.0 OPERATION AND MAINTENANCE

11.1 Water System Management and Operator Certification

The following City personnel have responsibility for the water system.

Dave Schettler, P.E., Public Works Director
Stan Adams, Water Treatment Plant Operator, WTPO II, CCS
Tracy Valentine, Assistant Water Treatment Plant Operator, WTPO II

Dave Schettler can be reached at City Hall at (509) 548-5725. Stan Adams or Tracy Valentine can be reached at the WTP at (509) 548-4235.

11.2 System Operation and Control

11.2.1 Identification of Major System Components

Refer to **Section 2.3** for an inventory of system components.

11.2.2 Routine System Operation

Refer to **Section 2.3.1** and **2.3.2** for a description of how the City operates the system using the WTP and wells as sources of supply.

11.3 Monitoring Procedures

The City performs all routine water quality monitoring as required by WAC 246-290-300. Refer to **Section 5.2.5** for a summary of the City's recent sampling. The City's water quality monitoring meets the requirements of the WAC and no adjustments to procedures appear necessary at this time.

11.4 Emergency Response Procedures

The Table following describes the City's planned response for various types of emergencies. In an emergency the City (509) 548-5275 should be notified whereupon the Public Works Director, or in his absence, an assistant (or the person on call if after hours) will assign responsibilities.

Table 11-1 Emergency Response Procedures

Potential Emergency	Action
Fire	• Provide assistance to fire department as needed
Contaminant Spill near Wells or WTP	• Contact fire department – 911 • Contact police department – 911 • Contact DOE spill response unit (509) 456-2926 • Shut down well pump(s) or WTP if contaminant could reach aquifer or Icicle Cr. • If necessary, notify public of emergency water consumption restrictions by way of Wenatchee TV station
Main Break	• Isolate reach by closing nearest valves • Repair main, if parts not available from City inventory obtain from suppliers
Power Outage at WTP (the wells have backup power)	• Contact Chelan County PUD at (888) 663-8121 • Demand temporarily supplied from wells or storage. Historically, power outages have been short.
Controls Between Reservoir and Sources Disrupted	• Operate well pumps or WTP manually if necessary • Contact Art Stokes at (509) 467 0770
Well Pump Out of Service	• Contact Grays Electric at (509) 662 6834
WTP or Well Related Alarm (Auto-dialer)	• Contact Stan Adams, Tracy Valentine, or Dave Schettler at (509) 548-5275 or (509) 548-4235

11.5 Cross Connection Control (CCC)

The City has prepared its CCC program with the assistance of BMI and in accordance with WAC 246-290-490. The City's complete CCC program as prepared by BMI available for DOH review upon request. The following list summarizes the City's CCC Program.

Element 1 - Ordinance
City Ordinance 1178 establishes the City's authority to implement and enforce CCC, describes the operating policies and technical provisions of the program, and describe the corrective actions used to ensure that consumers comply with the City's CCC requirements.

Elements 2 & 3 – Procedures Evaluating New and Existing Services for Potential Hazard and Correcting Same
Prior to connection of a new service to the City's water system, City personnel determine the nature of the new service. If the service presents a potential hazard, the City notifies the property owner and requires that the cross connection be eliminated, or, if that is not possible, an appropriate backflow preventer be installed. See SOP 2.2 and 2.7 in the City's complete CCC program (separately bound).

The City evaluates all existing service connections to determine the nature of the water use and whether or not a backflow preventer is required. If necessary, the cross connections are eliminated or an appropriate backflow preventer installed.

Upon completion of the initial evaluation, the City reviews annually the adequacy/necessity of backflow prevention devices. In addition, whenever there is a change in building occupancy or use, the City reviews the adequacy/necessity of a backflow prevention device.

Element 4 – Certification of Personnel as CCS
The City's WTP Operator (Stan Adams) is a CCS and is responsible for implementation of the CCC program.

Elements 5 & 6 – Procedures to Ensure that Backflow Preventers are Inspected and/or Tested by Qualified Personnel
The City contracts with a BAT who tests all BAs annually. BA owners are billed for this service by the City. Customers must immediately repair backflow assemblies which fail the test or the City may terminate service. The City keeps test results on file on the master list.

Element 7 – Response to Backflow Incident
The City's water system has experienced no known backflow incidents. If one were to occur, the City would take all necessary steps to determine the origin and nature of the problem and remedy that problem. Refer to SOP 2.13 in the City's complete CCC program (separately bound).

Element 8 - Education
The City mails a report annually to all customers regarding CCC requirements. The City makes CCC literature provided by DOH available at City Hall.

Element 9 – CCC Records
As part of its contract with BMI, the City has established a computerized database of backflow assemblies. The City updates as necessary a master list of services with installed backflow assemblies. This list includes the locations, types, sizes, brand, model numbers, dates of testing, and repairs made for all installed backflow assemblies. The list includes services which should but do not yet have backflow assemblies. The list also includes a status field for monitoring progress toward installation of an appropriate backflow prevention device.

Element 10 – Reclaimed Water
Reclaimed water is used at the WWTP. There is no interconnection with the potable water system.

Premise Isolation
The City has approximately 20 services which require premises isolation in accordance with Table 9 of WAC 246-280-490.

11.6 Record Keeping and Reporting

All water system records are filed at City Hall. Available records include:

- Water quality sampling results
- Source meters records
- Service meter records
- Customer complaints
- Project record drawings
- Water system engineering reports
- Billing records

The period of record for each of these types of records varies. In general it is the City's policy retain any potentially valuable system records.

11.7 O&M Improvements

The water system is operated efficiently and effectively. Unlike many systems, knowledge of water system operation is shared by more than one person which increases system reliability. The City's O&M practices do not appear to require improvement at this time.