City of Cashmere

2020 WATER SYSTEM PLAN
Volume 1 - Chapters

Prepared By

RH2

THE HEART OF CASHMERE WASHINGTON

Second Draft
June 2020

City of Cashmere
2020 Water System Plan

Final Draft (for City Approval)

June 2020

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Certification

This Water System Plan for the City of Cashmere was prepared under the direction of the following registered professional engineers.

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0 | EXECUTIVE SUMMARY

PURPOSE OF THIS PLAN

The City of Cashmere's (City) water system is a major infrastructure, much of which is invisible to the people it serves. The water system requires qualified staff to operate and maintain it and an ongoing capital improvement program to replace old components to meet the requirements mandated by federal and state laws. The primary purpose of the City's *Water System Plan* (WSP) is to identify and schedule water system improvements that correct existing system deficiencies and ensure a safe and reliable supply of water to current and future customers. This WSP complies with Washington State Department of Health (DOH) regulations under Washington Administrative Code (WAC) 246-290-100, which requires water purveyors to update their water system plans every 6 years.

Although this WSP was finished in 2019, the majority of the work was completed just prior to the end of 2017. Therefore, only some operational information from 2018 and 2019 is included.

CHANGES SINCE THE LAST COMPREHENSIVE PLAN

The City's last WSP was completed in November 2012 and approved by DOH on January 28, 2013. The following are the most significant changes since the last WSP.

- Water system leakage has reduced dramatically from 30-percent of supply to less than 10-percent. The primary cause of the leakage was a single old steel pipe that has since been replaced.
- Population has remained essentially unchanged, falling well below the City and Chelan County (County) projections of approximately 2-percent growth per year. While this helps defer projects needed for growth, it reduces the City's anticipated revenue.
- The City is working with other regional agencies to acquire additional water rights. At the time this WSP was written, the results of the request have not yet been received.
- The City installed almost two miles of pipe, mostly to replace old pipe in conjunction with road reconstruction projects.
- The City installed a remote telemetry system to control and monitor pumps and reservoirs.
- The Sherman Reservoir roof suffered damage in early 2019 and must be replaced. This unforeseen project is expected to postpone other projects due to the high cost.

SUMMARY OF KEY ELEMENTS

The WSP presents a description of the existing water system and service area, a forecast of future water demands, policies and design criteria for water system operation and improvements, the Operations and Maintenance (O&M) program, staffing requirements, a schedule of improvements, and a financial plan to accomplish the improvements. The WSP also includes several ancillary elements, such as a water conservation plan, a water quality monitoring plan, a wellhead protection and watershed control plan, and an emergency response plan. A summary of the key issues related to these elements is provided in the following sections.

WATER SERVICE AREA

The City provides water service to approximately 1,020 customer accounts throughout its water service area boundary, which extends beyond the City's corporate limits. The City is responsible for providing public water service, utility management, and water system development within this area. These services will be provided by the water system as the city limits expand to incorporate new properties.

PAST WATER USE AND CONSERVATION

The City experienced a trend of increasing system-wide water demand up to 2007, due to population and industry growth. Water use dropped in 2008 due to the loss of TreeTop, but has been increasing with Crunch Pak and new residential customers. The City's relatively high average per capita demand of 187 gallons per day (gpd) reflects significant industrial use and the irrigation water usage of a portion of the City's customers. In Central Washington, irrigation is often served by a separate system. The City of Cashmere is unique in that, prior to 2008, the majority of overall water demand was not from residential users, as it is in most systems. The City has a significant amount of large non-residential water users. Prior to 2012, approximately 30-percent of the water supplied was lost through distribution system leakage (DSL), but has been reduced to 7-percent by replacing leaking pipes.

FUTURE WATER USE AND WATER SUPPLY

Overall water demand within the City system is expected to increase between 0 and 25 percent within the next 6 years, and between 5 and 40 percent within the next 20 years, depending on the amount of future water use reductions from the City's conservation program and the increase in use from the growing Crunch Pak company. The City is expected to have sufficient physical capacity from its three existing supply sources to meet the demand requirements of the system through the 20-year planning period, but could be at capacity shortly thereafter.

WATER SOURCE AND QUALITY

The City's drinking water is supplied by two groundwater wells and one surface water source. The City has sufficient water rights from these sources to meet the demand requirements of the existing system; however, additional annual water rights will eventually be needed. The City began planning for these additional rights several years ago to ensure an adequate and reliable source of water is available for both existing and future customers. This prudent planning of water sources is especially necessary today, given the complexities involved with and the lengthy process of acquiring additional water rights. However, there is no guarantee that water rights will become available, which would have a direct impact on the City's ability to take on additional growth. The City partnered with other local agencies in 2017 to request additional rights and is currently waiting on a decision from the Washington State Department of Ecology (Ecology).

Additional physical source capacity will eventually be needed, perhaps as soon as 20 years. The City should begin studying options for increasing supply.

The City currently provides water treatment on a system-wide basis. The quality of the City's water supply has been good and has met or exceeded all drinking water standards. Drinking water regulations are constantly changing and additional monitoring and reporting will be required in the future to ensure safe drinking water for the public. Therefore, it is imperative that the City stays abreast of the regulations and maintains compliance.

OPERATIONS AND MAINTENANCE

The City's O&M organization is staffed by well-qualified, technically trained personnel. City staff regularly participates in safety and training programs to keep abreast of the latest changes in the water industry and to ensure smooth and safe operation of the water system. The current staff of supervisory personnel and field crew, many of whom are responsible for the water system and other utilities, effectively operate and maintain the water system. O&M staff has been reduced in the last few years, requiring efficient time management and occasional outside contracting to supplement staff availability.

The City has taken several steps to prepare for emergency situations. The Emergency Response Plan, which was prepared by the City, assesses the vulnerability of the major water system facilities during a number of emergency events and identifies follow-up procedures to be carried out. The plan also includes emergency call lists and notification procedures. Several water system improvements have been identified to reduce the vulnerability of the water system during emergency situations.

WATER SYSTEM EVALUATION

The existing water system was evaluated to determine its ability to meet the policies and design criteria of the City and those mandated by the DOH. The results of the evaluation are summarized below.

- The City has sufficient physical supply capacity to meet the demands of existing customers and to meet the projected demands of the system for the next 20 years, based on the population growth forecast.
- The three existing sources need improvements related to control systems, equipment improvements, and emergency power supply.
- The 1000 and 1050 Zones do not have pressure relief facilities to protect the system from possible over-pressurization.
- The 1114 Zone does not have sufficient backup supply to ensure uninterrupted service in the zone in the event that the Sherman Booster Pump Station (BPS) is out of service.
- The existing reservoirs provide enough storage to meet the storage requirements of the existing customers and the near future, based on the City's current standards for reliability.
- Pressure zone improvements are necessary to fully utilize all of the existing storage and improve reliability.
- Several areas of the system require replacement of existing water main to resolve deficiencies related to low fire flows and aging pipes.
- The existing telemetry and control equipment is not yet being used to its full potential for operating and monitoring all facilities.

CAPITAL IMPROVEMENT PROGRAM

Improvements to the water system are necessary, primarily to resolve existing system deficiencies, but also to accommodate the increase in water demands from future growth. Improvements identified for the first 6 years of the capital improvement program (CIP) (2019 to 2024) are estimated to cost approximately $3,300,000, which results in an average expenditure of approximately $550,000 per year. Improvements in the 4 years that follow (2025 to 2028) are estimated to cost approximately $1,600,000 or approximately $410,000 per year.

The first 6 years of capital improvements and the O&M of the water system are expected to be funded by rates and cash on hand. Other funding sources may include low-interest Public Works Trust Fund loans or State Revolving Fund loans. The financial plan shows that a rate increase of 4-percent annually, and an increase to the system development charge are needed to fund operations and the capital projects. Financing through a bond sale is not currently anticipated.

1 | INTRODUCTION AND WATER SYSTEM DESCRIPTION

AUTHORIZATION AND PURPOSE

In 2017, the City of Cashmere (City) authorized RH2 Engineering, Inc., (RH2) to prepare a Comprehensive *Water System Plan* (WSP) as required by state law under Washington Administrative Code (WAC) 246-290-100. In accordance with WAC 246-290-100, the WSP will be updated and submitted to the Washington State Department of Health (DOH) every six to ten years. The previous WSP was approved by the DOH in January 2013. The purpose of this updated WSP is as follows:

- To evaluate existing water demand data and project future water demands.
- To analyze the existing water system to determine if it meets the minimum requirements mandated by the DOH and the City's own policies and design criteria.
- To identify water system improvements that can resolve existing system deficiencies and can accommodate future needs of the system for at least 20 years into the future.
- To prepare a schedule of improvements that meets the goals of the City's financial program.
- To evaluate past water quality and identify water quality improvements, as necessary.
- To document the City's operations and maintenance (O&M) programs.
- To prepare conservation, emergency response, cross connection control, watershed control, and water quality monitoring plans.
- To comply with all other WSP requirements of the DOH.

This is a planning document only, it is not intended as a definitive statement or analysis of the full scope of all water rights held by the City or in which the City may have an interest. As noted in **Chapter 5**, there are a number of disagreements with Washington State Department of Ecology (Ecology) regarding the scope of the City's water rights. Nothing herein shall be interpreted or used as a statement against the interests of or binding upon the City in any future proceeding or analysis concerning the scope of the water rights held by the City or in which the City may have an interest.

OWNERSHIP AND MANAGEMENT

The City is a municipal corporation that owns and operates a public water system within its corporate boundaries. **Table 1.1** shows the DOH system information.

Table 1.1
System Information

Information Type	Description
System Type	Group A - Community
System Name	City of Cashmere
County	Chelan
DOH System I.D. Number	11700
Owner Number	923
Address	101 Woodring Street, Cashmere, WA 98815
Contact	Bruce Germain, Water / Wastewater Supervisor
	Steve Croci, Director of Operations
Contact Phone Number	(509) 782-3513

HISTORY AND BACKGROUND

The area was originally settled in the late 1800s when it was called the town of Mission. The town was incorporated in 1904, and the name was changed to Cashmere because numerous other town sites were also named Mission.

The City's first water works and street lighting construction is described in great detail in Ordinance Number 53, dated June 27, 1907 (**Appendix D**). Shortly after this ordinance was written, a bond was passed and the bond proceeds were used to construct the City's first well (Well No. 1) located near the intersection of River Street and the Great Northern Railroad, on the north side of the tracks. The well pump was powered by a 40 horse power (hp) gasoline engine and had a capacity of 270 gallons per minute (gpm). Historical records indicate that the water from Well No. 1 had high manganese content. This caused a manganese buildup in the water mains resulting in black water complaints when fire hydrants were opened or when changes in water flow direction or velocity took place. Well No. 1 was taken out of service on July 5, 1990. The City's first reservoir, near the center of Section 4, Township 23 North, Range 19 E.W.M. (50 feet due east of the current Sherman Reservoir) was also constructed during the 1907 to 1908 project. This reservoir had a capacity of 250,000 gallons, and the structure is still in place, but was removed from service in 1980. The 1907-1908 project also included the construction of 7-inch wood stave pipe from the well to the reservoir, and 2-inch through 5-inch wood stave pipe that supplied water to the homes at that time. The cost to construct the water and street lighting systems was $13,200 (about $1,000,000 in 2018 dollars).

A second reservoir, which also had a 250,000 gallon capacity, was constructed adjacent to the first reservoir in the 1920s. A second well (Well No. 2) was also constructed at this time near the intersection of River Street and Sunset Avenue. Pumps with electric motors were installed in both Well No. 1 and Well No. 2 at this time. Well No. 2 had a capacity of about 100 gpm and was difficult to keep clean. The City began using cast iron (CI) pipe during this period and continued to do so until ductile iron (DI) pipe was used in the late 1960s. Well No. 2 was taken out of service in the late 1980s and was filled in and abandoned in 1991, which included demolition of the building.

Well No. 3 was constructed in the 1930s adjacent to the City's public swimming pool. Its capacity was only 50 gpm and was difficult to maintain; therefore, its primary use was to fill the pool until it was taken out of service in 1989. Also, during this time, more water mains were constructed, and the wood stave pipe was replaced with larger CI piping.

Well No. 4 was constructed in 1942 across the street from the swimming pool on Paton Street. The well is 65 feet deep and 6 feet in diameter. It is still in use and produces approximately 230 gpm.

The City explored other well sites during the 1940s, 1950s, and 1960s to meet the increasing demands for water. A well was drilled at the junction of Chapel Street and Valley View Drive. The water from this well had a strong odor of sulfur compounds. A well was drilled on the west bank of the Wenatchee River near the intersection of Riverfront Drive and East Parkhill Street. Its capacity was less than 10 gpm. It was also during this time that the City purchased the land on the east bank of the Wenatchee River, south of the Cottage Avenue Bridge. Well No. 5 was drilled at the southern end of this property, but soon caved in. It was re-drilled a short distance away but would only produce 50 gpm. Well No. 6 was an existing well on the property, but only produced 50 gpm or less. Well No. 7 was also constructed on this property. It was a dug well, having a 12-foot diameter casing and 35 feet deep into sandstone. Well No. 7 was near the Wenatchee River and its capacity of 150 to 350 gpm was influenced by river flows or elevations. To maintain the Well No. 7's capacity, water was pumped from the Wenatchee River to recharge the area around it. By doing this, capacities of 450 gpm could be reached for short times and 350 gpm could be maintained with good water quality.

One-third of a mile to the southeast of Well No. 7, Well No. 8 was drilled, though it produced only 50 gpm or less and soon became contaminated. Several attempts were made, even in the 1970s, to clean the well and use it, but these efforts were unsuccessful, and the well was sealed in 1991.

In 1967, Well No. 9 was drilled on the north side of the Cashmere-Dryden Airport runway and at the end of what is now known as Fisher Street. This well had odor problems and was pumped onto the Cashmere Cemetery grounds for many months before it could be used. The well capacity was 350 gpm but required close attention to ensure desirable water quality.

A consultant was hired for the design of a reservoir, and funding was secured for the construction of the Sherman Reservoir in 1973. The reservoir was named in honor of the family that sold two parcels of property to the City, for one dollar each, for the reservoir sites in 1907. The concrete reservoir has a capacity of one million gallons (MG). The reservoir was a great asset to the City, but water rationing was required by 1975 due to severe water shortages during the summer. This continued until another consultant was hired and further improvements were completed in 1980. The consultant hired a hydrogeologist to determine the best source of water for the City. The City Water Superintendent felt that the City's history with wells had proved unsatisfactory and that another source should be investigated. The hydrogeologist's report stated that a well located at Simpson Park, the Cashmere-Dryden Airport, or the Cashmere Cemetery would be the best and most economical source of water. Since the City owned the park property, a well was drilled there. It produced less than 10 gpm and the site was abandoned. Well No. 10 was drilled at the southeast end of the airport runway. It initially produced 375 gpm and the water was of excellent quality. The consultant also recommended that Well No. 9 be improved, which was done in the 1979-1980 project along with the construction of the Kennedy Reservoir, seven pressure reduction stations, and about four miles of 10-inch and 12-inch water mains. The 2.0 MG Kennedy Reservoir is constructed of steel and is located 1,800 feet southeast of and 200 feet higher than the Sherman Reservoir. The consultants believed that Well Nos. 9 and 10 would be the City's primary source of water. These wells were connected directly to the Kennedy Reservoir and automatically operated by sensors in the reservoir and telemetry to the wells. The automation proved unsatisfactory as the telephone lines were unreliable. There were many false alarms and the system needed hands-on checking to function properly. Four pressure reducing stations were constructed between the wells and reservoir to supply water to the mid-pressure zone (1000 Zone) located in the south part of the City. This proved most satisfactory in that it eliminated the need for a booster pump station (BPS) in that area. A 12-inch water main connected the Kennedy and Sherman Reservoirs, while a pressure reducing station was added to serve the area around the Sherman Reservoir. A float valve was placed in the Sherman Reservoir to enable the transfer of water from the Kennedy Reservoir to the Sherman Reservoir upon sensing of a low level in the Sherman Reservoir.

In 1985, the City once again began experiencing water shortage problems. The capacity of Well No. 10 had fallen to 250 gpm and Well No. 9 became unusable because of water odor and color problems. The static water level in Well No. 10 had not changed, so the City attempted to improve its capacity by cleaning the screens, but this was not successful. The water supply was maintained, though at a lower level, by a massive recharging of the area around Well No. 7. A fire truck was used to pump water from the Sherman Reservoir to the Kennedy Reservoir to supply the south part of the City. Later, an electric pump was installed for this purpose. Water was being rationed during the summer months while all of this was taking place.

The City Water Superintendent was determined to find a different, good quality, and reliable source of water. He had, for some time, thought of taking water from the aquifer under the Wenatchee River or pumping water to ponds with a man-made aquifer under them. In 1987, with the permission of the City Council, he hired the Ranney Method Western Corporation, of Kennewick, Washington, to investigate the feasibility of a Ranney Well producing 2,400 to 3,000 gpm near Well No. 7. Another consultant, Mr. William E. Schmidt of IntegriTech from Leavenworth, Washington, was hired to design the pumping and piping systems for the new well and a booster pump to transfer water from the Sherman Reservoir to the Kennedy Reservoir. The Ranney engineers' investigation indicated that the aquifer near Well No. 7, and probably in most other areas of the City, consisted of poorly sorted silt, sand, and gravel with a relatively low permeability. The results further showed that this aquifer was hydraulically connected to the river; therefore, an infiltrated water supply could be developed, but the maximum yield would be 630 gpm in the summer and 480 gpm in the winter. Some thought was given to the construction of a series of Ranney wells, but at an estimated cost of $200,000 each, a decision was made to look into a slow sand filter treatment plant. Mr. Schmidt was retained to continue design of the Sherman Reservoir BPS, and to investigate the feasibility of a slow sand filter treatment plant. City staff worked closely with Mr. Schmidt in the gathering of field data, and in construction of a pilot plant. Mr. Schmidt did extensive studies to determine the best slow sand filter treatment plant design. City staff and Mr. Schmidt worked closely to bid all construction materials for the project. These materials were assigned a part number, warehoused by the City, and supplied to the contractor during construction. The slow sand filter treatment plant construction was completed in November 1989 and was fully operational by March of 1990. The treatment plant and the Sherman booster pumping system have proven to work very well.

In 2006, Picatti Brothers was hired to redevelop Well No. 10 to recover lost capacity. The test after the casing perforations were "cleaned and treated" indicated that a steady capacity was available of 250 gpm at 34 feet drawdown (55 feet below grade). Unfortunately, the well capacity again declined over time, and as of 2019, the capacity was down to approximately 130 gpm.

In 2007, a closed zone BPS and distribution system were constructed to serve residential properties above the Kennedy Reservoir. These users were previously on separate systems served by groundwater wells of diminishing capacity. Rather than drill additional wells, they requested to join the City's water system. The Fire Marshal did not require fire protection, as the residential development had previously been approved for construction without fire protection. Eight-inch mains and hydrants were installed in anticipation of future fire flow requirements. The project is documented in the 2007 Water System Plan Amendment.

Since 2007, little has changed except replacement of distribution mains and installation of new control equipment. Specific projects are described in **Chapter 8**.

CITY MEETINGS

The City is administered by a Mayor and a five-person Council. Regularly scheduled public meetings are held on the second and fourth Monday of each month at the City Hall located at 101 Woodring Street.

CITY LOCATION

The City is in Chelan County, Washington, on the banks of the Wenatchee River approximately 8 miles northwest of the Columbia River and the City of Wenatchee. **Figure 1.1** shows the city limits.

GEOLOGY

Located in the Chiwaukum graben, the City's geological conditions were established between 40 to 50 million years ago when the North Cascade subcontinent converged with the original North American continent and the Okanogan subcontinent. This convergence subsequently initiated a northward movement of the North Cascade subcontinent, causing settlement in the surrounding soils. The rocks that have filled this Chiwaukum graben have been termed Chumstick formations by geologists, and the soils surrounding this area include Beverly, Bjork, Burch, Cashmont, Terrace Escarpment, and River Wash. No indication has been found that glaciers reached the City area, however, the existing soils in this region have been significantly affected by the snowmelt of adjacent glaciers.

TOPOGRAPHY

The ground elevation within the City service area ranges from approximately 750 feet near the Wenatchee River to approximately 1,250 feet along Rank Road near the Kennedy Reservoir. Ridges along the north side of the valley rise to over 2,000 feet before ascending higher into the Entiat Mountains. South of the City, ridges rise again to over 2,000 feet above sea level and are connected with the Wenatchee Mountains and Mission Ridge.

Approximately 52 acres of the service area are located within the 100-year flood zones of Mission and Brender Creeks. Approximately 360 acres are located within the combined 500-year flood zones of the creeks and the Wenatchee River.

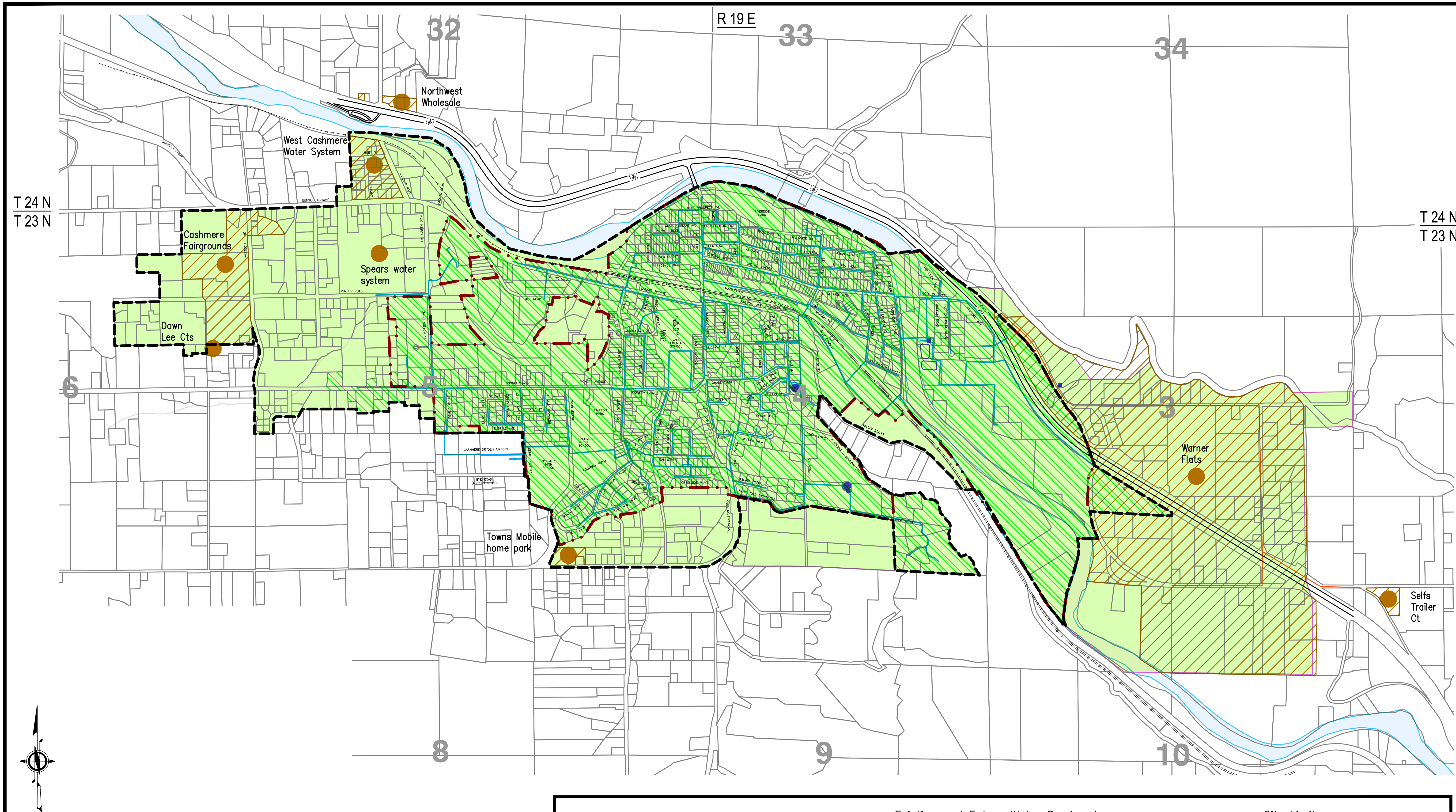


Figure 1.1: Service Areas

CITY OF CASHMERE
2019 COMPREHENSIVE WATER SYSTEM PLAN

SCALE: 1 in = 1/4 Mile

DRAWING IS FULL SCALE WHEN BAR MEASURES 1"

PLOT DATE: 12/19/2019 JOB: CA 217.102
FILE NAME: CAWSP19-F-SA.DWG

Service areas shown for adjacent water systems are meant only as a reference and are not guaranteed to be accurate.

- Existing and Future Water Service Area / Future Retail Service Area / Water Rights Place of Use
- Existing Retail Service Area
- Adjacent Water System
- City Limits
- Urban Growth Boundary

RELATED PLANS

The following document provides additional information on the City's domestic water system and was consulted in the preparation of this WSP.

- *2017-2037 Chelan County Comprehensive Plan* (December 2017).

The above document provides planning and land use information for Chelan County (County). Land use and population projection information in the City's *2019 Comprehensive Land Use Plan* are the same as those in the County's 2017 Plan.

SATELLITE SYSTEM MANAGEMENT

A Satellite System Management Agency (SSMA) is defined as a person or entity that is certified by the DOH to own or operate more than one public water system without the necessity for a physical connection between such systems. SSMAs were created to stop the proliferation of small water systems, many of which could not meet federal and state water quality and water system planning regulations. Based on the success of SSMA's, the DOH made recommendations to the legislature to include rules for designating entities as qualified SSMAs. In July 1995, Senate Bill 5448 became law that governs approvals of new water systems and sets forth requirements for SSMAs. The goal of the new law is to ensure that the people of this state will receive safe and reliable water supplies in the future from professionally managed or properly operated water systems. SSMAs can provide 3 different levels of service:

1. Ownership of the satellite system;
2. Operations and management of the satellite system; and
3. Contract services only.

The service can be provided to new systems, existing systems which are no longer viable, or existing systems placed into receivership status by the DOH.

The City does not own or operate any satellite systems and is not currently a SSMA. The City will consider providing satellite system management services to small neighboring water systems and will evaluate becoming an SSMA on a case-by-case basis. Upon agreement between the two systems to have the City provide SSMA services, the City will pursue the necessary steps to become an approved SSMA. These include:

1. Submitting a notice of intent to the DOH;
2. Participating in a pre-submittal meeting with the DOH;
3. Submitting a SSMA plan to the DOH that meets the plan requirements; and
4. Obtaining approval of the plan from the DOH.

If the City decides not to become the SSMA for small systems requesting assistance, then the Public Utility District No. 1 of Chelan County (District) may provide these services. The District currently operates several satellite systems and is an approved SSMA.

WATER SERVICE AREA

The City's corporate boundary encompasses an area of approximately 1.16 square miles (743 acres), as shown in **Figure 1.1**. The City's existing water distribution system lies within these limits, as shown in the figure. The existing water system extends north and east to U.S. Highway 2 and south to Skyline Drive. The Cashmere Cemetery serves as the existing water system's most westerly limit.

The City's current retail water service area includes the City limits and customers along Rank Road. The current service area is coincident with the Urban Growth Area (UGA) and encompasses an area of approximately 1,170 acres, or 1.8 square miles, as shown in **Figure 1.1**. The City is responsible for providing public water service, utility management, and water system development within the retail service area. These services will be provided by the water system as the city limits expand to incorporate new properties. The water service area boundary extends 0.4 miles west of Westcott Drive and as far south as Binder Road, north to U.S. Highway 2, and approximately 1/8 mile east of Hughes Road.

The future service area and future retail service area are the same as the current service area and encompass an additional area of 344 acres or 0.53 square miles.

SYSTEM DESCRIPTION

OVERVIEW

The City provides service to approximately 1,120 customer connections within the city limits. The 2018 population is estimated to be 3,095. The City also serves a small number of customers outside the city limits, but who are still within the retail service area.

This section describes the physical system components. An evaluation of the condition and performance of the components is provided in **Chapter 6**.

SUPPLY

Water supply to the City water system is provided through the Water Treatment Plant (WTP) from the Wenatchee River and the City's only two domestic groundwater wells that are still in active service, Well No. 4 and Well No. 10. Well No. 7 is on standby for emergency use if the WTP river pumps are out of service. The WTP flow is measured through two parallel propeller flow meters, one from each filter cell. Well No. 4 flow is measured through a turbine meter and Well No. 10 uses a vertical propeller meter. The Riverside Park well currently supplies only irrigation water. A more detailed description of each active source is provided below. A summary of the well data is shown in **Table 1.2**.

Table 1.2
Source Physical Information

Name and DOH Source No.	Well 4 [S04]	Well 10 [S10]	River Lift [S11] (2 Equal Casings)	Riverside Park Well
Year Drilled	1942	1978	1989	2012
Location	NW SE Sec05 T23N R19E	SW NW Sec04 T23N R19E	SE NE Sec04 T23N R19E	NE NW Sec04 T23N R19E
Casing Diameter (inch)	72	12	48	8
Casing Depth (ft BGS)	65	94	20	56
Screen Depth (ft BGS)	43 to 63	65 to 70	n/a	51 to 56
Pump Intake Depth (ft BGS)	50	61	20	u/k
Static Water (ft BGS)	24	21	15	15
Drawdown (ft) [varies]	2	40	15	u/k
Ground Elev. (ft)	804	832	765	775
DOE Well Tag	AGJ072	ABR435	n/a	BCF923

BGS = Below ground surface

Water Treatment Plant (Wenatchee River Supply)

The City's largest source of water is delivered through the WTP that is located approximately 200 yards south of the Cottage Avenue Bridge, near the east bank of the Wenatchee River. The WTP, which was constructed in 1989, includes slow sand filtration for treatment, and pumps that move the water directly into the 895 Zone and the Sherman Reservoir.

Water is first collected through two intake screens at the bottom of the Wenatchee River and flows by gravity into two caissons located at the river's edge. A 1,200 gpm submersible (wastewater style) pump is located inside each caisson and lifts the river water into each of the two filter cells. Treated water is pumped into the system by three pumps with a combined peak flow rate of up to 2,400 gpm, or 3.46 million gallons per day (MGD).

Photo 1-1
Wenatchee River Intake


Well No. 4

Well No. 4 is located near 103 Paton Street in a concrete building that houses the well and electrical and mechanical equipment. When it was installed in 1942, the 6-foot diameter concrete casing was dug to a depth of 63 feet and thirty 4-inch diameter pipes were positioned in the bottom 20 feet to allow water into the well. The well has a current capacity of approximately 230 gpm and is equipped with a 15 hp submersible pump that supplies water to the 895 Zone. Well No. 4 is manually operated based on system demands and the water quality at the WTP. The well is also used during the summer to reduce the water temperature in the system and improve the taste. In the winter, the well is used to warm the water in the system and minimize the chance of freezing of the water services. The well is also operated during the spring when the WTP is unable to treat the highly turbid water from the Wenatchee River. The water is treated with a gas chlorination system.

The well pump was replaced in 2008 with a pump that can produce up to 310 gpm. The discharge valve is throttled to keep the pump between 200 and 250 gpm to prevent excessive drawdown of the well.

Photo 1-2
Well No. 4

Well No. 10

Well No. 10 is located at the southeast corner of the Cashmere-Dryden Airport in a concrete masonry unit (CMU) block building that also houses the electrical and mechanical equipment. The well was drilled to a depth of 140 feet in 1978 and resulted in the discovery of sandstone with very little water between depths of 95 feet to 140 feet. Attempts failed to pull the 12-inch steel casing back to expose the well screen above the sandstone, thus the casing was left at a depth of 95 feet and perforated with 150, 3/8-inch by 2-inch holes from a depth of 65 feet to 70 feet. The well capacity has varied from as high as 375 gpm to as low as 130 gpm. It is equipped with a 50 hp vertical shaft turbine pump that supplies water to the 1114 Zone. The pump discharge valve is throttled between 100 and 200 gpm (130 gpm in 2019) due to excessive well drawdown. However, the throttling creates very high pressure upstream of the throttling valve, limiting the range. The well has responded favorably to redevelopment in the past, but performance drops quickly as the screen becomes re-clogged. Verbal recollections of past redevelopment imply the clogging may be due to both mineral deposits and sanding.

The pump is run manually and operated for the same purposes as Well No. 4, in that it supplies the City's water system seasonally based on system demands and water quality at the WTP. Gas chlorine is used for disinfection.

Photo 1-3
Well No. 10

TREATMENT

The WTP houses two filter cells. Each is approximately ½-acre in size and is an earthen basin with a water-retaining hypalon liner. Each cell contains approximately 4 feet of specifically sized sand that is used as a media for the growth of microscopic organisms. The microbiology that is grown on the face of the sand granules essentially consumes the resident impurities from the river water. The top layer of this sand also provides some physical straining of debris from the river water. The water levels in the cells are kept approximately 5 feet above the sand surface, and the water slowly filters through the sand barrier to the bottom where manifold plumbing allows the filtered water to gravity flow to the control building that houses the pumps. When the system is at optimal function, the capacity is 1,200 gpm per cell for a total of 2,400 gpm. A buildup of cake on the sand surface can reduce the capacity until cleaned.

After undergoing the filtration process, the water is metered through two 12-inch propeller meters, one for each cell, chlorinated with a gas system for disinfection purposes, and retained in a contact basin. The meters are calibrated by an outside contractor to ensure continued accuracy. At the entrance to the contact basin, the water receives an initial dosage of approximately 1.3 parts per million (ppm) of free chlorine residual. The contact basin contains longitudinal baffling and has a capacity of approximately 153,000 gallons.

The design of the WTP incorporates both old and new technology. The filter itself has been known to be an effective treatment process for hundreds of years, yet the amalgamation of such items as programmable logic controllers, automated valves, proportional chlorination equipment, and continuous monitoring of chlorine, pH, temperature, turbidity, and flow all collaborate to give the operator better control in producing quality water.

Gas chlorination is provided at both Well No. 4 and Well No. 10.

Photo 1-4
Water Treatment Plant North Cell

Photo 1-5
Water Treatment Plant Pumps and Cell Level Board

STORAGE

895 Zone 1.0 MG Sherman Reservoir

The Sherman Reservoir, which is located near the intersection of Cedar Street and Fasken Drive, provides 1.0 MG of water storage for the City’s 895 Zone. The 106-foot diameter, 21.5-foot tall partially-buried concrete reservoir was constructed in 1973, and is filled from the WTP and Well No. 4. The two submersible pumps in the Sherman Reservoir are installed horizontally on the floor inside the reservoir. A single 10-inch inlet/outlet pipe in the center of the floor feeds two 10-inch CI mains running southwest and southeast under the floor. The floor of the Sherman Reservoir is a truncated cone shape and contains approximately 230,000 gallons between the elevations of 877 feet (floor) and 883 feet (base of vertical wall). The bottom elevation of the reservoir’s vertical wall is 883 feet and the reservoir’s overflow elevation is 895 feet. The overflow discharges to the City’s storm system. The Kennedy Reservoir overflow and drain pipe runs through the Sherman Reservoir site and connects to the Sherman Reservoir overflow, but a check valve installed on the Sherman Reservoir overflow prevents Kennedy water from entering the Sherman Reservoir. The water level is sensed by a level transducer and reported back to the supervisory control and data acquisition (SCADA) system.

Photo 1-6
Sherman Reservoir

1114 Zone 2.0 MG Kennedy Reservoir

The Kennedy Reservoir, which is located north of Rank Road and east of Kennedy Road, provides 2.0 MG of water storage for the City's 1114 Zone. The 105-foot diameter, 34-foot tall (32-foot maximum water depth) steel tank was constructed in 1979 and is filled from Well No. 10 and the Sherman BPS. A single 12-inch diameter DI water main serves as the reservoir's inlet/outlet piping. The reservoir's overflow system consists of a 6-inch diameter DI pipe set at an elevation of 1,114 feet. The overflow system runs to the north and connects to the Sherman Reservoir overflow system. The floor elevation of the reservoir is 1,082 feet at the outer edge and 1,082.75 feet at the center. The water level is sensed by a level transducer and reported back to the SCADA system. The reservoir was last repainted in 2003.

Photo 1-7
Kennedy Reservoir

A summary of the reservoir physical data is shown in **Table 1.3**.

Table 1.3
Reservoir Physical Information

Name	Date	Material	Diameter	Overflow Elevation	Floor Elevation	Volume (Floor to Overflow)
Sherman	1973	Concrete	106.0 ft	895.0 ft	877.0 ft	1,035,890 gal
Kennedy	1979	Steel	105.0 ft	1,114.0 ft	1,082.5 ft	2,046,736 gal

DISTRIBUTION SYSTEM

The City's water service area contains approximately 20 miles of water main ranging in size from 2 inches to 16 inches. Approximately one half of the water mains are CI; one third of mains within the service area are 6 inches in diameter, and half of all water mains are 6 inches in diameter or smaller, as shown in **Table 1.4**.

Table 1.4
Watermain Inventory

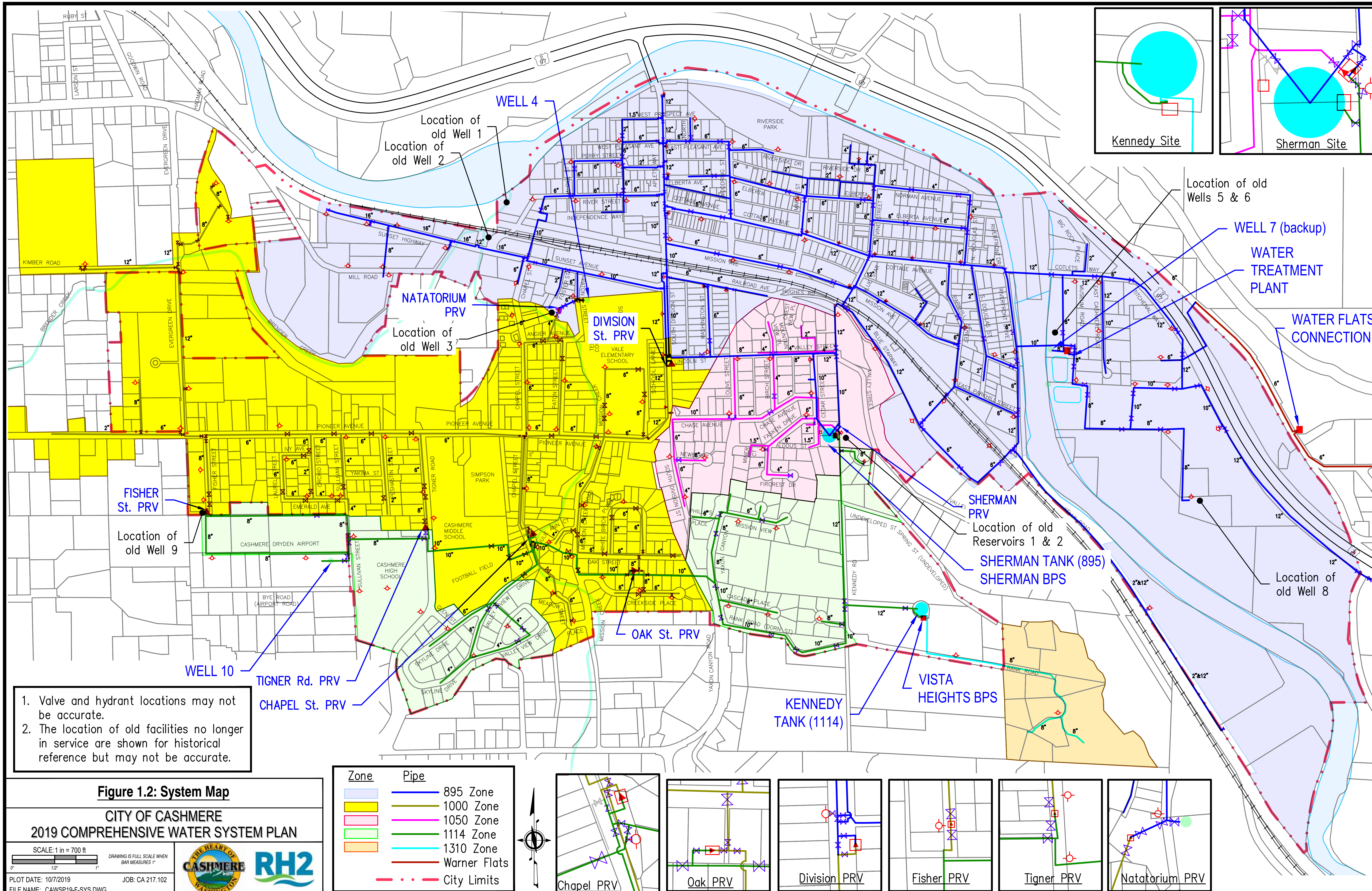
Material	Age (Years)	Pipe Length (ft)							Total Length (ft)
		2 inch	4 inch	6 inch	8 inch	10 inch	12 inch	16 inch	
Cast iron		0	7,010	32,814	7,078	5,086	2,332	0	54,319
	Unknown	0	7,010	32,814	7,078	5,086	2,332	0	54,319
Ductile Iron		0	441	2,631	11,270	4,853	16,966	1,658	37,820
	0-10	0	311	38	2,237	75	11,001	1,658	15,321
	11-20	0	7	0	2,563	0	0	0	2,570
	31-40	0	0	21	2,887	4,778	4,148	0	11,833
	Unknown	0	123	2,573	3,583	0	1,817	0	8,096
Galvanized iron		7,520	0	0	0	0	0	0	7,520
	31-40	46	0	0	0	0	0	0	46
	Unknown	7,474	0	0	0	0	0	0	7,474
PVC		0	0	242	306	0	0	0	548
	0-10	0	0	0	306	0	0	0	306
	Unknown	0	0	242	0	0	0	0	242
Steel		0	0	0	0	1,305	0	0	1,305
	Unknown	0	0	0	0	1,305	0	0	1,305
HDPE		2,825	0	0	0	0	230	0	3,055
	0-10	2,825	0	0	0	0	0	0	2,825
	Unknown	0	0	0	0	0	230	0	230
Total Length (ft)		***10,345***	***7,451***	***35,687***	***18,654***	***11,244***	***19,528***	***1,658***	***104,568***

The water mains in the existing system are comprised of approximately 52-percent CI, 36-percent DI, 8-percent steel, and 4-percent high-density polyethylene/polyvinyl chloride (HDPE/PVC) by length. Nearly 70-percent of the water mains are of unknown age, though likely older than 40 years. All new water main installations are required to use DI water main in accordance with the City's development and construction standards.

Pressure Zones

The City serves customers within an elevation range of approximately 750 to 1,230 feet above sea level. The wide range of elevations requires that the water pressure be increased or reduced to maintain pressures that are safe and sufficient to meet the flow requirements of the system. This is achieved in the City system by dividing the water system into five pressure zones, as shown in **Figure 1.2**. Historically, these pressure zones have been identified as the high, mid, and low pressure zones, with the area designated as the mid pressure zone being physically separated into two isolated zones, each operating at slightly different hydraulic elevations. For this WSP, each of these zones will be referred to by their maximum hydraulic elevation, as described below.

The pressures in the 1114 Zone and the 895 Zone are regulated by reservoir levels, as illustrated in the existing system hydraulic profile in **Figure 1.3**. The 1114 Zone has a maximum hydraulic elevation set by the Kennedy Reservoir overflow and is primarily located south of Oak Street, in the southern region of the city. The service elevations range from approximately 824 feet to 1,031 feet.


WELL 4
Location of old Well 1
Location of old Well 2
NATATORIUM PRV
Location of old Well 3
DIVISION St. PRV
Location of old Wells 5 & 6
WELL 7 (backup)
WATER TREATMENT PLANT
WATER FLATS CONNECTION
FISHER St. PRV
Location of old Well 9
SHERMAN PRV
Location of old Reservoirs 1 & 2
SHERMAN TANK (895)
SHERMAN BPS
Location of old Well 8
WELL 10
TIGNER Rd. PRV
CHAPEL St. PRV
OAK St. PRV
VISTA HEIGHTS BPS
KENNEDY TANK (1114)
Kennedy Site
Sherman Site
1. Valve and hydrant locations may not be accurate.
2. The location of old facilities no longer in service are shown for historical reference but may not be accurate.
Zone
Pipe
895 Zone
1000 Zone
1050 Zone
1114 Zone
1310 Zone
Warner Flats
City Limits
Chapel PRV
Oak PRV
Division PRV
Fisher PRV
Tigner PRV
Natatorium PRV
Figure 1.2: System Map
CITY OF CASHMERE
2019 COMPREHENSIVE WATER SYSTEM PLAN
SCALE: 1 in = 700 ft
DRAWING IS FULL SCALE WHEN BAR MEASURES 1"
PLOT DATE: 10/7/2019
JOB: CA 217.102
FILE NAME: CAWSP19-F-SYS.DWG
RH2

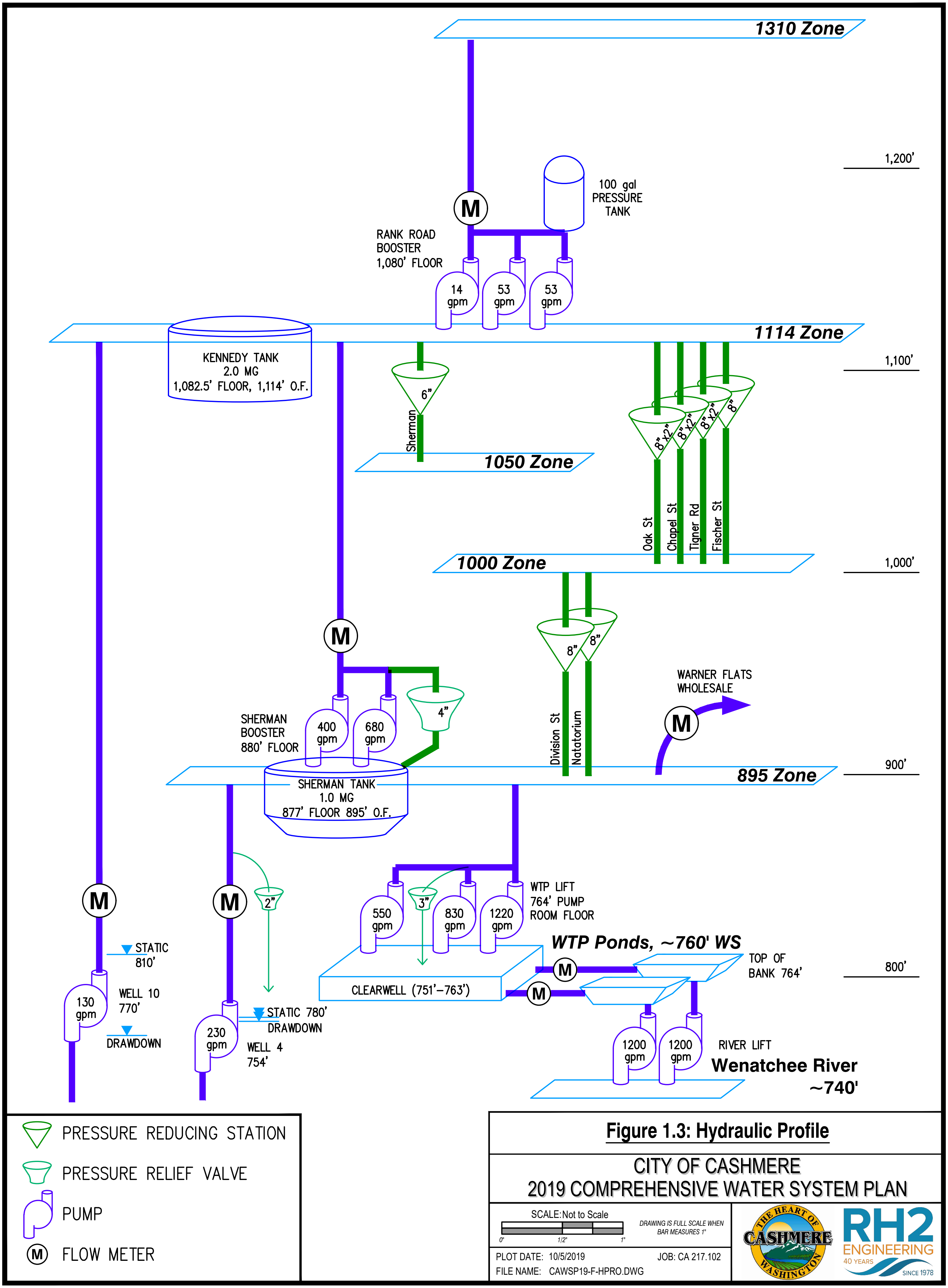


Figure 1.3: Hydraulic Profile

CITY OF CASHMERE
2019 COMPREHENSIVE WATER SYSTEM PLAN

SCALE: Not to Scale

0" 1/2" 1"

DRAWING IS FULL SCALE WHEN BAR MEASURES 1"

PLOT DATE: 10/5/2019 JOB: CA 217.102

FILE NAME: CAWSP19-F-HPRO.DWG

RH2 ENGINEERING 40 YEARS SINCE 1978

Pressures in the 895 Zone are established by the surface water level in the Sherman Reservoir. The 895 Zone encompasses the northern portion of the city, with the majority of the zone lying north of the Burlington Northern Railroad. This zone has a maximum hydraulic elevation of 895 feet and serves customers within an elevation range of approximately 750 feet to 833 feet.

The area historically referred to as the mid pressure zone is comprised of two independent zones which operate at different hydraulic elevations. This area is located between the 1114 and 895 Zones, predominately south of the Burlington Northern Railroad and north of Oak Street. The common boundary of the two zones is located approximately along South Division Street, where the 1000 Zone is located on the west side and the 1050 Zone is located to the east. The 1050 Zone is served with water from the 1114 Zone through a single pressure reducing valve (PRV), which regulates pressures to maintain a maximum hydraulic elevation of 1050 feet within the zone. The pressure reducing station is located adjacent to the Sherman Reservoir. Customers served within this zone are at elevations ranging from approximately 823 feet to 908 feet. The 1000 Zone is served with water from the 1114 Zone through four pressure reducing stations, which regulate pressures to maintain a maximum hydraulic elevation of 1000 feet within the zone. Customers served within this zone are at elevations ranging from approximately 803 feet to 873 feet.

The 1310 Zone is a closed zone supplied by the Vista Heights pump station and serves an elevation range of 1,040 feet to 1,225 feet. Variable frequency drives (VFD) and a 100-gallon pressure tank are used to maintain pressure in the zone.

Pressure Reducing Stations

Pressure reducing stations are connections between adjacent pressure zones that allow water to flow from the higher pressure zone to the lower pressure zone by reducing the pressure of the water as it flows through the station, thereby maintaining a safe range of pressures in the lower zone. A pressure reducing station is a structure which normally contains one or two PRVs, piping, and other appurtenances. The PRV hydraulically varies the flow rate through the valve (up to the flow capacity of the valve) to maintain a constant pressure on the downstream side of the valve for water flowing into the lower pressure zone.

Pressure reducing stations can serve multiple purposes. They can function as an active supply facility by maintaining a continuous supply of water into a lower zone that has no other source of supply, such as a well or reservoir. Pressure reducing stations can also function as standby supply facilities that are normally inactive (no water flowing through them). The operation of this type of station is typically triggered by a drop in water pressure near the downstream side of the station. A typical application of this function is a pressure reducing station that is only needed to supply additional water to a lower zone during a fire flow situation. The pressure setting of the control valve within the station allows it to remain closed during normal system operation and open only during high demand conditions, like fire flows, to provide the additional supply needed.

The City water system has a total of seven pressure reducing stations, as shown in **Figures 1.2** and **1.3**. Four pressure reducing stations actively supply water to the 1000 Zone from the 1114 Zone:

- Fisher Street PRV;
- Tigner Road PRV;
- Chapel Street PRV; and
- Oak Street PRV.

These four stations include an 8-inch PRV, and three are also equipped with a 2-inch low-flow PRV, the exception being Chapel Street. The 1000 Zone can supply the 895 Zone with water through the Natatorium PRV and the Division Street PRV stations in an emergency situation requiring supplemental fire flow. Each of these two stations has an 8-inch PRV, which has a pressure setting that limits the supply of water to the lower zone only during fire flow situations. The Sherman PRV station, which is located near the Sherman Reservoir site, is the sole supply to the 1050 Zone. The station reduces water pressure from the 1114 Zone to provide continuous supply to the 1050 Zone through a single 6-inch PRV. There is also a disabled 8-inch hydraulic valve in the Sherman PRV station which originally served the 895 Zone. It is not known why or when that PRV was disabled. All the City's PRV stations, excluding the Chapel Street PRV, are located in underground vaults and do not have available power. The Chapel Street PRV building used to be a BPS but was converted to a PRV in 1979. A listing of all pressure reducing stations and related data is contained in **Table 1.5**.

Table 1.5
Pressure Reducing Station Physical Information

Station Name	Nearest Street Address	Year Built	Valve Size (inch)		Valve Model	Pressure Zone		Ground Elev. (ft)	Valve Elev. (ft)	Calculated Pressure		Lead Set Point	
			Big	Small		From	To			Inlet (psi)	Outlet (psi)	(ft HGL)	(psi)
Sherman	209 Cedar St	1979	6	none	Cla-Val 90G-01-ABC	1114	1050	894	890	97	69	1,050	69
Fisher Street	320 Fisher St	1979	8	2	Cla-Val 90G-01-ABC	1114	1000	843.5	840	119	69	991	65
Tigner Road	327 Tigner Rd	1979	8	2	Cla-Val 90G-01-ABC	1114	1000	830	826	125	75	995	73
Chapel Street	325 Chapel St	1979	8	none	Cla-Val 90G-01-ABC	1114	1000	825	828	124	74	987	69
Oak Street	110 Oak St	1979	8	2	Cla-Val 90G-01-ABC	1114	1000	835.5	832	122	73	1,000	73
Natatorium	104 Paton St	1979	8	none	Cla-Val 90G-01-ABC	1000	895	804	800	87	41	882	36
Division Street	301 Division St	1979	8	none	Cla-Val 90G-01-ABC	1000	895	807	802	86	40	880	34

Photo 1-8
Chapel Street PRV

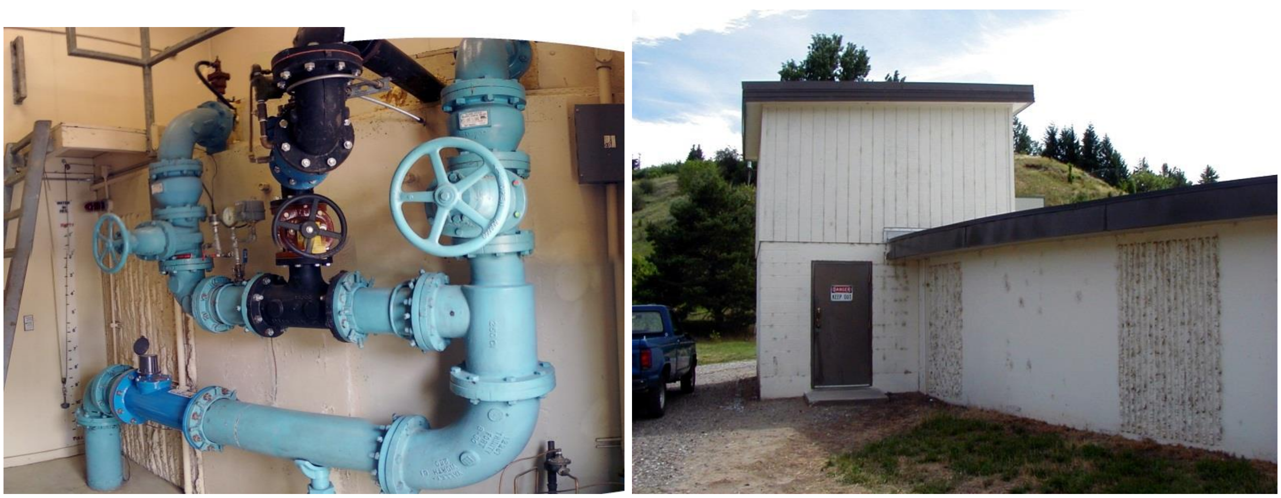
BOOSTER PUMP STATIONS

Sherman Booster Pump Station

A small abandoned pump station currently sits on the west side of the reservoir site. Records imply that this station may have been constructed shortly after the Sherman Reservoir was built, and that it supplied the 1050 Zone. It is not known exactly when or why this station was decommissioned, but it may have occurred when the Kennedy Reservoir and Sherman PRV station were constructed in 1979.

The current Sherman BPS was constructed in 1988 and is comprised of two submersible well-style turbine pumps that are installed on the floor of the Sherman Reservoir, and a pump control building that is attached to the side of the reservoir. The two pumps are mounted on skids and attached to an overhead cable system that allows access to the pumps without draining the reservoir. Each pump is equipped with 6-inch diameter flexible discharge piping. The smaller pump has a capacity of 400 gpm and is powered by a 30 hp motor and reduced voltage starter. The larger pump has a capacity of 680 gpm and is powered by a 60 hp motor with across-the-line starter. The pump control building contains a 6-inch flow meter and 4-inch pressure relief valve. Water is pumped from the Sherman Reservoir (in the 895 Zone) to the Kennedy Reservoir in the 1114 Zone. The pumps are called to operate based on the level of the Kennedy Reservoir. A pressure relief valve dumps water back into the reservoir if discharge pressure gets too high.

Photo 1-9
Sherman Booster Pump Station



Vista Heights (aka Rank Road) Booster Pump Station

The Vista Heights Booster Pump Station was installed in 2008 to provide water to a small number of residential properties situated too high to be adequately served by the 1114 Zone. The station is housed in a stick framed structure adjacent to the Kennedy Reservoir. The station includes three vertical multistage centrifugal pumps, operating on VFD controls set to maintain approximately 100 pounds per square inch (psi). Pump No. 1 has a 2 hp motor and rated at 15 gpm. Pump Nos. 2 and 3 each have a 5 hp motor rated at 53 gpm. This is a package skid-mounted station incorporating a 100-gallon pressure tank to supply water during periods of low pressure. All control systems are local and are included with the package.

Photo 1-10
Vista Heights Booster Pump Station

A summary of the City's pump data is shown in **Table 1.6**.

Table 1.6
Pump Physical Information

Name	Rated Flow (gpm)	Rated Head (ft)	Actual Flow (gpm)	Power (hp)	Speed (rpm)	Original Date	Replace Date	Floor Elev. (ft)	Model
River Lift 1	1,200	27	1,200 *	15	1,750	1989	2018	765	Myers 6VC150M4-43
River Lift 2	1,200	u/k	1,200 *	15	u/k	1989	2018	765	Unknown
WTP 1	400	192	550	30	1,765	1989	n/a	765	Worthington/Dresser 12L-40-3
WTP 2	800	192	830	60	1,765	1989	n/a	765	Worthington/Dresser 12M-75-3
WTP 3	1,200	192	1,220	75	1,775	1989	n/a	765	Worthington/Dresser 12H-135-3
Well 4	310	150	230	15	u/k	1942	2008	804	Peerless
Well 10	350	380	140	50	1,775	1978	2006	832	Byron Jackson 781-S-0063
Sherman 1	400	225	400	30	3,450	1989	2015	880	Unknown
Sherman 2	700	225	680	60	u/k	1989	n/a	880	Ingersoll Rand 8 NKL
Rank Rd 1	15	270	15	2	3,450	2007	n/a	1,080	Grundfos CRE3-12-A-B-A-C
Rank Rd 2	53	227	53	5	3,460	2007	n/a	1,080	Grundfos CRE10-06-A-GJ-A-E-HQQE
Rank Rd 3	53	227	53	5	3,460	2007	n/a	1,080	Grundfos CRE10-06-A-GJ-A-E-HQQE

* River Lift pump flow is estimated. Pumps are not directly metered.

TELEMETRY AND CONTROL

Although historically the system has been controlled manually by balancing water demands with production, there was a brief period between 1980 and 1990 when some telemetry and control systems were operable. However, due to system changes and unreliable equipment, the telemetry system was shelved. System control was then accommodated with to two Gronel System 455-83 pressure-sensing stations at the WTP and Sherman BPS that controlled pumping, with daily manual inspection as a backup. A new cell-based telemetry system was installed in 2015, which reads and logs alarms, reservoir levels, and pump status (on/off). The system is provided by Mission Communications (www.123mc.com) and includes their M110 remote telemetry unit (RTU) at

Well Nos. 4 and 10, and the M800 RTUs at the WTP, Sherman Reservoir, Kennedy Reservoir, and Vista Heights Booster Pump Station.

OPERATIONAL SUMMARY

The 895 Zone is supplied with water from Well No. 4 and from the WTP. The WTP fills the Sherman Reservoir at rates dependent upon the hydraulic needs of the reservoir, as sensed by a level transducer in the reservoir. The WTP pumps are then turned on or off, as needed, to maintain adequate reservoir levels. Well No. 4 is used nearly full time and can only be operated manually to pump water directly to the distribution system of the 895 Zone.

The alkalinity of the influent to the City's Wastewater Treatment Facility (WWTF) is modestly affected by the domestic water source. Ground water sources are typically much higher in alkalinity than surface water sources. Biological nitrification at the WWTF consumes alkalinity and can lower effluent pH without sufficient influent alkalinity. WWTF operators should be made aware of any extended outage of the domestic groundwater sources as this condition may reduce wastewater influent alkalinity and affect the pH of the effluent. The Natatorium PRV and the Division Street PRV stations do not normally supply water to the 895 Zone, but are set to deliver water from the upper 1000 Zone upon a localized drop in pressure within the 895 Zone, such as during a fire flow.

The 1000 Zone is a closed zone (i.e., no storage) which is supplied with water continuously from the 1114 Zone through four PRV stations. Settings in each of the PRVs determine the pressures within the zone and the sequence in which each of the valves opens to supply water to the zone. This sequence is as follows:

1. Oak Street PRV;
2. Tigner Road PRV;
3. Fisher Steet PRV; and
4. Chapel Street PRV.

The 1050 Zone, which is also a closed zone, is supplied with water continuously from the 1114 Zone through the Sherman PRV station. Pressures in this zone are controlled, based on the setting of the PRV.

The 1114 Zone is supplied with water from Well No. 10 and from the Sherman BPS. This pump station supplies the Kennedy Reservoir, with the water level monitored by a level transducer in the tank. Pumps in the Sherman BPS are then turned on or off, as needed, to fill the reservoir and adequately supply the 1114 Zone. Well No. 10 is used seasonally and can only be operated manually to pump water directly to the distribution system of the 1114 Zone.

The 1310 Zone is a closed zone supplied by the Vista Heights BPS. Pumps are cycled on and off based on a local pressure transducer. The pumps are controlled with VFDs to maintain a constant discharge pressure. If the lead pump cannot maintain pressure at full speed, the lag pump is cycled on. The controller periodically tests the discharge pressure and shuts down the lag pump if it is no longer needed. Under periods of very low demands, all pumps shut off and the water is supplied by the pressure tank.

WATER SYSTEM INTERTIES

Water system interties are physical connections between two adjacent water systems. Interties are normally separated by a closed isolation valve or control valve. Emergency supply interties provide water from one system to another during emergencies situations only. An emergency situation may occur when a water system loses its main source of supply or a major transmission main and is unable to provide a sufficient quantity of water to its customers. Normal supply interties provide water from one system to another during non-emergency situations and are typically supplying water at all times.

The City water system does not currently have any interties. The closest public water systems are approximately three or more miles away and are therefore not economically feasible for inter-connection. Smaller nearby private systems have generally been strapped with poor water quantity problems in the past. Thus, if a system intertie were accomplished, it would need to depend on the City water system for additional volume. Because of both historical and present limitations to available water rights and ecological concerns, any intertie with adjacent water systems appears unlikely.

ADJACENT WATER SYSTEMS

The City is situated within a virtual bowl of mountains adjacent to the Wenatchee River. Most of the water systems located close to the City are relatively small Group A and B water systems. A brief description of some nearby community water systems follows; most of these systems are also shown in **Figure 1.4**.

Chelan County Fairgrounds Water System

The adjacent Chelan County Fairgrounds water system is located within the western portion of City's water service area at the intersection of Westcott Drive and Kimber Road. This small system has multiple service connections that serve the Fairgrounds office, event facilities, and temporary recreational vehicle (RV) parking. Water is supplied to the Chelan County Fairground's water system through two groundwater wells. Discussions regarding intertying the Chelan County Fairgrounds water system and the City systems have occurred over the years, but there are no current plans to do so.

Warner Flats Domestic Water Company

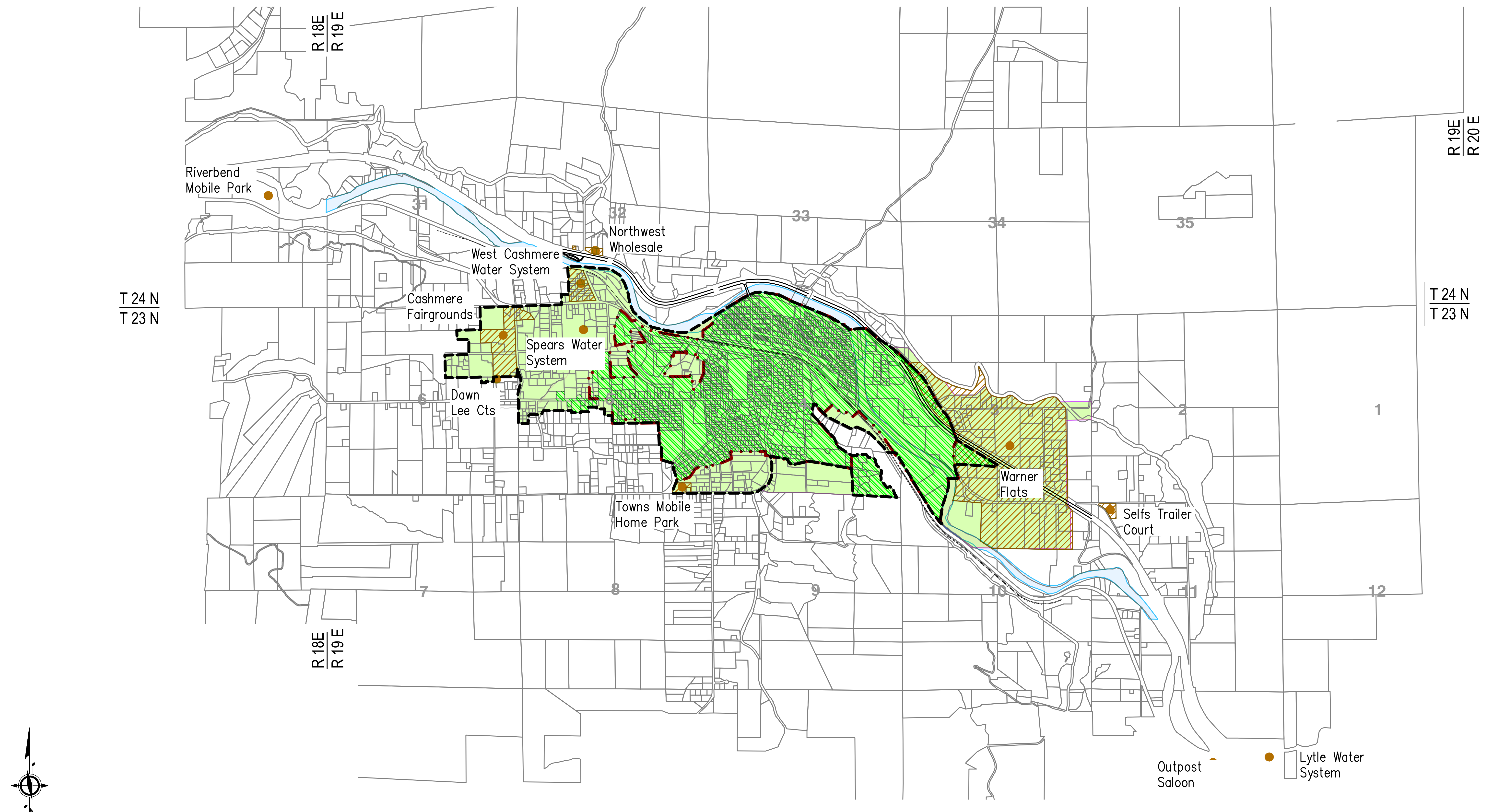
The adjacent Warner Flats Domestic Water Company is located within the eastern portion of City's water service area. The system has 34 single-family residential service connections and serves a population of approximately 100 people. Water is supplied to the Warner Flats Domestic Water Company's system by the City through a wholesale water agreement.

Dryden Water System

The Dryden Water System is owned and operated by the District and lies approximately 5 miles northwest of the City's service area boundary and along the Wenatchee River. This communities' water system currently has 63 service connections and serves a residential population of 157. Water is supplied to the system by three groundwater wells. There are no current plans for interties between this system and the City water system because of its remote location.

Monitor Water System and East Monitor Water Association

The Monitor Water System and East Monitor Water Association serves the community of Monitor and are located approximately 4 miles southeast of the City, along the banks of the Wenatchee River. The systems were converted to be owned, supplied, and run by the District in 2008. Water comes



Service areas shown for adjacent water systems are meant only as a reference and are not guaranteed to be accurate.

(light green)	Existing and Future Water Service Area Future Retail Service Area Water Rights Place of Use
(green hatch)	Existing Retail Service Area
(brown hatch with dot)	Adjacent Water System
(red dash-dot line)	City Limits
(black dashed line)	Urban Growth Boundary

Figure 1.4: Adjacent Water Systems

CITY OF CASHMERE
2019 COMPREHENSIVE WATER SYSTEM PLAN

SCALE: 1 in = 1/2 Mile
0" 1/2" 1"
DRAWING IS FULL SCALE WHEN BAR MEASURES 1"

PLOT DATE: 12/19/2019 JOB: CA 217.102
FILE NAME: CAWSP19-F-ADJ.DWG

from the District via a new transmission main connected at two locations at Easy Street and Sleepy Hollow Road. The water source is the Greater Wenatchee Regional Water System. The water system currently serves a residential population of approximately 60 connections. The East Monitor Water Association infrastructure is still active and has approximately 25 connections, some of which may be transferred over to the District system in the future.

Olalla Canyon Water System

Located northwest of the City, the Olalla Canyon Water System is owned and operated by the District. The water system currently serves approximately 65 residential customers through 26 service connections. A spring with a capacity of 35 gpm supplies the Olalla system with water that has had a history of poor water quality. Because of the Olalla Canyon Water System's remote location from the City, there are no current plans for interties between this system and the City.

Dawn Lee Courts Water System

The Dawn Lee Courts Water System is located northwest of the of the City's service area. The Dawn Lee Courts system serves a residential population of approximately 100 people through 37 service connections. Water is supplied to the system through a groundwater well with a total capacity of 35 gpm. There are no current plans for interties between this system and the City's water system.

Northwest Wholesale

The transient non-community system serves 4 non-residential connections and lies north of the Wenatchee River, just outside of the City's service area. It is served by one groundwater well.

Lytle Water System

The transient non-community system serves 1 non-residential connection and one residential connection with a residential population of 5. It is served by one groundwater well. The system is located on the north side of the Wenatchee River, across from Monitor approximately two miles southeast from the City's limits.

Spears Water System

The transient non-community system is located within the northwest portion of the City's service area and serves 7 non-residential connections with one groundwater well.

Outpost Saloon

The transient non-community system is located within Monitor. There are four connections served by one groundwater well. The system is located two miles southeast of the City.

Riverbend Mobile Park

The community system serves 30 connections with a residential population of 75. It is served by three groundwater wells. The system is located 1.5 miles northwest of the City's service area.

Self's Trailer Court

The transient non-community system serves 15 connections and a residential population of 24 approximately 1 mile southeast of the City's service area. It has one groundwater well.

Town's Mobile Home Park

The community system serves 16 connections and a residential population of 35. The system is located just south of the City limits, but within the City's urban growth boundary. It has one groundwater well. The closest City main is a 4-inch pipe approximately 500 feet to the north.

West Cashmere Water System

This community system serves 25 connections and a residential population of 63 within the northwest part of the City's service area. It is supplied by three groundwater wells.

WATER SERVICE AGREEMENTS

The City provides wholesale water supply to the adjacent Warner Flats Domestic Water Company, which is located northeast of the City, just north of the Highline Irrigation Canal. A copy of the wholesale water supply agreement is contained in **Appendix D**.

2 | LAND USE AND POPULATION

INTRODUCTION

The City of Cashmere's (City) first *Comprehensive Land Use Plan* was completed in 1998 and has been periodically updated, with the most recent amendment having occurred in October 2013. The *Comprehensive Land Use Plan* contained in the City's overall Comprehensive Plan was developed to meet the requirements of the State of Washington's Growth Management Act (GMA). The GMA requires, among other things, consistency between land use and utility plans and their implementation. This chapter demonstrates the compatibility of the Water System Plan (WSP) with other plans, identifies the designated land uses within the existing and future service area, and identifies population projections within the City planning area.

COMPATIBILITY WITH OTHER PLANS

To ensure that the WSP is consistent with the land use policies that guide it and other related plans, the following planning documents were examined:

- Growth Management Act;
- 2017-2037 Chelan County Comprehensive Plan;
- 2019 City of Cashmere Comprehensive Land Use Plan;
- 2018 Wenatchee Regional Water System Water System Plan; and
- Water Resource Inventory Area 45 Watershed Management Plan.

GROWTH MANAGEMENT ACT

The State of Washington's GMA defines four goals relevant to this WSP:

- Growth should be in urban areas;
- There should be consistency between land use and utility plans and their implementation;
- There should be concurrency of growth with public facilities and services; and
- Critical areas should be designated and protected.

URBAN GROWTH AREA

The GMA requires that Chelan County (County) and the City cooperate in designating an Urban Growth Area (UGA). As part of the development of its Comprehensive Land Use Plan and recent amendment processes, a UGA was designated that will accommodate the City's projected population growth and provide resource conservation.

MUNICIPAL WATER LAW

The 2003 Municipal Water Law requires that WSPs be consistent with local plans and regulations. The consistency statement checklist from the County Planning Department included in **Appendix A** documents the determination that this WSP is consistent with County plans and regulations.

CONSISTENCY

The GMA requires planning consistency from several perspectives. First, it requires consistency of plans among jurisdictions. This means that plans and policies of the City and County must be consistent (Revised Code of Washington (RCW) 36.70A.100). The GMA also requires that the different elements within the WSP are internally consistent, and that the implementation of the plan, such as development and zoning regulations, is consistent with the City's Comprehensive Plan (RCW 36.70A.120).

CONCURRENCY

Concurrency means that adequate public facilities and services will be provided at the time that growth occurs. For example, growth should not occur where schools, roads, and other public facilities are overloaded. Concurrency ensures that public dollars are used efficiently, and that quality of life is preserved. To achieve this objective, the GMA directs growth to areas already served, or readily served, by public facilities and services (RCW 36.70A.110). It also requires that when public facilities and services cannot be maintained at an acceptable level of service, the new development should be prohibited (RCW 36.70A.100).

CRITICAL AREAS

The GMA requires that critical areas be classified, designated, and protected. Critical areas include aquifer recharge areas, wetlands, frequently flooded areas, fish and wildlife habitat conservation areas, and geologically hazardous areas. In 2002, the City adopted new critical area provisions in both the WSP and the Cashmere Municipal Code that were developed using "best available science" as required by the GMA. **Appendix C** contains a State Environmental Policy Act (SEPA) checklist that addresses environmental concerns related to this non-project action.

CHELAN COUNTY – COUNTY-WIDE PLANNING POLICIES

The Chelan County Board of Commissioners adopted the Chelan County Comprehensive Plan (Comprehensive Plan) in 2000. Since that time, the Comprehensive Plan has been amended several times with the most recent amendment occurring in December 2017. The County's Comprehensive Plan guides development in unincorporated Chelan County and designates land use in the unincorporated UGAs.

Mandated by the GMA, these policies guide the development of comprehensive land use plans within the County through establishing a county-wide framework for these plans. The City's WSP is consistent with these policies which address the following issues:

- Establishment of UGAs;
- Promotion of contiguous and orderly development, and the provision of urban governmental services to such development;
- Siting of county-wide or state-wide public capital facilities;
- Development of strategies and facilities for county-wide transportation;
- Adoption of parameters for the distribution of affordable housing and the need for affordable housing for all economic segments of the population;
- Joint County and City planning within UGAs and provisions for innovative land use management techniques;

- County-wide economic development and employment;
- Analysis of fiscal impacts;
- Public education and citizen participation; and
- Monitoring, reviewing, and amending the County-wide planning policies.

In 1997, a Memorandum of Understanding (MOU) was signed and set forth between the County and the Cities of Wenatchee, Chelan, Cashmere, Leavenworth and Entiat regarding adoption and implementation of the unincorporated UGA and Land Use Regulations and Development Standards. Land Use regulation includes zoning code; or shoreline master program; City's water, sanitary, and storm water sewer requirements; the Washington SEPA; and regulatory reform regulations. A copy of this MOU is included in **Appendix D**.

CITY OF CASHMERE COMPREHENSIVE LAND USE PLAN

The Land Use Element of the City's Comprehensive Land Use Plan is the City's vision of how growth and development will occur over a 20-year horizon. While the text of the plan sets forth goals and policies for new development, the Land Use Designations Map indicates geographically where certain types of uses are appropriate. The Land Use Designations Map is a blueprint for the development of the community, whereas the zoning code is the regulatory means for implementing it. This map has been reproduced and updated with Land Use Designations and is shown in **Figure 2.1**.

The Land Use Element is the aggregate of all other elements of the City's WSP and articulates many of the same goals and concerns of the GMA. Like the GMA, the Land Use Element seeks to accommodate growth while maintaining the City's residential but rural character and protecting environmentally sensitive areas. It describes the general distribution and location of land uses, considering factors of population density, building density, population growth, social and environmental considerations, and the ability to provide future governmental services. The Land Use Element also contains information related to the location of the City's UGA, with the purpose of establishing a boundary within which urban growth is expected to occur over the next 20 years. Although the authority to establish the location of the UGA is given to the County, the City has the ability and the responsibility to evaluate its growth expectations and the capabilities to serve that growth with utilities and services, and to provide recommendations to the County as it considers the UGA boundaries. The Utilities Element of the plan addresses the concern that this new development will be adequately serviced without compromising existing levels of service, similar to the principle of concurrency defined in the GMA.

GREATER WENATCHEE REGIONAL WATER SYSTEM PLAN

The City's current and future service areas are encompassed by the Greater Wenatchee Regional Water System (GWR) (also known as the Wenatchee Regional Water System, or Regional Water System) service area, specifically the future service area of the Public Utility District No. 1 of Chelan County (District). However, the City's water use is not included in the demand projections for the GWR. Currently, there are no plans to supply water to the City from the GWR.

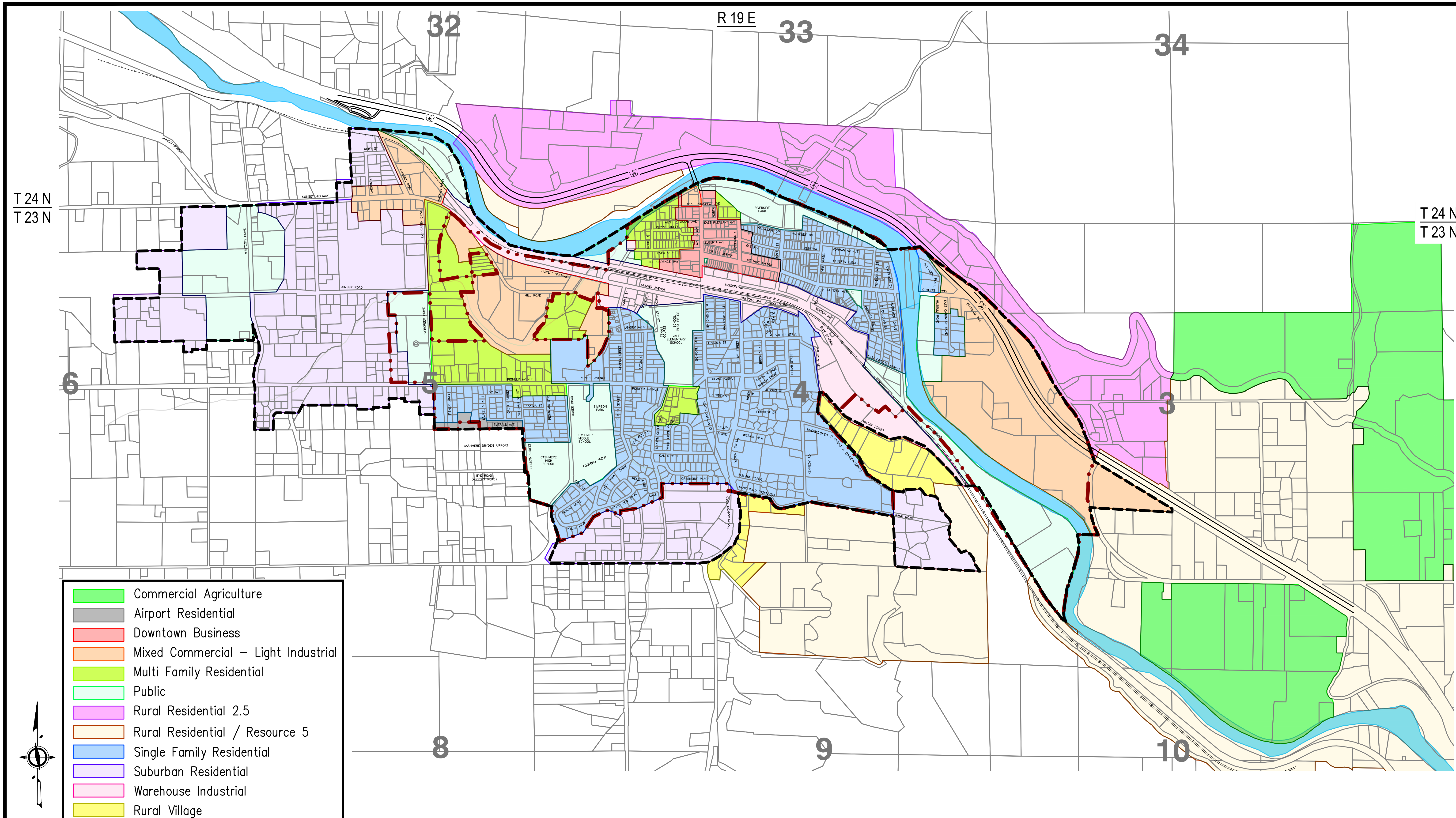


Figure 2.1: Land Use

CITY OF CASHMERE
2019 COMPREHENSIVE WATER SYSTEM PLAN

SCALE: 1 in = 1/4 Mile
DRAWING IS FULL SCALE WHEN BAR MEASURES 1"
PLOT DATE: 12/19/2019
JOB: CA 217.102
FILE NAME: CAWSP19-F-LU.DWG

WATER RESOURSE INVENTORY AREA (WRIA) 45 WENATCHEE WATERSHED MANAGEMENT PLAN

The WRIA 45 Wenatchee Water Management Plan by Golder & Associates developed several recommended actions, none of which requires any specific action by the City other than participation in future planning processes. The plan was written with the provision that existing water rights are not placed under new conditions. An additional water right of four cubic feet per second (cfs) was recommended to be reserved for future growth in existing water service areas within the watershed. The City prepared a request in 2009 for acquisition of this amount in water rights, with a subsequent joint-agency request in 2017. Other goals identified in the WRIA are as follows:

- Encourage the use of separate irrigation systems and maximize existing shares;
- Encourage water use efficiency practices during approval of new developments;
- Encourage private water rights transfers to municipal purveyors when land is annexed; and
- Encourage system-wide conservation practices, such as rate structures, education, and reuse.

A detailed discussion of the 2017 water right request is provided in **Chapter 5**.

LAND USE

CURRENT LAND USE

The City limits encompass an area of approximately 745 acres (ac) or 1.2 square miles. According to the City's Comprehensive Land Use Plan, a substantial portion of the land area within the city limits was developed prior to 1950. The City's UGA encompasses an additional 429 ac outside of the current city limits.

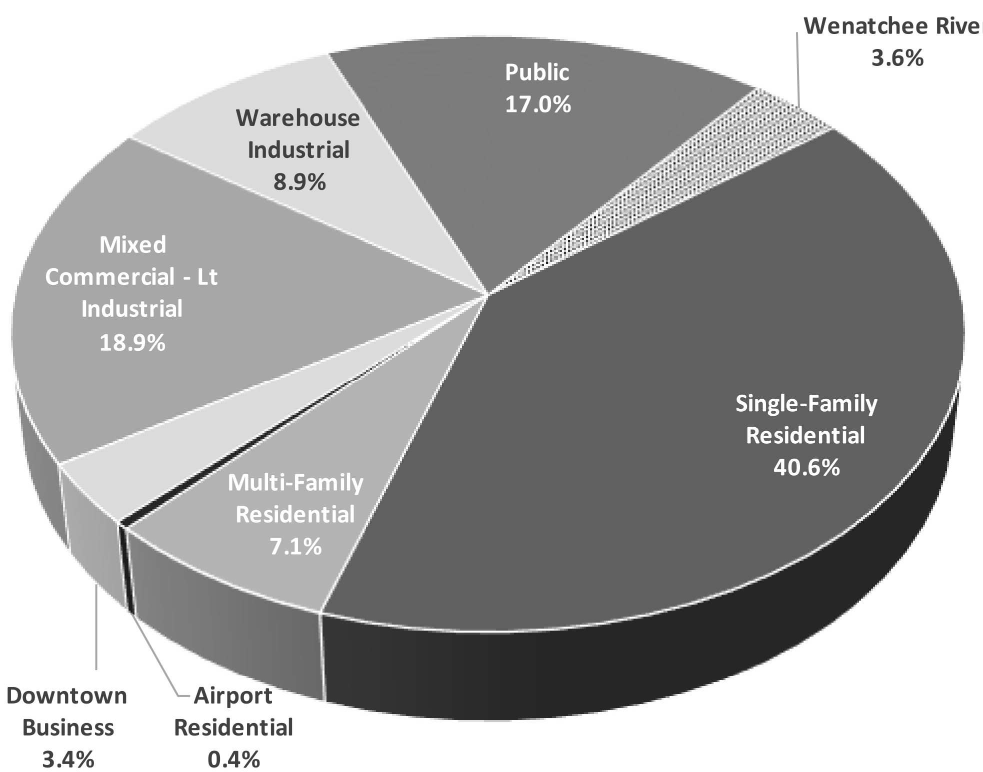
Historically, land use in the City was patterned by the establishment of commercial orchards, and by the construction of the Great Northern Railroad. With the adoption of the City's Comprehensive Land Use Plan, the Land Use Map (**Figure 2.1**) now guides development. Land use outside the UGA is designated by the County.

The area of each land use type is shown in **Table 2.1** and **Chart 2.1**.

Table 2.1
Land Use in Acres

Zoning	City Limits	UGA	Future UGA
Single-Family Residential	302	0	0
Multi-Family Residential	53	30	0
Suburban Residential	0	274	0
Airport Residential	3.2	1	0
Downtown Business	25	0	0
Mixed Commercial - Lt Industrial	141	37	0
Warehouse Industrial	67	21	0
Public	127	66	0
Wenatchee River	27	0	12
Rural Residential 2.5	0	0	57
Rural Residential / Resource 5	0	0	205
Commercial Agriculture	0	0	74
Total	**745**	**429**	**347**

Chart 2.1
Land Use Area Within City Limits



The land use outside the city limits and within the UGA is zoned as primarily suburban residential, rural residential, and agricultural, with some public and industrial.

Within the different land use designations, it is important to consider the allowed density of residential development, as described in the policies of the City's Comprehensive Land Use Plan and as depicted in **Table 2.2**. It should be noted that these are allowed densities and it is probable that not all new developments will occur at the maximum allowed density.

Table 2.2
Dwelling Unit (DU) Summary

Land Use Designation	Planning Density			City Limits		UGA		Future UGA	
	Max	Practical	Units	acres	DU	acres	DU	acres	DU
Single-Family Residential	6	4	DU/acre	302	1,209	0	0	0	0
Multi-Family Residential	15	10	DU/acre	53	529	30	303	0	0
Suburban Residential	4	3	DU/acre	0	0	274	822	0	0
Airport Residential	4	2	DU/acre	3	6	1	1	0	0
Downtown Business	1	1	DU/acre	25	25	0	0	0	0
Mixed Commercial - Lt Industrial	0	0	DU/acre	141	0	37	0	0	0
Warehouse Industrial	0	0	DU/acre	67	0	21	0	0	0
Public	0	0	DU/acre	127	0	66	0	0	0
Wenatchee River	0	0	DU/acre	27	0	0	0	12	0
Rural Residential 2.5	0.4	0.4	DU/acre	0	0	0	0	57	23
Rural Residential / Resource 5	0.2	0.2	DU/acre	0	0	0	0	205	41
Commercial Agriculture	0.1	0.1	DU/acre	0	0	0	0	74	7
Total				**745**	**1,770**	**429**	**1,127**	**347**	**71**

The maximum allowed densities are taken from the County's Comprehensive Land Use Plan and current City land use planning. The allowed residential density does not account for caretaker residences that are allowed in the Commercial and Industrial Districts. Additionally, the policies for the Downtown Business District do not allow for new, detached, single-family residential units. The only residential units allowed are those that currently exist, and any new residential units that are located within a commercial structure that are above street level. **Table 2.2** shows both the maximum theoretical density should the land be developed to its fullest capacity, and a practical density representing an estimation of actual future development. The practical density is reduced to account for rights-of-way, steep slopes, wetlands, and individual preference for larger lots. Based on current growth rates and land use designations, development to full buildout (saturation) won't occur for at least another 50 years.

FUTURE LAND USE

Three small additions to the current UGA occurred in 2013 with a combined total area of 13 ac. There are currently no known proposals to change the zoning within the existing UGA. The City serves wholesale water to the Warner Flats Domestic Water Company east of the city limits, which could one day add approximately 347 ac. The current zoning in this area is Rural Residential 2.5, Rural Residential/Resource 5, and Commercial Agriculture. Based on current zoning, the area has a development potential of approximately 71 DUs.

This WSP assumes that current zoning within the UGA will remain unchanged for projecting future water use. However, as the City limits expand into the UGA, it is very likely that the zoning designations and allowed development density will change. This may result in a larger ultimate number of customers in the City's service area. The City's 2017 application for water rights is intended to support this potential higher density development.

POPULATION

HOUSEHOLD DEMOGRAPHICS

The City is a primarily residential community comprised largely of single-family residences with much of the population commuting to Wenatchee for work. In 2000, the Cashmere Census County Division (CCD) included approximately 69-percent single-family residences, whereas 11-percent were multi-family and 20-percent were mobile homes. A trend toward manufactured housing was observed in prior years, but recent construction appears to be moving back to site-built homes. It is believed that within the city limits, the percentage of single-family homes is higher than in the CCD.

Per the 2010 Census, which provided data for the city limits rather than the CCD, the average household size in the City was 2.74 persons per household, which is slightly higher than the average household size of 2.60 in the County. The County revised the estimate for the City UGA to 2.66 persons per household in 2017. The higher value in the City reflects the higher percentage of single-family homes in the City as compared to the rest of the County.

HISTORICAL AND FUTURE POPULATION

The County has experienced rapid population growth and extensive physical development since 1990. The population of the County increased more than 45-percent from 1990 to 2017, or approximately 1.4-percent per year. The population in the City increased approximately 24-percent during the same period, or approximately 0.7-percent per year. Growth within the City averaged 0.65-percent per year between 1990 and 1998, about half of the prior historical 50-year average of 1.22-percent per year. This decline has been attributed to a deficiency in available water rights to supply domestic water to potential customers. In 1998, the Washington State Department of Ecology (Ecology) approved a transfer of water rights from Blue Star Growers to the City, allowing the City to support additional growth. A rapid increase in population followed, and the City saw a 10-percent growth in its population from 1999 to 2000. The population has since remained relatively steady, most likely due to the housing market downturn starting in 2006. From 2000 to 2017, population growth in the City has been relatively flat, increasing by only 4 percent total, or about 0.2 percent per year.

The total population within the city limits in 2017 was 3,075 people based on the 2018 Office of Financial Management (OFM) Postcensal Estimates of Population. According to County Resolution 2015-112, which was based the 2012 OFM medium growth estimate, the population within the city limits and UGA is estimated to reach approximately 4,172 residents in 2040. This value is the result of a projected diminishing growth rate starting at 0.53 percent annually in 2017 and dropping to 0.28-percent annually by 2040.

Prior to 2013, the City and County Land Use Plans differed in estimating population between the city limits and City UGA. The estimates for 2017 population use the more recent Resolution 2015-112 for the UGA population (3,807 persons) and the OFM Postcensal Estimates for the City population (3,075 persons). This indicates that in 2017, 732 persons (or 19 percent) reside in the UGA, but outside of the City.

Recent population growth estimates for the city limits have not been prepared by either the City or County, as the County estimates are only for the UGA, and the City's last estimate in 2013 was based on growth projections that have since been superseded. Since there is no historical data to support whether the population in either the city limits or UGA grows faster than the other, it will be assumed that the annual growth rate will be the same in both areas.

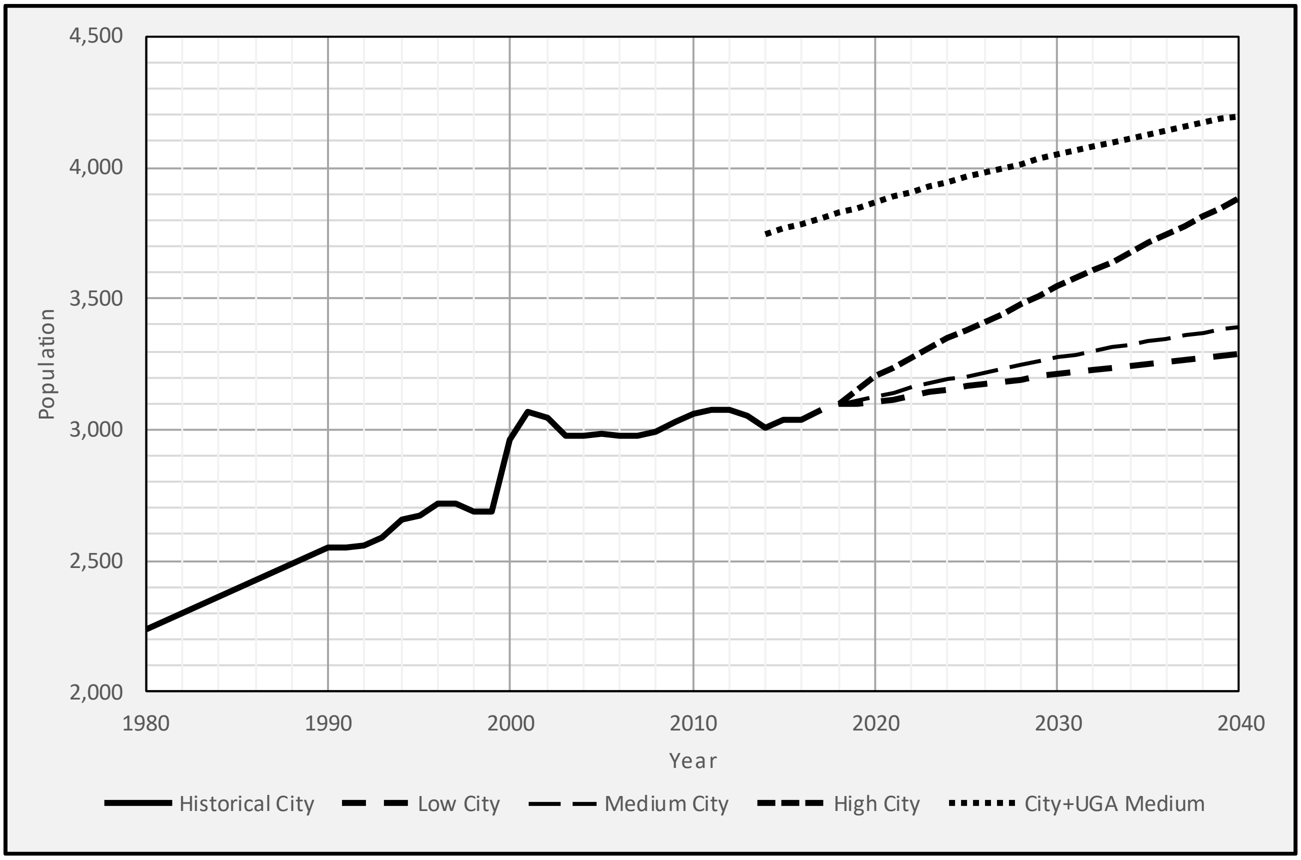
The current UGA contains over 200 single-family residences, two manufactured home courts with a combined total of over 50 homes, and the Chelan County Fairgrounds. The service area east of the UGA currently contains approximately 55 single-family residences, most of which are assumed to be served by the Warner Flats Domestic Water Company water system, which currently obtains its water wholesale from the City.

Table 2.3 shows the City's historical population growth since 1980, and the projected future growth of the City and UGA. The data is illustrated graphically in **Chart 2.2**. The data shown represents both the population within the established city limits for each year, and the projected population based on growth estimates both inside the current city limits and within the UGA.

Table 2.3
Population History and Projections

Year	City Limits			UGA
	Low	Medium	High	Medium
1980	2,240	2,240	2,240	
1990	2,554	2,554	2,554	
2000	2,965	2,965	2,965	
2010	3,063	3,063	3,063	
2018	3,095	3,095	3,095	3,828
2019	3,101	3,111	3,151	3,847
2024	3,154	3,191	3,348	3,946
2029	3,203	3,261	3,513	4,033
2034	3,244	3,324	3,677	4,112
2039	3,281	3,383	3,845	4,185

Chart 2.2
Population History and Projections



Based on the estimated population within the City in 2018 of 3,095 and a density of 2.66 persons per DU, there are approximately 1,164 dwelling units. Comparing to the maximum estimated housing density of 1,770 presented in **Table 2.2**, land within the City limits could theoretically accommodate a 52 percent increase in housing units. In reality, the number is likely significantly lower due to unbuildable slopes, high groundwater areas, protected riparian zones, and owners of large lots who are uninterested in subdividing. The 895 Pressure Zone in particular has very little developable land remaining.

Based on an evaluation of the number of accounts and water sales in each pressure zone, the approximate demographic breakdown for 2018 is estimated as follows:

- 895 Pressure Zone:
    - 1,447 persons;
    - 544 dwelling units (386 single-family, 158 multi-family).
- 1000, 1050, 1114, and 1310 Pressure Zones:
    - 1,648 persons;
    - 620 dwelling units (536 single-family, 84 multi-family).

3 | WATER DEMANDS AND WATER USE EFFICIENCY

INTRODUCTION

A detailed analysis of water system demands is crucial to the planning efforts of a water supplier. A system demand analysis first identifies current demands to determine if the existing water system can effectively provide an adequate quantity of water to its customers under the most crucial conditions, in accordance with federal and state laws. A Future Demand Analysis identifies projected demands to determine how much water will be needed to satisfy future growth of the water system, while continuing to meet federal and state laws.

Demands on the water system determine the size of storage reservoirs, supply facilities, water mains, and treatment facilities. Several different types of demands are analyzed and addressed in this chapter, including average day demand (ADD), maximum day demand (MDD), peak hour demand (PHD), fire flow demand, future demands, and a conservation demand reduction forecast.

The magnitude of water demands is typically based on three main factors: population, weather, and water use classification. Population growth tends to increase the annual demand, whereas high temperatures tend to increase the demand over a short period of time. Population does not solely determine demand, because different population demographics use varying amounts of water. The use varies based on the number of users in each type of customer class, land use density, and irrigation practices. Water conservation efforts will also impact demands and can be used to accommodate a portion of system growth without increasing a system's supply capacity.

The full analysis of water supply and consumption was performed for the City of Cashmere (City) prior to the end of 2018, therefore, 2017 is the last complete year reported in this Water System Plan (WSP). A brief mention of 2018 overall water supply is shown in **Chart 3.1** and **Chart 3.2**.

EXISTING WATER SUPPLY

Water supply, or production, is the total amount of water supplied to the system, as measured by the meters at the water treatment plant and well facilities. Water supply is different from water consumption in that water supply is the recorded amount of water put into the system, and water consumption is the recorded amount of water taken out of the system. The measured amount of water supply of any system is typically larger than the measured amount of water consumption, due to non-metered water use and water loss.

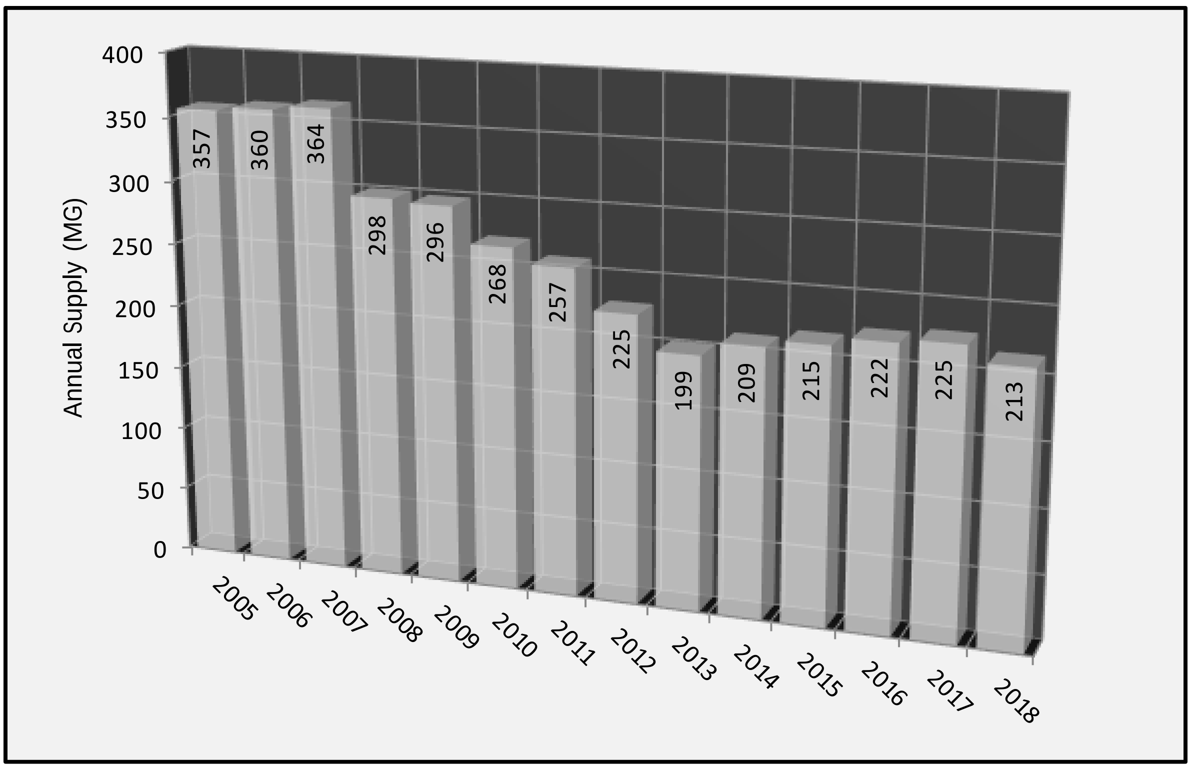
Table 3.1 summarizes the total amount of water supplied to the City’s system from 2011 through 2017. A longer-range summary is shown on **Chart 3.1**. The City had experienced an increasing water supply, or system-wide water demand through 2007, after which time the yearly demand decreased. The primary reason for the initial drop in supply was the reduction in water use by TreeTop in 2008. Supply continued to drop until 2012 for unidentified reasons, but possible contributors were increasing water rates, three years of cool summer weather, and replacement of existing plumbing fixture with low flow units. The reduction from 2012 to 2013 is mostly due to leak repairs, and the increase since 2013 is due primarily to increased demand by Crunch Pak.

Table 3.1
Historical Water Supply

		2011	2012	2013	2014	2015	2016	2017
Average Day		0.70 MGD	0.62 MGD	0.54 MGD	0.57 MGD	0.59 MGD	0.61 MGD	0.62 MGD
		488 gpm	427 gpm	378 gpm	398 gpm	410 gpm	421 gpm	428 gpm
Maximum Day		1.31 MGD	1.45 MGD	1.12 MGD	1.22 MGD	1.30 MGD	1.10 MGD	1.16 MGD
		910 gpm	1,007 gpm	778 gpm	847 gpm	903 gpm	764 gpm	806 gpm
Total for Year		257 MG	225 MG	199 MG	209 MG	215 MG	222 MG	225 MG

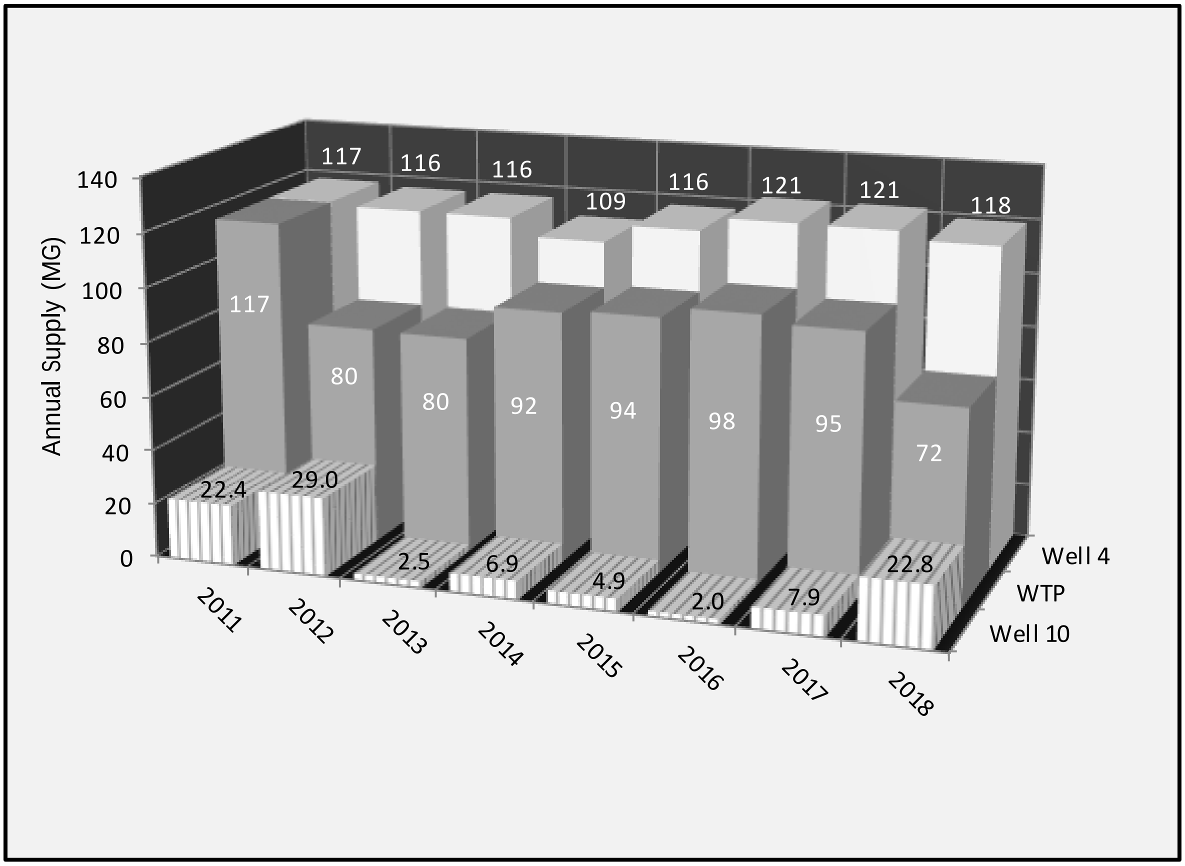
MGD – Million gallons per day
gpm – gallons per minute
MG – million gallons

Chart 3.1
Historical Water Supply (Million Gallons (MG) per Year)



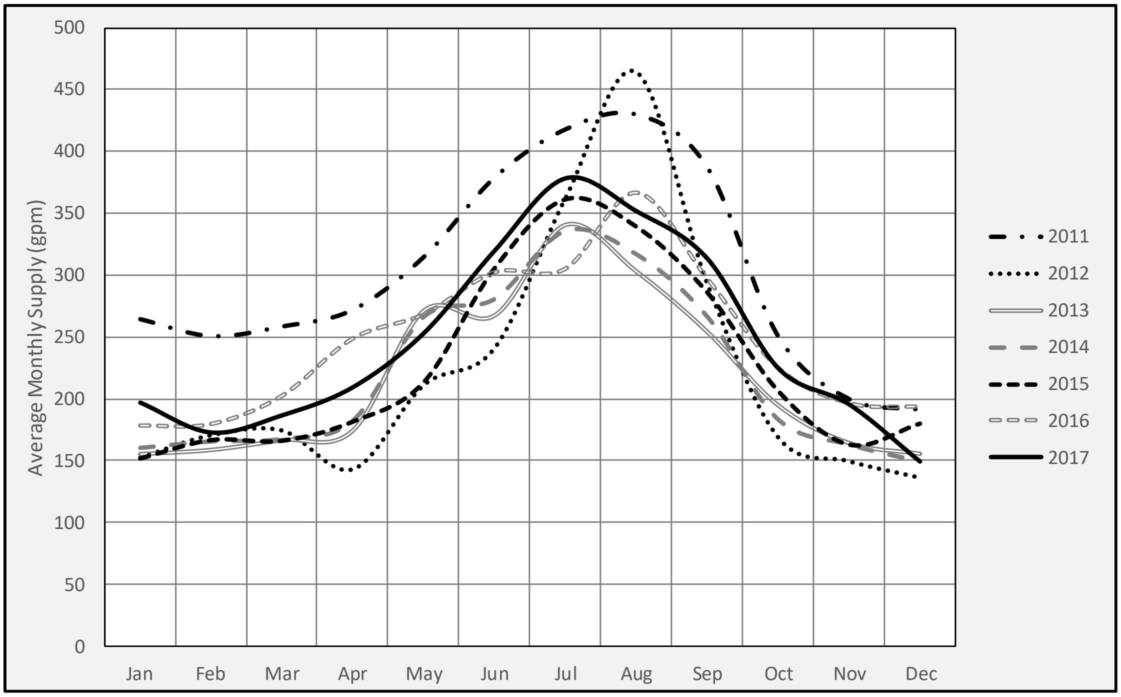
Well No. 4 is run almost continuously, with the water treatment plant (WTP) operated to accommodate demand fluctuations. Well No. 10 is operated only during high demand periods, or when needed to accommodate maintenance activities. The relative annual supply amounts per source are shown on **Chart 3.2**.

Chart 3.2
Annual Supply per Source (MG)



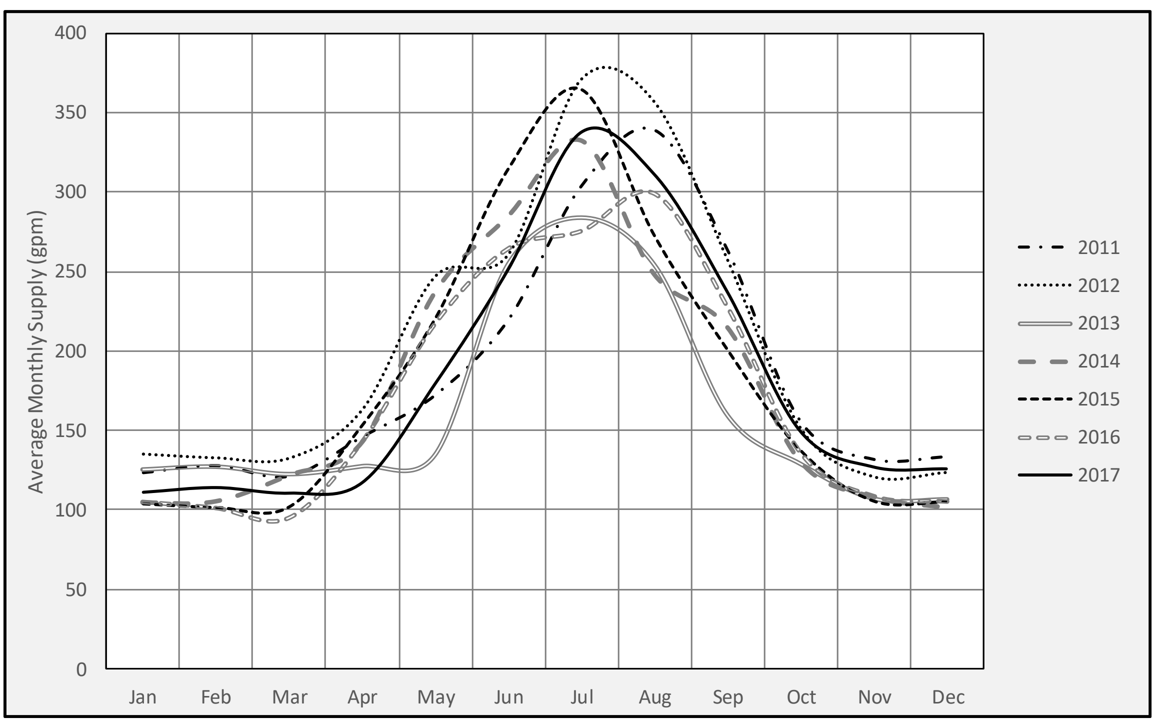
Charts 3.3 and **3.4** show the monthly supply to the low (895 Zone) and upper pressure zones, respectively, for 2011 through 2017. The 895 Zone has a mix of residential, commercial, and industrial uses that contribute to the variable water use patterns. The upper zones are primarily residential areas that contain schools, which results in a relatively consistent pattern from year to year.

Chart 3.3
895 Pressure Zone Monthly Supply



gpm = gallons per minute

Chart 3.4
1000, 1050, 1114, and 1310 Pressure Zones Monthly Supply



An alternate view is comparing monthly to annual supply as a percentage of total, as shown on **Chart 3.5**.

Chart 3.5
Monthly Supply as a Percentage of Annual Supply (3-Year Average)

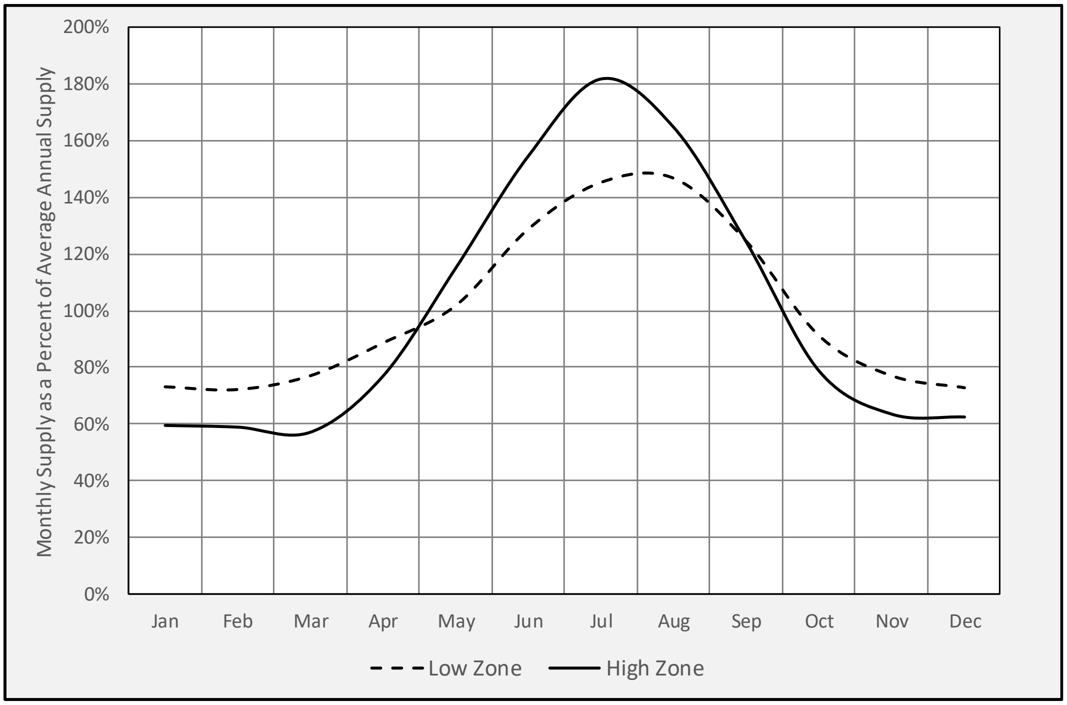
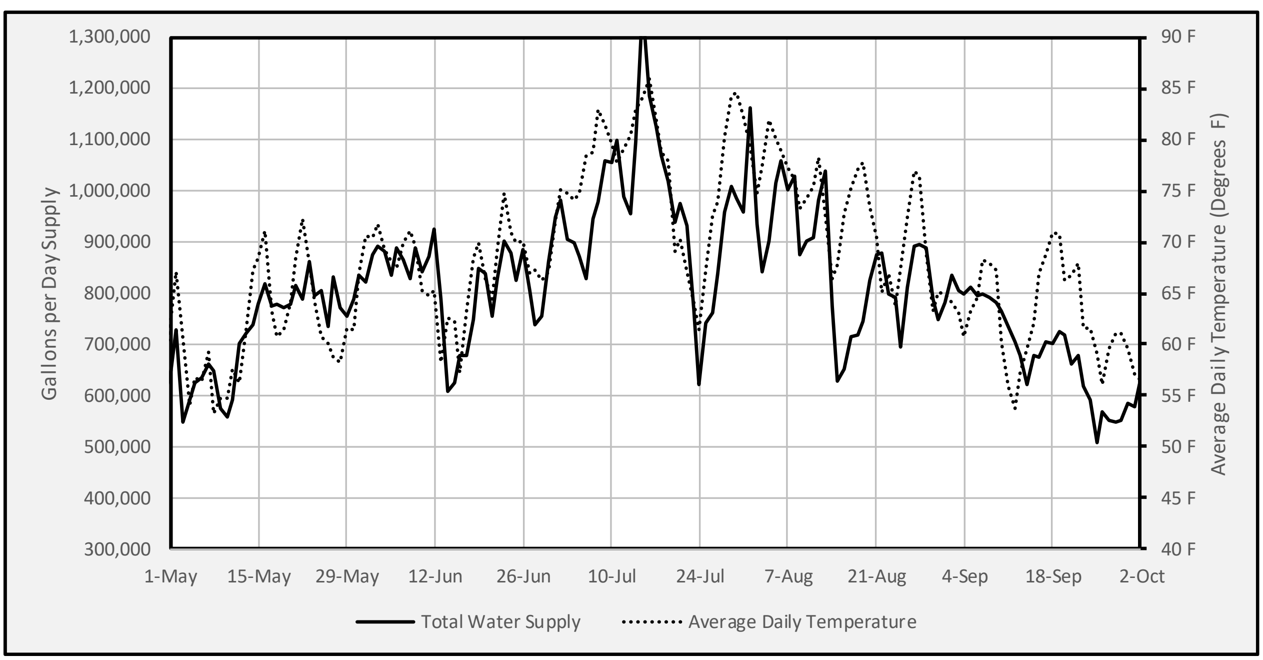


Chart 3.6 shows a clear correlation between water supply and the average daily temperature during the irrigation season for a sample year.

Chart 3.6
Water Supply Vs. Average Daily Temperature (2017 Data)



EXISTING WATER USE

WATER USE CLASSIFICATIONS

In 2017, the City provided water service to an average of 1,121 customer accounts. The City has divided water customers into six classes for billing purposes, as shown in **Table 3.2**. Public accounts are primarily for the City and include park and landscape irrigation. Schools are included in the commercial category. Wholesale is water to Warner Flats Domestic Water Company. The demand analysis that follows will report on the water use patterns of these six user groups.

CUSTOMER CONSUMPTION

Water consumption is the amount of water used by all customers of the system, as measured by individual customer meters. **Table 3.2** shows the historical average number of connections per customer class. An estimate for the number of multi-family dwelling units (DUs) is included based on an actual count in 2017, and estimated for 2011 through 2016 based on winter consumption as described later in this chapter. This estimation has been done to be consistent with the Washington State Department of Health (DOH) method of counting individual multi-family DUs as separate connections, even if multiple DUs are served by a single meter.

Table 3.2
Number of Service Connections

	2011	2012	2013	2014	2015	2016	2017
Single Family	837	893	894	902	912	917	919
Multi Family	24	24	24	24	31	32	32
Public	30	35	34	38	37	41	41
Commercial	106	123	124	123	128	128	126
Industrial	3	3	3	3	3	2	2
Wholesale	1	1	1	1	1	1	1
Total	***1,001***	***1,079***	***1,080***	***1,091***	***1,112***	***1,121***	***1,121***
Multi Family DU (1)	224	234	234	224	224	252	243
Total using MF DU	***1,201***	***1,289***	***1,290***	***1,291***	***1,305***	***1,341***	***1,332***

(1) 2011-2016 are estimated from consumption. No physical count performed.

Table 3.3 shows the average annual consumption as tabulated by the customer meter records. Industrial use has been steadily increasing primarily due to Crunch Pak's increased production.

Table 3.3
Annual Consumption (MG/Year)

	2011	2012	2013	2014	2015	2016	2017
Single Family	85.6	95.7	91.5	99.4	98.6	90.0	90.5
Multi Family	10.9	12.4	11.9	11.3	11.4	12.5	12.4
Public	6.5	8.6	8.0	10.3	9.2	8.6	9.7
Commercial	37.4	36.9	36.0	37.5	36.6	38.8	43.2
Industrial	19.5	22.9	28.6	31.3	37.2	39.7	42.1
Wholesale	2.1	1.8	2.5	3.2	2.7	2.6	1.6
Total	**162**	**178**	**179**	**193**	**196**	**192**	**199**

Consumption for Warner Flats Domestic Water Company in 2011 is estimated due to lack of meter records.

Table 3.4 is the result of dividing the annual consumption shown in **Table 3.3** by the number of connections shown in **Table 3.2**. While limited information can be obtained from this data, it is presented for consistency with prior WSPs.

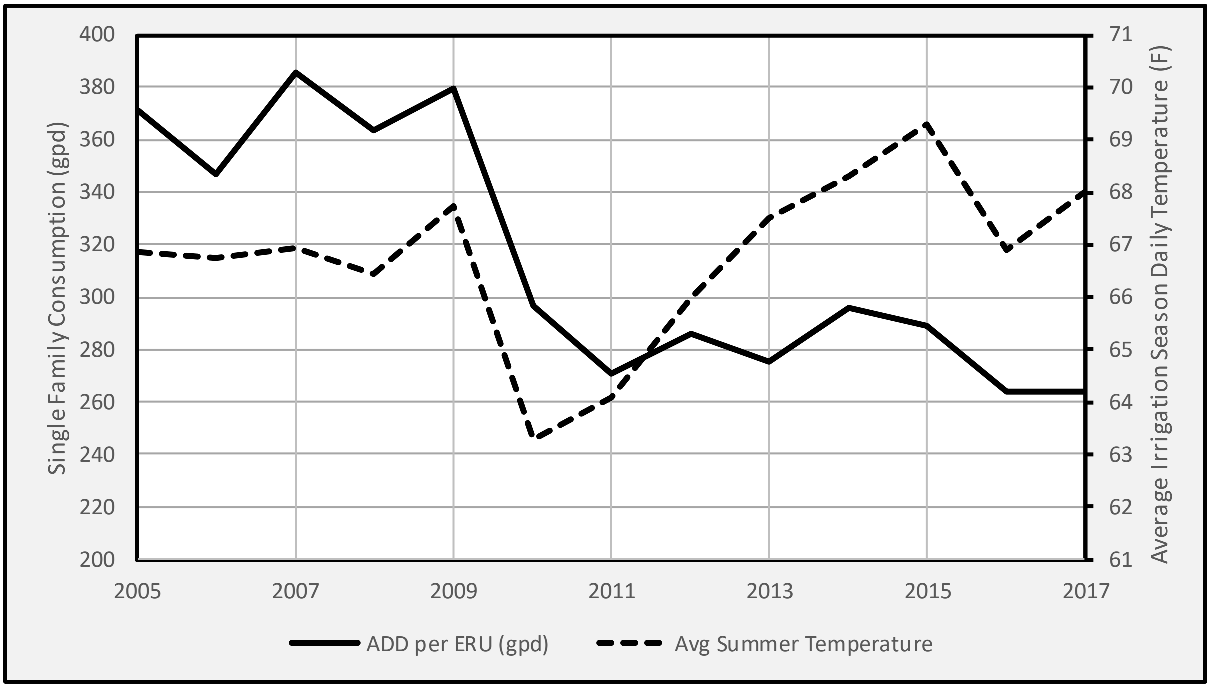
Table 3.4
Average Annual Consumption per Connection (in gpd)

	2011	2012	2013	2014	2015	2016	2017
Single Family	280	294	281	302	296	269	270
Multi Family (Accounts)	1,250	1,416	1,361	1,286	1,010	1,067	1,058
Multi Family (Units)	134	145	140	138	140	135	139
Public	591	676	647	741	682	578	645
Commercial	967	821	796	835	784	830	939
Industrial	17,843	20,868	26,147	28,587	33,937	54,435	57,684
Wholesale	5,733	4,795	6,767	8,748	7,293	7,178	4,348

gpd = gallons per day

At first glance, the consumption per single-family residence appears inconsistent over the last 7 years. **Chart 3.7** shows a comparison of single-family water use to average daily temperatures during the irrigation season of May through September.

Chart 3.7
Single-Family Consumption vs. Summer Temperature



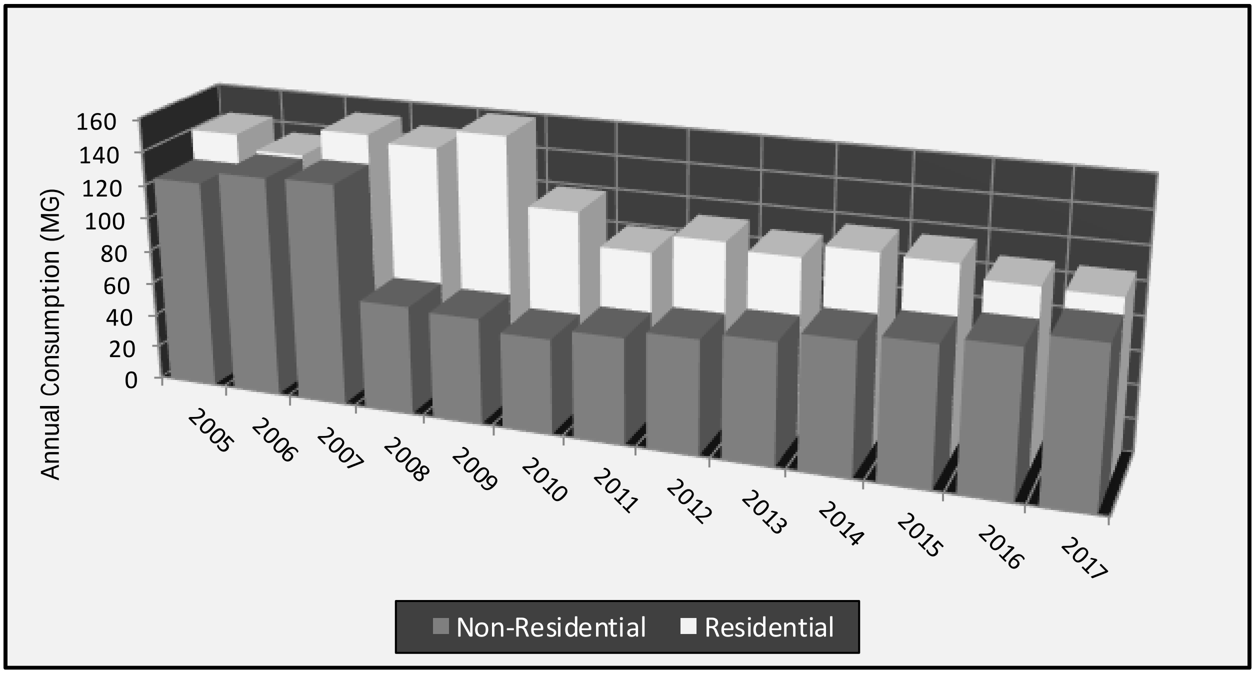
There appears to be a substantial correlation between single-family water use and temperature. Consumption in the year 2013 does not seem to follow the temperature pattern, but that year had unusually high precipitation, which likely reduced the need for landscape irrigation. In 2015, the temperature was hot and the area had low precipitation. It is interesting to note that the drop-in consumption in 2010, possibly due to the unusually cool weather that year, has not increased even as the temperature has. A specific reason has not been identified, but may be due in part to the City's water rates, which increased by about 15-percent from 2011 to 2013.

Between 2011 and 2017, the following patterns were observed.

- Single-family residential customers used an average of approximately 285 gpd per connection.
- Multi-family customers use an average of approximately 1,200 gpd per connection, or 140 gpd per DU.
- Commercial customers used an average of 910 gpd per connection.
- Industrial use has tripled from 18,000 gpd to 58,000 gpd per connection.

A graphical comparison of residential to non-residential consumption since 2005 is shown on **Chart 3.8**. The large drop in non-residential use in 2008 was due to TreeTop shutting down. The subsequent increase is primarily due to Crunch Pak's growth. Residential and non-residential consumption is currently nearly equal. The reduction in residential consumption in 2010 is assumed to be due to the unusually cool summer and higher than normal precipitation that year. It is also possible that some consumption records prior to 2010 may have been incorrect with some wastewater usage inadvertently included in domestic water summaries, but a review of those prior records to check this possibility has not been performed.

Chart 3.8
Historical Consumption (MG per year)



Largest Water Users

Table 3.5 shows the largest water users for 2015 through 2017 and their total amount of metered consumption for the year. The total water consumption of these 10 water accounts represents approximately 40-percent of the system's total consumption. The list of accounts in the table consists of multi-family, public, commercial and industrial customer classes, and includes agricultural companies, school facilities, and a nursing home. Prior to 2008, TreeTop alone used approximately 75 MG per year.

Table 3.5
Largest Water Users (MG)

Customer	2015	2016	2017
Crunch Pak	38,733,000	41,742,000	44,366,000
Blue Star Growers	9,504,000	11,445,000	12,335,000
City of Cashmere	9,226,000	8,647,000	9,654,000
Cashmere Convelescent	5,951,000	6,014,000	9,417,000
Warner Flats	2,662,000	2,620,000	1,587,000
Cashmere School District	1,831,000	1,806,000	1,944,000
Cashmere Park Apts	1,225,000	1,167,000	1,459,000
303 Independence Way (Apts)	1,012,000	1,490,000	1,441,000
Wenatchee Housing Authority	1,080,000	1,035,000	1,011,000
Epledalen Assisted Living	962,000	1,050,000	1,223,000
Total	***71,224,000***	***75,966,000***	***83,214,000***

NON-REVENUE CONSUMPTION

Water is used throughout the City for many authorized purposes that do not generate revenue. Water used for fire suppression, water main flushing, treatment plant flushing, irrigation of City facilities, or other authorized uses is classified as non-revenue water consumption.

DISTRIBUTION SYSTEM LEAKAGE

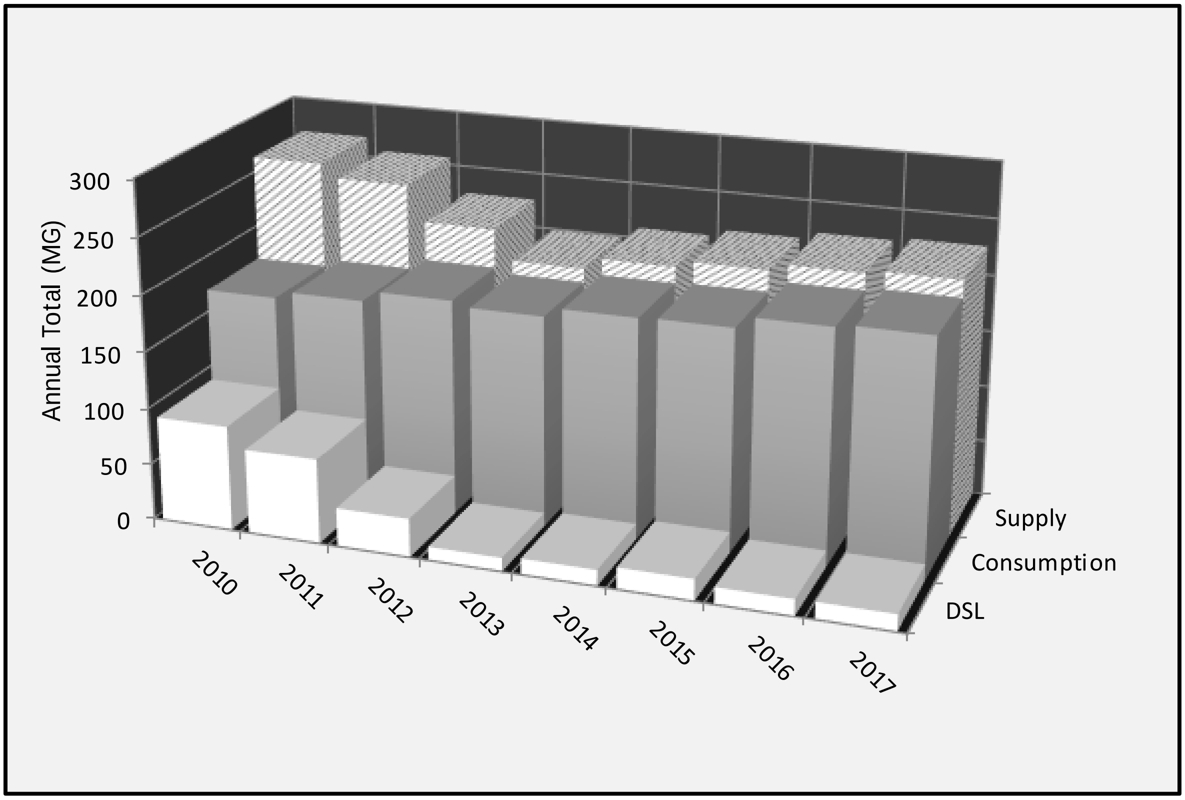
The difference between the amount of water supply and authorized water consumption is the amount of distribution system leakage (DSL). DSL is water that is supplied to the system but is not recorded as it leaves the system. There are many sources of DSL in a typical water system including: physical leakage, inaccurate supply metering, inaccurate customer metering, unrecorded fire hydrant usage, unrecorded water main flushing, illegal water use, and overflowing of reservoirs.

From at least 2005 to 2011, the amount of DSL remained relatively consistent at approximately 0.19 MGD to 0.25 MGD, or approximately one quarter of water produced by the City. A large leak was discovered and repaired in 2012, with a dramatic subsequent reduction of DSL to approximately 0.04 MGD, or 7-percent of water produced. These values are summarized in **Table 3.6** and **Chart 3.9**. The row titled "Unmetered" includes estimates for authorized use such as firefighting, flushing of dead-end mains, and construction flushing.

Table 3.6
Distribution System Leakage

	2011	2012	2013	2014	2015	2016	2017
Supply (MG)	256.5	225.2	198.9	209.3	215.4	221.7	224.8
Sales (MG)	162.1	178.7	178.6	192.9	195.7	192.7	199.4
Unmetered (MG)	19.4	12.3	8.2	2.1	0.5	14.0	10.0
DSL (MG)	75.1	34.2	12.1	14.2	19.1	15.0	15.4
Percentage	29.3%	15.2%	6.1%	6.8%	8.9%	6.8%	6.9%
3-Year Average	29.2%	26.4%	16.8%	9.4%	7.3%	7.5%	7.5%

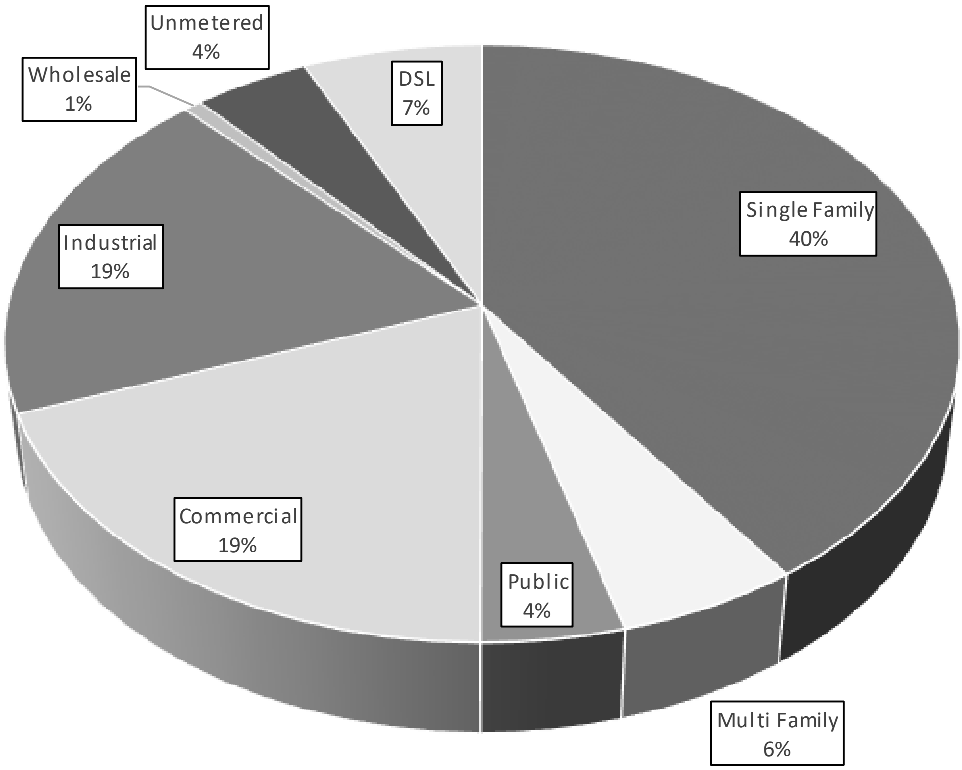
Chart 3.9
Distribution System Leakage



The DSL values presented differ slightly from those submitted in prior Water Use Efficiency reports due to errors found in the customer sales records during preparation of this WSP.

Chart 3.10 shows water consumption by customer class compared to total DSL in 2017.

Chart 3.10
Consumption and DSL (2017)



For the analyses in this WSP, DSL was distributed between the 895 Zone and the upper pressure zones by comparing zone supply to consumption. This tabulation results in an estimated distribution of one third of DSL in the 895 Zone and two thirds in the upper zones.

EQUIVALENT RESIDENTIAL UNITS

The demand of each customer class can be expressed in terms of Equivalent Residential Units (ERUs) for demand forecasting and planning purposes. One ERU is equivalent to the amount of water used by an average single-family residence. The number of ERUs represented by the demand of the other customer classes is determined from the total demand of the customer class and the unit demand per ERU from the single-family residential demand data. To develop ERU consumption values, the sales for the single-family customer class served by 5/8-inch and 1-inch meters is divided by the number of accounts. The resulting tabulation is shown in **Table 3.7**.

Table 3.7
Annual Consumption per ERU

	2011	2012	2013	2014	2015	2016	2017
Annual (gpd)	220,307	248,052	238,867	259,453	255,775	234,918	235,475
Winter (gpd)	116,241	124,544	126,438	127,044	120,599	120,771	120,830
Max Month (gpd)	492,499	553,713	548,573	556,427	527,523	474,655	488,289
No. of Accounts	814	867	867	876	886	891	893
ERU_{ADD} (gpd)	271	286	276	296	289	264	264
ERU_{WDD} (gpd)	143	144	146	145	136	136	135
ERU_{MMD} (gpd)	605	639	633	635	595	533	547
MDD/MMD Ratio	1.18	1.21	1.25	1.27	1.25	1.15	1.13
ERU_{MDD} (gpd)	716	770	789	806	741	611	615

The values shown in **Table 3.5.7** are defined as follows:

- Annual: Average daily consumption for the year. Total consumption divided by 365.
- Winter: Average daily consumption from November through April. This is a good representation of year-round indoor water use.
- Max Month: The highest water consumption month for that year, typically July or August.
- No. of Accounts: The total number of 5/8-inch and 1-inch single family connections.
- ERU_{ADD}: The average day consumption per ERU.
- ERU_{WDD}: The average winter day consumption (indoor use) per ERU.
- ERU_{MMD}: The maximum month consumption per ERU.
- MDD/MMD Ratio: The value obtained from dividing the maximum day supply by the maximum month supply. Consumption data is only available per month, so this ratio is used to estimate maximum day consumption.
- ERU_{MDD}: The estimated maximum day consumption per ERU.

For future demand projections, the average for ERU_{ADD} and ERU_{WDD} will be used, and the maximum value for ERU_{MDD} for the last 7 years. Though ERU_{MDD} for recent years has been significantly lower, another hot and dry year could again produce high demands. These values are shown in **Table 3.8**.

Table 3.8
Consumption per ERU

ERU_{ADD} (gpd)	278
ERU_{WDD} (gpd)	138
ERU_{MDD} (gpd)	806

This consumption rate is slightly higher than single-family residential demands in large neighboring water systems due to the use of City water for landscape irrigation, rather than water provided by irrigation districts. Multi-family consumption per DU averages approximately 110 gpd in the winter, 140 gpd annually, and 220 gpd in the summer.

Table 3.9 presents the computed number of ERUs for each customer class broken out by pressure zone. DSL is tabulated as a separate consumption class with ERUs assigned accordingly.

Table 3.9
ERU Tabulation

	2015		2016		2017	
895 Zone	**gpd**	**ERU**	**gpd**	**ERU**	**gpd**	**ERU**
Single Family	102,124	368	90,610	327	93,994	339
Multi Family	19,118	69	21,494	78	20,524	74
Public	8,062	30	8,682	32	11,602	42
Commercial	76,349	275	81,919	295	83,136	300
Industrial	101,811	367	108,573	391	115,368	416
Wholesale	7,293	27	7,158	26	4,348	16
Unmetered	685	3	19,178	70	13,699	50
DSL	11,985	44	19,061	69	11,928	43
Subtotal	***327,427***	***1,183***	***356,675***	***1,288***	***354,599***	***1,280***
1000, 1050, 1114 Zones						
Single Family	167,029	602	154,120	555	152,736	550
Multi Family	12,203	44	12,561	46	13,330	48
Public	17,166	62	14,945	54	14,847	54
Commercial	24,012	87	23,980	87	35,155	127
Unmetered	685	3	19,178	70	13,699	50
DSL	40,468	146	23,193	84	30,280	110
Subtotal	***261,563***	***944***	***247,978***	***896***	***260,047***	***939***
1310 Zone						
Single Family	1,054	4	1,072	4	1,318	5
Total	***590,044***	***2,131***	***605,724***	***2,188***	***615,964***	***2,224***

The average demand per ERU of 278 gpd will be used later in this WSP to forecast ERUs in future years, based on estimated future demands. This demand per ERU value will also be used to determine the capacity of the existing system.

WATER USE PATTERNS

Average Day Demand

ADD is the total amount of water delivered to a system in a year, divided by the number of days in the year. The ADD is determined from the system's historical water use data, and can be used to project future demand within the system. ADD data is typically used to determine standby storage requirements for water systems. For this analysis, water production records from the City's sources were reviewed to determine the system's ADD. The system's ADD from 2010 through 2017 is shown in **Table 3.10**.

Table 3.10
Average Day Supply and Consumption

	2010	2011	2012	2013	2014	2015	2016	2017
Supply (MGD)	0.73	0.70	0.62	0.54	0.57	0.59	0.61	0.62
Supply (gpm)	510	488	427	378	398	410	421	428
Consumption (MGD)	0.48	0.50	0.52	0.51	0.53	0.54	0.57	0.57
Consumption (gpm)	333	345	363	355	371	373	393	398

Irrigation

The difference between ERU_{MDD} and ERU_{WDD} is primarily landscape irrigation. Since 2011, that difference has ranged from 400 gpd to 500 gpd. Assuming that average irrigation is 36 inches of water applied per year, this would translate to a typical irrigated yard size of 3,000 square feet. The City averages approximately 6 MG of water use per year for irrigation of parks and landscape islands, with approximately 60,000 gallons on maximum day. A few businesses have irrigation accounts which total approximately 0.7 MG per year, or approximately 7,000 gallons on maximum day.

Total irrigation demand is estimated to be 45 MG per year and 450,000 gallons on maximum day. These values are approximately 23-percent of annual consumption and 42-percent of maximum day consumption.

Maximum Day Demand

MDD is the maximum amount of water used throughout the system during an average 24-hour time period of a given year. MDD typically happens on a hot summer day when lawn watering is occurring throughout much of the system. There are no large dedicated irrigation systems within the City’s service area, apart from some private wells and the Pioneer Ditch used by the cemetery; therefore, most customers use domestic water for landscape irrigation. In accordance with WAC 246-290-230 - Distribution Systems, the distribution system must provide fire flow at a minimum pressure of 20 pounds per square inch (psi) during MDD conditions. Supply facilities are typically designed to supply water at a rate that is equal to or greater than the system’s MDD.

Daily water production records of flow meters and reservoir levels were reviewed to determine the system’s MDD. The City’s MDD over the last 5 years occurred on July 9, 2015, with a total supply of 1.3 MG (or 903 gpm), when temperature in the area reached as high as 102 °F. Maximum day supply and consumption for the last 7 years is shown in **Table 3.11**. Though the City did have higher maximum demand days prior to 2013, these were partly due to the high DSL from leakage that has since been remedied.

Table 3.11
Maximum Day Supply and Consumption

	2010	2011	2012	2013	2014	2015	2016	2017
Supply (MGD)	1.40	1.28	1.52	1.10	1.16	**1.30**	1.11	1.16
Supply (gpm)	976	889	1056	764	806	**903**	771	806
Consumption (MGD)	1.15	1.07	1.43	1.07	1.12	1.25	1.07	1.12
Consumption (gpm)	798	746	992	741	778	866	743	776

Peak Hour Demand

Peak Hour Demand (PHD) is the maximum amount of water used throughout the system, excluding fire flow, during a one-hour time period of a given year. In accordance with WAC 246-290-230 - Distribution Systems, new public water systems or additions to existing systems must be designed to provide domestic water at a minimum pressure of 30 psi to the customer meter during PHD conditions. Equalizing storage requirements are typically based on PHD data.

The PHD, like the MDD, is typically determined from the combined flow of water into the system from all supply sources and reservoirs. Real time reservoir level data became available in 2016 with the installation of a new supervisory control and data acquisition (SCADA) system. Each of the three maximum days of 2016 and 2017 were used to develop diurnal curves and calculate actual PHD. These curves are found in **Chapter 6**.

A number of ratios were calculated to assist with water supply projections. The ratios are summarized in **Table 3.12**. Over the last 4 years, the overall maximum supply averaged approximately 2.2 times the average supply. The 895 Zone has lower peaking ratios because over half of the consumption is from industrial and commercial customers, which have a more stable daily water use pattern compared to residential customers. The upper pressure zones have predominantly residential customers, hence the higher peaks.

Table 3.12
Supply Ratios

Ratio	Low Zone	High Zones	Overall
MMD ÷ ADD	1.55	2.00	1.76
MDD ÷ MMD	1.20	1.35	1.25
MDD ÷ ADD	1.86	2.70	2.20
PHD ÷ MDD	1.42	1.90	1.65

MMD = Maximum Month Demand

For comparison, the City’s 2012 WSP presented two PHD ÷ MDD multiplier options. The DOH Design Manual method produced a ratio value of 1.65, while a comparison to the nearby East Wenatchee Water District resulted in a value of 2.5.

A summary of PHD using the supply ratios in **Table 3.12** is shown on **Table 3.13**. These values include DSL.

Table 3.13
Peak Hour Demand

	2010	2011	2012	2013	2014	2015	2016	2017
Low Zone								
PHD ÷ MDD	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
MDD (gpm)	607	528	556	396	458	410	431	438
PHD (gpm)	862	749	789	562	651	582	611	621
High Zones								
PHD ÷ MDD	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90
MDD (gpm)	396	382	451	382	389	493	333	368
PHD (gpm)	753	726	858	726	739	937	633	699
Overall PHD (gpm)	***1,615***	***1,475***	***1,647***	***1,288***	***1,390***	***1,519***	***1,245***	***1,321***

Per Capita Consumption

Water consumption per capita is shown in **Table 3.14** using the multipliers from **Table 3.12**. Because these values include all authorized consumption, they are highly sensitive to changes in non-residential consumption. For example, prior to 2007 the average per capita consumption was 250 gpd, compared to the lowest at 155 gpd in 2010, then increasing to 187 gpd by 2017. This range is almost entirely due to changes in industrial water sales. Because of this variability, the per capita values presented in **Table 3.14** are for the reader’s information and comparison to the prior WSP but are not used for future forecasts.

Table 3.14
Per Capita Consumption (All Consumption Included)

	2011	2012	2013	2014	2015	2016	2017
Population	3,075	3,075	3,055	3,010	3,040	3,040	3,075
Authorized Consumption (MG)	181	191	187	195	196	207	209
ADD_{CAP} (gpd)	162	170	167	178	177	186	187
MDD ÷ ADD	1.86	2.36	2.06	2.13	2.20	1.82	1.89
MDD_{CAP} (gpd)	301	401	344	378	390	338	352
PHD ÷ MDD	1.62	1.64	1.66	1.64	1.68	1.63	1.64
PHD_{CAP} (gpm)	0.34	0.46	0.40	0.43	0.46	0.38	0.40

ADD_{CAP}, MDD_{CAP}, and PHD_{CAP} are consumption values per capita.

A more accurate representation of per capita consumption is to disregard industrial customers (primarily process water) and public (primarily irrigation and maintenance) usage. This method assumes that most commercial consumption is still for “personal” use such as restrooms, food preparation, dishwashing, showers, etc. The results of this method are shown on **Table 3.15**.

Table 3.15
Per Capita Consumption (Industrial and Public Removed)

	2011	2012	2013	2014	2015	2016	2017
Population	3,075	3,075	3,055	3,010	3,040	3,040	3,075
Annual Consumption (MGY)	124	133	130	138	138	126	134
Annual Per Capita (gpd)	111	119	116	126	125	113	119
MDD Per Capita (gpd)	246	309	247	277	289	212	232
PHD Per Capita (gpm)	0.25	0.32	0.25	0.28	0.30	0.22	0.24

FUTURE WATER USE

BASIS FOR DEMAND PROJECTIONS

This section describes the assumptions used in the demand forecasts.

Population Growth

For sizing infrastructure, the high range growth projections are used to account for possible expansion of the service area outside the current City limits. For revenue forecasts, the low range growth projections are used. The number of billable ERUs is set proportionate to the rate of population growth, except for an additional non-residential component discussed later.

Pressure Zone Distribution

Very little developable land remains in the 895 Zone. The projections assume approximately 90-percent of the residential growth will happen in the upper pressure zones for the next 15 years. After 15 years, it is assumed that land east of the current City limits (Warner Flats) will slowly convert to residential use and be supplied from the 895 Zone.

Water Use Efficiency Effects

Although current DSL is approximately 7-percent, DSL is set at 10-percent of supply for conservative forecasting.

Future demand projections were computed with and without a further reduction in water use from efficiency improvements. For revenue forecasts, consumption is reduced per the goals in the Water Use Efficiency Program. Customer water conservation is expected to derive mostly from reduction in water used for landscaping irrigation, although replacement of old plumbing fixtures with low flow fixtures may also contribute.

Non-Residential Consumption

For the purposes of projection, the commercial use is assumed to increase proportionally with population. Industrial water use has been increasing rapidly since 2011, due primarily to Crunch Pak, though that rate of growth is not expected to continue due to limited space for expansion of their facilities. Crunch Pak currently has a reserve to possibly increase its water use up to 0.25 MGD within 10 years. Crunch Pak’s current use is approximately 0.12 MGD. For sizing infrastructure, the projections assume Crunch Pak will use the full 0.25 MG by the year 2025. For projecting revenues, Crunch Pak’s consumption is assumed to remain steady at 0.12 MGD. Forty ERUs of water have been committed to the Christ Center Church (Church) by the City. The Church has not yet opened, but once the Church has been in operation for a few years, the City should evaluate its actual water use.

Unmetered authorized consumption (firefighting, water main flushing, etc.) is assumed to be steady at 10 MGY.

Full Buildout

This projection assumes that all land within the service area is built to the density allowed under the current land use classifications as shown in **Table 2.2** in **Chapter 2**. A timeline has not been associated with this condition.

DEMAND FORECAST

Table 3.16 presents the water demand forecast for the City water system. The Low Zone section is the 895 Zone and Warner Flats. The High Zone section is all of the other pressure zones combined.

Table 3.16
Demand Forecast for Infrastructure Sizing

	2018	2019	2024	2029	2034	2039	Buildout
Low Zone							
Population	1,449	1,451	1,475	1,483	1,492	1,534	3,611
Billable ERUs	1,199	1,236	1,617	1,626	1,635	1,681	3,958
Average Day Sales (gpd)	332,940	343,476	449,092	451,608	454,099	466,886	1,099,397
MDD ÷ ADD	1.86	1.86	1.86	1.86	1.86	1.86	1.86
Max Day Sales (gpd)	619,267	638,866	835,312	839,991	844,624	868,408	2,044,878
PHD ÷ MDD	1.42	1.42	1.42	1.42	1.42	1.42	1.42
Peak Hour Sales (gpm)	611	630	824	828	833	856	2,016
Unmetered (gpd)	14,000	14,000	14,000	14,000	14,000	14,000	14,000
DSL (gpd)	27,755	35,748	46,309	46,561	46,810	48,089	111,340
ADD (gpd)	374,695	393,224	509,401	512,169	514,909	528,974	1,224,736
MDD (gpd)	661,023	688,614	895,621	900,552	905,434	930,496	2,170,217
PHD (gpm)	652	679	883	888	893	918	2,140
Total ERUs	1,349	1,416	1,834	1,844	1,854	1,904	4,409
High Zones							
Population	1,646	1,659	1,873	2,030	2,185	2,311	4,389
Billable ERUs	799	806	909	986	1,061	1,122	2,131
Average Day Sales (gpd)	222,018	223,804	252,613	273,793	294,762	311,758	592,002
MDD ÷ ADD	2.70	2.70	2.70	2.70	2.70	2.70	2.70
Max Day Sales (gpd)	599,449	604,272	682,055	739,241	795,858	841,747	1,598,405
PHD ÷ MDD	1.90	1.90	1.90	1.90	1.90	1.90	1.90
Peak Hour Sales (gpm)	791	797	900	975	1,050	1,111	2,109
Unmetered (gpd)	14,000	14,000	14,000	14,000	14,000	14,000	14,000
DSL (gpd)	18,881	23,780	26,661	28,779	30,876	32,576	60,600
ADD (gpd)	254,900	261,585	293,274	316,572	339,638	358,334	666,602
MDD (gpd)	632,331	642,052	722,716	782,021	840,734	888,323	1,673,005
PHD (gpm)	834	847	954	1,032	1,109	1,172	2,207
Total ERUs	918	942	1,056	1,140	1,223	1,290	2,400
Overall							
Population	3,095	3,111	3,348	3,513	3,677	3,845	8,000
ADD (gpd)	629,594	654,809	802,676	828,742	854,548	887,309	1,891,338
MDD (gpd)	1,293,353	1,330,666	1,618,337	1,682,573	1,746,169	1,818,819	3,843,222
PHD (gpm)	1,486	1,526	1,837	1,920	2,002	2,090	4,348
Total ERUs	2,267	2,357	2,890	2,983	3,076	3,194	6,809

The analysis and evaluation of the existing water system with proposed improvements, as presented in **Chapter 6**, is based on the 20-year projected demand data without conservation reductions. This ensures that the future system will be sized sufficiently to meet all requirements, whether or not additional water use reductions from conservation are achieved. However, the City will pursue reductions in water use by implementing the Water Conservation Plan presented later in this chapter.

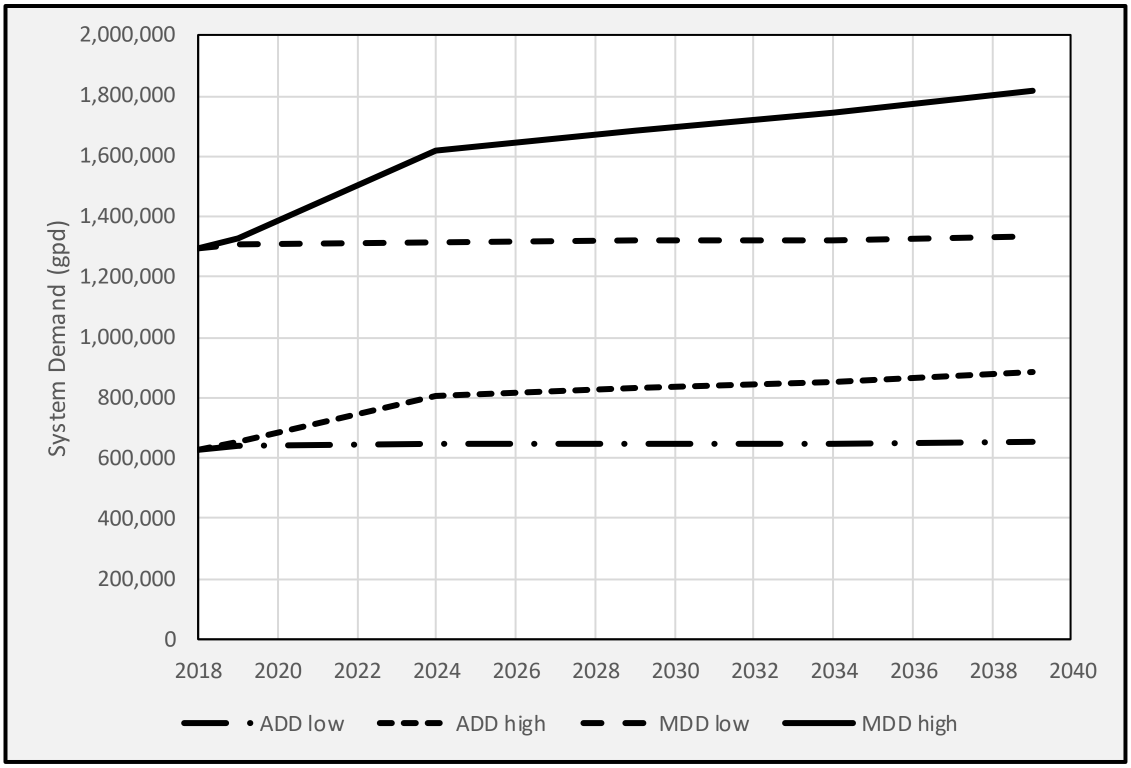
The projected water sales for revenue planning, if the City meets all of its water conservation goals and population growth, is slow, as shown in **Table 3.17**.

Table 3.17
Demand Forecast for Revenue Planning

	2018	2019	2024	2029	2034	2039
Low Zone						
Population	1,449	1,450	1,455	1,458	1,460	1,469
Billable ERUs	1,199	1,199	1,204	1,206	1,207	1,215
Average Day Sales (gpd)	332,940	333,153	331,027	328,234	325,337	327,398
MDD ÷ ADD	1.86	1.86	1.86	1.86	1.86	1.86
Max Day Sales (gpd)	619,267	619,664	615,710	610,516	605,127	608,960
PHD ÷ MDD	1.42	1.42	1.42	1.42	1.42	1.42
Peak Hour Sales (gpm)	611	611	607	602	597	601
Unmetered (gpd)	14,000	14,000	14,000	14,000	14,000	14,000
DSL (gpd)	27,755	34,715	34,503	34,223	33,934	34,140
ADD (gpd)	374,695	381,868	379,530	376,458	373,271	375,537
MDD (gpd)	661,023	668,380	664,213	658,740	653,061	657,099
PHD (gpm)	652	659	655	650	644	648
Total ERUs	1,349	1,375	1,380	1,383	1,385	1,394
High Zones						
Population	1,646	1,651	1,699	1,745	1,784	1,812
Billable ERUs	799	802	825	848	866	880
Average Day Sales (gpd)	222,018	222,728	226,871	230,728	233,416	237,045
MDD ÷ ADD	2.70	2.70	2.70	2.70	2.70	2.70
Max Day Sales (gpd)	599,449	601,365	612,553	622,964	630,223	640,021
PHD ÷ MDD	1.90	1.90	1.90	1.90	1.90	1.90
Peak Hour Sales (gpm)	791	793	808	822	832	844
Unmetered (gpd)	14,000	14,000	14,000	14,000	14,000	14,000
DSL (gpd)	18,881	23,673	24,087	24,473	24,742	25,104
ADD (gpd)	254,900	260,401	264,958	269,200	272,157	276,149
MDD (gpd)	632,331	639,038	650,640	661,437	668,964	679,125
PHD (gpm)	834	843	858	873	883	896
Total ERUs	918	937	963	989	1,010	1,025
Overall						
Population	3,095	3,101	3,154	3,203	3,244	3,281
ADD (gpd)	629,594	642,269	644,488	645,658	645,428	651,686
MDD (gpd)	1,293,353	1,307,418	1,314,853	1,320,177	1,322,025	1,336,224
PHD (gpm)	1,486	1,502	1,513	1,522	1,527	1,544
Total ERUs	2,267	2,312	2,344	2,372	2,395	2,419

With the low growth rate countered with the high conservation assumptions, gallons sold could be essentially unchanged over the next 20 years. A graphical comparison of the high and low range demand forecasts is shown on **Chart 3.11**.

Chart 3.11
Low and High Range Demand Forecasts



WATER USE EFFICIENCY

INTRODUCTION

The City is required to develop and implement a Water Use Efficiency Plan as described in WAC 246-290-800. To promote water use efficiency, a document titled, *Water Use Efficiency Guidebook* was prepared by DOH. This document addresses water use data collection requirements for public water systems. It identifies the minimum data required to project water demand and to provide a basis for evaluating the effectiveness of conservation programs. At least 5 years of continuous water use data is required. The City has collected and kept on file more than 5 years of supply data, which was presented earlier in this chapter.

WATER USE EFFICIENCY RULE

The Municipal Water Supply Efficiency Requirements Act, also known as the Municipal Water Law, became effective in 2007, and was upheld by the Washington State Supreme Court in 2010. The intent of the program is to help reduce the demand that growing communities, agriculture, and industry have placed on the state's water resources and to better manage these resources.

CURRENT WATER USE EFFICIENCY PROGRAM

The City currently complies with the requirements to annually prepare a Water Use Efficiency (WUE) report. All water sources and customer services are metered. Customer information packets are sent out annually. As shown in **Table 3.14**, average per capita water use has increased by approximately 15-percent since 2011, although this is primarily due to an increase in industrial consumption. Disregarding industrial and public use, per capita consumption has held relatively steady (**Table 3.15**). Consumption per ERU appears to have dropped by 2-to 3-percent since 2011 (**Chart 3.7**), but a definitive pattern is not apparent. The annual quantity of DSL dropped significantly in 2012 due to leak repairs, and has remained relatively steady since (**Chart 3.9**).

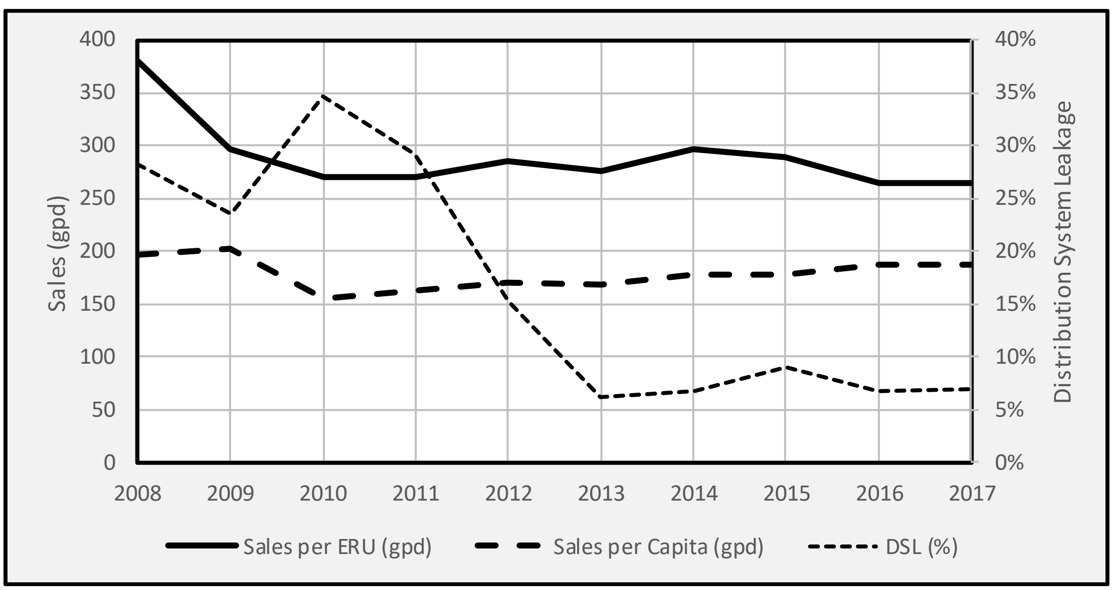
Prior Goal Performance

The 2011 WUE goals were adopted at the June 13, 2011, City Council meeting. The goals established were to reduce per capita consumption by 2-percent from 2010 to 2017 and reduce DSL by 33-percent from 2010 to 2017. From 2010 to 2017, actual DSL dropped from 29.3-percent to 6.9-percent (a 76-percent reduction). Actual per capita consumption dropped from 195 gpd to 187 gpd (a 4-percent decrease).

Per capita consumption is calculated by dividing all sales by total population, which means it can be significantly affected by industrial consumption. Industrial sales increased by over 300-percent from 2011 to 2017, artificially increasing the per capita value. A better comparison is the consumption per ERU which is tied directly to the water used by individual people. ERU_{ADD} from 2009 to 2017 dropped from 297 gpd to 264 gpd (a 12-percent reduction). The data is illustrated in **Chart 3.12**.

The City has exceeded its 2011 WUE goals.

Chart 3.12
Water Use Efficiency Performance



Current Goals and Public Process

WUE goals must be set through a public process and be evaluated and reestablished a minimum of every 6 years. Public hearings are scheduled with City Council meetings, with the most recent held on January 14, 2019. The City's current goals as adopted by the Council are listed below.

1. Endeavor to achieve ERU_{ADD} consumptive reduction of 1-percent by 2024, and 2-percent by 2039, by combined implementation of the measures adopted.
2. Maintain DSL below 10-percent.

3. Promote customer education via publicly-available information fliers and consumer confidence report mailings.
4. Perform periodic leak detection surveys.

Mandatory Measures

The water use data collection requirements vary, depending on the size of the water system. The water use data for the City is presented earlier in this chapter and discussed throughout. The following conservation measures are mandatory, and do not count towards the City's quota of other conservation measures.

1. Source of Supply Meter Readings

   Requirement:

   a. Read meters daily. Record monthly and annual totals.

   Compliance Status: Water supply to the City is provided by its two wells and one surface water source. Each of the sources has a meter that is read and recorded daily. The City also tabulates monthly and yearly totals from this data for each source and verifies the accuracy of their meters periodically.

2. Customer Service Meters

   Requirement:

   a. Record monthly totals. Monthly totals may be estimated if water usage is billed less frequently.
   b. Record usage for the following classes: single-family, multi-family, commercial, industrial, and public.

   Compliance Status: Most customer meters are read every month. However, some meters remain snow-covered through the winter months, in which case they are not read until the following spring. The City has grouped customers into several classes that meet the requirements stated above.

3. Meter Calibration

   Requirement:

   a. Verify meter accuracy and repair or replace on a regular schedule.

   Compliance Status: Both WTP meters were replaced in 2015 and recalibrated in 2016. The Well No. 4 meter was replaced in 2008 and calibrated in 2016. The Well No. 10 meter was replaced in 2013. A 10-year (or shorter) recalibration schedule for source meters is recommended. Customer meters were all replaced or installed new within the last 10 years. A 15- to 20-year replacement program for customer meters is recommended.

4. Leak Detection

   Requirement:

   a. Conduct a leak detection survey at least every 6 years until DSL is reduced to below 10-percent.

   Compliance Status: The last survey was performed in 2010. Current DSL is below 10-percent.

5. Customer Education

   Requirement:

   a. Provide periodic water system updates at public City Council meetings. Conduct a formal public forum every 6 years, or in conjunction with a WSP update.

   Compliance Status: Forums are held either in conjunction with City Council meetings, or separately. The last forum was held on January 14, 2019. The last informational meeting was held in May 2015.

6. Determine DSL Rate

   Requirement:

   a. Record annual totals.

   Compliance Status: Source and customer meters are totaled yearly, and authorized unmetered uses (firefighting, construction flushing, etc.) are estimated.

Measures to be Evaluated or Implemented

Because the City has more than 1,000 connections, at least 5 additional measures must be evaluated for applicability and cost-effectiveness. The following identifies the data requirements for the City and the City's status for meeting these requirements. The following measures are presented and evaluated for cost-effectiveness and applicability to the City's water system. If a measure will not be implemented, it is evaluated on three bases:

- The cost-effectiveness to the City;
- The cost-effectiveness if costs are shared with other entities; and
- The cost-effectiveness on a societal view.

Measures that will be, or are currently, implemented do not include any further cost evaluation.

1. Reclaimed Water

   The City intends to use reclaimed water from the WTP for irrigation of City-owned property and for mitigation of stream flows against future water rights requests. The City may also use reclaimed water for maintenance purposes such as street sweeping or dust control.

   Status: Implemented. A Water Right Impairment Analysis was approved by Department of Ecology (Ecology) in 2011. A permit for reclaimed water use was received in 2012, and the water was put to use.

2. Conservation Rates

   The City's current rate schedule consists of a base rate which covers the cost of system operation and maintenance. Water used is billed in 1,000-gallon increments. This encourages customers to minimize water use. The single-family and duplex-family billing classes have an increasing block rate structure. The multi-family and commercial billing classes have a uniform block rate structure to not discourage economic development in these areas. The billing rates can be found in **Chapter 9** and **Appendix K**.

   Status: Implemented in 2001, reevaluated annually.

3. General Customer Education

   The City makes many publications from DOH, Ecology, and the American Water Works Association (AWWA) available to the public. These publications are available at the City Hall. Additional general water system information is available on the City's website.

   Status: Implemented in 2004 and 2011.

4. Landscape Management

   The City uses a large amount of water for landscape irrigation. The City has installed water-conserving sprinkler heads. Some irrigated landscaping has been replaced with xeriscaping. Irrigation operation had historically been performed manually but has been upgraded with automatic timers.

   Status: Implemented.

5. Riverfront Park Irrigation

   The City supplies irrigation water to Riverfront Park through a separate irrigation well instead of the domestic water system. See **Chapter 5** for additional water rights information.

   Status: The project was completed in 2012.

6. Review Bills for Abnormal Use

   The City can review billing trends and identify individual customers whose usage increases dramatically. This can indicate a leak in a customer's private service.

   Status: Implemented.

7. Industrial Customer Requests

   When an industrial customer requests a new service with a large projected water use, the City will require such a request to include information regarding the amount and scheduling of the amount of water desired. For large requests, the City may elect to reduce the water available to that customer based on an evaluation of the City's other priorities.

   Status: Implemented. Such a request was made by Crunch Pak in 2011, and was evaluated in detail before committing to a compromise quantity of water available.

8. Add Historical Water Use to Customer Bills. This would provide each customer the ability to track water use and determine the effectiveness of personal conservation efforts.

   Status: The City's billing system does not allow for historical data to be shown on the monthly billing. However, the City can provide this information to an individual customer upon request.

   Cost to City: The cost of a new billing system would be substantial. Should a new billing system be warranted in the future, due to technological or other changes, implementation of this feature will be evaluated.

   Shared Cost: The City already provides a billing system that combines water and sewer. The only other relevant local public utility agency is the Public Utility District No. 1 of Chelan County (District) which provides electricity. Combining these billing systems would be a substantial initial cost, estimated to be as high if not higher than implementing a new City billing system. Once implemented, the maintenance costs may or may not be lower due to reduction in meter reading and accounting personnel.

Societal Cost: A billing system shared with the District could result in fewer miles travelled for meter reads, but given the small size of the City, the cost would be insignificant. Water savings from voluntary customer reductions could be used to supply new housing without the need for additional water rights.

Water Loss Control Action Plan

Because the City's current DSL is below 10-percent, the City is in compliance with WAC 246-290-820(4). A water loss control action plan is not required.

Monitoring of Conservation Measure Effectiveness

Water usage by the City as a whole and by customer class will continue to be tracked over time. Examples are shown in **Chart 3.7** and **Chart 3.12**. There are no discernable trends in residential water use over the last 6 years. The household water use is 278 gpd per ERU, which is between that of the nearby District (206 gpd), the East Wenatchee Water District (313 gpd), and City of Wenatchee systems (247 gpd). The difference is most likely due to the partial availability of irrigation water in the latter two systems, and the District's high increasing block rate. Also, the District includes multi-family customers in its calculation, which artificially lowers the value. Without a local irrigation system, a reduction in City landscape water use will be challenging.

4 | CITY POLICIES, DESIGN STANDARDS, AND CONSTRUCTION STANDARDS

INTRODUCTION

The City of Cashmere (City) operates and plans water service for its residents according to the design criteria, laws, and policies that originate from the following seven sources, listed in descending order from those with the broadest authority to the narrowest:

- U.S. Department of Health and Human Services (Federal);
- U.S. Environmental Protection Agency (Federal);
- Washington State Department of Health (State);
- Washington State Department of Ecology (State);
- Chelan County Commissioners (County);
- Cashmere City Council (City); and
- American Water Works Association (Standards).

These laws, standards, and policies guide the City's daily operation and maintenance of the water system, and its planning for growth and improvements. Their overall objective is to ensure that the City provides high quality water service at a minimum cost to its customers. They also set the standards that the City must meet to ensure that the water supply is adequate to meet existing and future water demands.

The highest three governmental entities establishing policies and laws – U.S. Government, Washington State, and Chelan County Board – establish requirements in statutes, regulations, or ordinances. The City Council and Mayor adopt policies that cannot be less stringent, or in conflict, with those established by governments above them. The City's policies take the form of ordinances, memoranda, and operational procedures, many of which are summarized in this chapter or found in the Appendices.

The City publishes its policies and standards online with the Code Publishing Company at the following link:

https://www.codepublishing.com/WA/Cashmere/

SYSTEM POLICIES

CAPACITY

The City will plan for saturation population use of its supply sources so that future water resource limitations can be handled effectively.

The City will ensure that the capacity of the system, including sources, pump stations, and transmission mains, is sufficient to meet the maximum day demand (MDD) of the system.

SATELLITE MANAGEMENT AGENCIES

The City will consider providing satellite system management or ownership services within and adjacent to the City's existing service area. The City does not currently manage any satellite systems.

WHOLESALING

The City currently wholesales water to one system and may consider wholesaling water on a case-by-case basis.

CONDITIONS OF WATER SERVICE

City Authority

1. The City shall have the power at any time, without notice, to amend, change or modify any rule, rate, or charge, and make rates or contracts. All water service is subject to such power.
2. Failure to comply with utility development standards shall be a civil infraction and subject to civil penalties and remedies and corrective actions. The enforcing official may revoke, modify, or suspend any subdivision, plat or other development by the issuance of a notice of violation and order. Appeals may be made in writing to the hearing examiner within ten calendar days of the decision.

Where Water Service is provided and Service Limitations

1. The City will strive to provide potable water service to all people within the City limits and designated retail water service area, provided all policies related to service can be met.
2. The City will supply all customers within the City retail water service area unless a special agreement with an adjacent purveyor exists due to topography or other limiting factors.
3. All proposed developments within the City limits and designated retail water service area shall connect directly to the City's water system, unless deemed infeasible by the City at the time of the request.
4. Water system extensions required to provide water service to proposed developments shall be approved by the City's Department of Public Works and must conform to the City's adopted design criteria, construction standards, and specifications, as shown in the City's Water System Development Standards. All costs of the extension shall be borne by the developer.
5. Individual wells may be installed on existing platted lots within the City's service area if the City determines it is infeasible to provide a direct connection to the City's water system at the time of the request. Owners of individual wells will be required to connect to the City's water system at the time City water becomes available and shall decommission the existing well in accordance with Washington Administrative Code (WAC) 173-160-381. Costs associated with decommissioning existing wells shall be the responsibility of the owner.

Water Service Requests

1. Requests for new water services shall require at least a 24-hour notice prior to connecting the water service. Requests shall be made on a form provided by the City, found in **Appendix M**. Once requests are received by the City's Department of Public Works, the location of the property that will receive the new water service shall be verified to ensure that

it is within the City limits. The water system's capacity analysis shall also be reviewed to ensure that adequate capacity exists to serve the proposed development.

2. For single water service connections to the water system, any water service connection (tap) shall be performed by the City following the approval of the new water service request. Connections from the water main to service the development shall be installed by a licensed contractor and inspected by the City, and the property owner shall pay all installation costs.
3. For subdivisions, short plats, or other developments, a pre-application meeting shall be held to discuss the proposed project, project timelines (determined on a case-by-case basis), and any other potential non-technical conditions that may affect the City's ability to provide water to the proposed services. Any delays resultant from these conditions shall be the responsibility of the applicant. Environmental assessments that may be required pursuant to the construction of the project shall also be the responsibility of the applicant. Development plans shall be reviewed by a Technical Review Committee before the new water service request is approved. The developer shall also be required to provide assurances and guarantees in the form of surety bond or cash deposit. The developer shall be required to provide a certification by a licensed engineer that the methods of construction, workmanship, materials, and testing of the improvements comply with the City's Water System Development Standards. The developer shall be required to provide a two-year warranty period for maintenance and repair of the installed improvements. All connections to the water system must be installed prior to final approval of a development.

Certificate of Water Availability

1. In accordance with the requirements of the Growth Management Act (GMA), the City must identify that water is available prior to issuing a building permit. A "Certificate of Water Availability" (CWA) is issued if there is sufficient water supply to meet the domestic water service and fire flow requirements of the proposed building. The requirement for providing evidence of an adequate water supply is codified in Title 19.27.097 of the *Revised Code of Washington* (RCW) in the Building Code Section.

Water Service Responsibility of the City

1. The City will exercise reasonable diligence and care to furnish and deliver a continuous and sufficient supply of water meeting or exceeding regulatory requirements to the customer and avoid any shortage or interruption of delivery of the same. The City will not be liable for high or low-pressure conditions, interruption, storage or insufficiency of supply, or loss or damage occasioned thereby. The use of water upon the premises of the customer is at the risk of the customer, and the responsibility of the City ceases at the meter, except as required by state guidelines for water quality.
2. The City will exercise reasonable care to provide adequate and continuous water service but does not guarantee the same and shall not be liable for injury, loss, or damage resulting from any failure or curtailment of water service, nor shall such failure or curtailment constitute a breach of contract. The City shall have the right to temporarily suspend water service for the purpose of making repairs or improvements to its facilities. In such case, when practicable, advance public notice shall be given, and every effort will be made to make interruptions as short as possible and at such times as will cause the least inconvenience to the customer.

Customer Responsibility

1. The customer line must be kept in repair by the owner or occupant of the premises. The customer will be responsible for all damages resulting from breaks in said pipe or water service along with water loss resulting from said break or leak.
2. If the customer's water service fails, he shall endeavor to determine if he has a broken water service line or a broken pipe inside or under the house. If a City serviceman is sent to the customer's premises at the customer's request after regular working hours, and it is determined that the problem is caused by failure of the customer's line or equipment, a charge may be made. A main shut-off valve on the customer side of the meter chamber is recommended to be installed by the customer for his use and convenience.
3. The City does not recommend resistance thawing (utilizing electrical energy to thaw pipes) and disavows all liability associated with its use. Damage to the customer's electrical system due to resistance thawing is the responsibility of the customer.
4. If excessive water pressure exists at the customer's service connection, the customer shall furnish and install at his own expense, a pressure reducing valve (PRV). Property owners assume all responsibility for damage to property and/or persons resulting from excessive water pressure.
5. Customers shall install, maintain, and operate their plumbing systems using the City water supply in accordance with Washington State plumbing codes.
6. The City shall not be liable for any loss or damage of any nature whatsoever caused by any defect in the customer's line, plumbing, or equipment.
7. The property owner shall pay for all costs for repairs or replacement of a leaking water service from the main line to the unit being served.

Water Service Meters

1. The City will install all the necessary meters for measuring the water service used by the customer. The meter will remain the property of the City.
2. Permanent changes in the size of the meters and/or water service connections shall be made on request of the customer. The customer will be charged for all conversions based on the actual cost to the City. If a customer increases the total water consumption served on the premises to a point where the meter is operating beyond its rated capacity, or decreases the total water use to a point where the meter is too large to accurately indicate the water used, the City may, upon notification to the customer, change the size of the meter, and bill the actual cost to the customer.
3. The meters will be maintained by the City and will be inspected from time to time and tested for accuracy.
4. No meter will be placed in water service or allowed to remain in service that is known to have an error in registration more than two-percent under conditions of normal operation.
5. The City, its duly authorized agents, or its employees shall have the right to install meters on the customer's premises and shall at all reasonable times have the right to enter or leave the customer's premises to install, read, repair, test, maintain, or reinstall the meter and its related appurtenances.
6. Customers shall be liable for damage to meters resulting from their neglect. It is unlawful for any person to disconnect or remove any meter.

7. Customers shall keep their premises adjacent to the meter free from all rubbish, landscaping, or material of any kind that will prevent City employees' access to the meter.

Water Service Discontinuance

1. Water service may be temporarily discontinued because of unforeseen emergencies or other reasons beyond the control of City, or for necessary maintenance and repair of the water system. In case the supply of water shall be interrupted or fail by any such reason, accident or any other cause, the City shall not be liable for damages for such interruption or failure, nor shall such failure or interruption for any reasonable period of time be held to constitute a breach of contract on the part of the City or in any way relieve the customer from performing its obligations to the City.
2. Where water is wastefully or negligently used on a customer's premises that seriously affects the general water service, the City may discontinue water service if such conditions are not corrected after due notice by the City.
3. Water services may be discontinued to customers having delinquent bills if action is necessary to enforce collection.
4. The City may, without further notice, discontinue water service to any customer when a defective condition of plumbing or equipment upon the premises of the customer results or is likely to result, in interference with proper water service or contamination of water.

DUTY TO SERVE

1. The City has the duty to serve all customers within the retail water service area if all the following conditions can be met.
    a. The City has sufficient capacity to serve water in a safe and reliable manner.
    b. The applicant complies with all applicable local plans, development regulations, and utility standards and policies.
    c. Sufficient water rights and supply are available.
    d. The City can provide such service in a timely and reasonable manner.
2. In areas requiring a developer's extension, timely water service does not start until all the provisions of the developer's extension agreement are satisfied, application forms are filled out, and applicable connection charges and fees are paid in full.
3. Appeals to the City's policies will be addressed at regular or special meetings of the City Council, and a record of the appeal shall be written in the meeting minutes.

ANNEXATIONS

1. Water service is provided to property outside of the City limits only after the property has been annexed into the City.
2. Areas annexed without existing municipal supply will be served by the City.
3. Areas annexed with existing municipal supply must meet City Water System Development Standards.
4. The City, as a condition of annexation, may require a transfer of water rights per City Municipal Code 13.10.025.

TEMPORARY SERVICES

1. No temporary service is allowed, unless there are plans for permanent water service that meets all City standards.

EMERGENCY SERVICE

1. Compliance with standards may be temporarily deferred for emergency water service.
2. Policy criteria may be waived for emergency service.

INSPECTION – ACCESS AUTHORIZATION

1. The City will only enter the customer's premises with their permission. The City will inform the customer that the City's survey of a customer's premises, by the City or its representative, is for the sole purpose of establishing the City's minimum requirements for the protection of the public water supply system, commensurate with the City's assessment of the degree of hazard. Should the customer fail to provide permission to access the premises for inspection purposes, action as outlined under the Cross-Connection Control Program may be taken.

COMPLAINTS

1. Complaints received by the City will be addressed, and a record of the resolved complaint shall be written in the meeting minutes.

FIRE FLOW

1. The City will plan to provide the following minimum fire flows where practical.

Table 4.1
Fire Flow Goals by Land Use

Land Use	Flowrate	Duration
Single Family Residential	1,500 gpm	2 hours
Multi-Family Residential	2,500 gpm	2 hours
Public	3,000 gpm	3 hours
Commercial	3,500 gpm	3 hours
Industrial	3,500 gpm	3 hours
Schools	3,500 gpm	3 hours

   a. These fire flows are goals and will be considered when sizing future infrastructure projects. These values do not indicate availability, nor commitment by the City to achieve these goals by any specific date.

REGIONAL PARTICIPATION

1. The City will participate in regional supply management and planning activities such as:
   a. The Wenatchee Watershed Planning Unit Water Right Inventory Assessment (WRIA 45);
   b. The Wenatchee Watershed Total Maximum Daily Load Study; and
   c. The Wenatchee River Channel Migration Zone project.

2. Participation in these projects will include attending meetings, providing information for studies, and performing water quality monitoring tasks as needed.

JOINT USE

1. All joint-use facilities (with other public water systems) must comply with City of Cashmere policy and design standards.
2. All joint-use facilities will be maintained by the City Water Department.
3. Joint-use facilities will be pursued only in those areas that improve reliability or reduce operating costs.

FINANCIAL POLICIES

General

1. The City will set rates that comply with standards established by the American Water Works Association (AWWA).
2. Rates and additional charges established for the City should be:
    a. Cost-based rates which recover current, historical, and future costs associated with the City's water system and services;
    b. Equitable charges to recover costs from customers, commensurate with the benefits they receive; and
    c. Adequate and stable source of funds to cover the current and future cash needs of the City.
3. The existing customers of the City will pay the direct and indirect costs of operating and maintaining the facilities through user rates. In addition, the user rates will include debt service incurred to finance the capital assets of the City.
4. New customers seeking to connect to the water system will be required to pay a connection charge for an equitable share of the historical cost of the system, and for the system's Capital Improvement Program (CIP). Connection charge revenues will be used to fund the CIP in conjunction with rate revenue.
5. New and existing customers will be charged for extra services through separate ancillary charges based on the costs to provide the services. Ancillary charges can increase equitability, as well as increase operating efficiency by discouraging unnecessary demand for services. The charges should be reviewed regularly and updated annually, based on increases in the Consumer Price Index. Revenue from ancillary charges will be used to finance annual operations and maintenance.
6. The City will maintain information systems that provide sufficient financial and statistical information to ensure conformance with rate-setting policies and objectives.
7. User charges must be sufficient to provide cash for the expenses of operating and maintaining the system. To ensure the fiscal and physical integrity of the utility, each year an amount should also be set aside and retained for capital expenditures, which will cover some portion of the depreciation of the physical plant. The amount may be transferred from the Maintenance Fund to the Construction Fund for general purposes or for specific purposes.
8. A Working Capital Reserve will be maintained to cover unanticipated emergencies and fluctuations in cash flow.

9. Water rates will be based on either the Base-Extra Capacity Method or the Commodity-Demand Method. Both methods strive to equitably charge customers with different service requirements based on the cost of providing the water service. Service requirements relate to the total volume of water used, peak rates of use, and other factors.
10. Fees and charges are calculated for the service area as a whole. Rates will be the same regardless of service location for existing customers. Rates charged in annexed areas will be evaluated on an individual basis.

Connection Charges

1. Owners of properties that have not been assessed, charged, or have not borne an equitable share of the cost of the water system will pay one or more of the following connection charges, prior to connection to a water main:
    a. Latecomers Fees (aka Reimbursement Charges): Latecomers fees are negotiated with developers and property owners; they provide for the reimbursement of a pro rata portion of the original cost of water system extensions and facilities.
    b. Connection Charge: The connection charge will be assessed against any property that has not participated in the development of the water system. Meter charges, or hookup fees, are additional in order to recover the cost of meter and service line installation.
    c. Developer Extension Charges: These charges are for the administration, review, and inspection of a developer extension project.

ORGANIZATIONAL POLICIES

Staffing

1. Personnel certification will comply with State standards.
2. The City Water Department will promote staff training.

Relationship with Other Departments

1. The City Finance Department is responsible for customer billing, payment collection, project cost accounting, and fund activity reporting.
2. The City Personnel Department is responsible for employee records, union labor negotiations, and salary schedules.
3. The City Fire Department uses water utility facilities for fire protection and establishes fire flow requirements.
4. The City staff members are responsible for enforcing violations of City water ordinances.
5. Fire hydrant testing is performed jointly by the Fire Department and the Water Department.

DESIGN AND PERFORMANCE STANDARDS

PURPOSE

This section describes the criteria and policies used to establish an acceptable performance level and a standard of quality for the water system. Additional criteria are contained in the *City of Cashmere Water System Development Standards*, a copy of which is included in **Appendix N** of this Plan.

All proposed developments within the City's existing and future service areas shall conform to the City's adopted design criteria, construction standards, and specifications.

DRAWING FORMAT

1. Drawings shall be provided on ANSI D-Size or 24-inch by 36-inch sheets at a standard engineering scale, and as-builts provided in hard copy and electronic format (Adobe .PDF required. AutoCAD .DWG if requested by the City). Electronic files must be native vector format, not scanned.

PRESSURE

1. The City will endeavor to maintain a minimum pressure of 40 pounds per square inch (psi) at customer meters during normal demand conditions, excluding a fire or emergency.
2. The City will endeavor to maintain a minimum pressure of 30 psi at customer meters during peak hour demand (PHD) conditions, excluding a fire or emergency.
3. The City will endeavor to maintain a maximum pressure of 120 psi in the water mains during normal demand conditions, excluding pressure surges. Individual residences are responsible for reducing pressures over 80 psi.
4. During fire conditions, the minimum pressure at customer meters and throughout the remainder of the distribution system shall be 20 psi.
5. During a failure of any part of the system, the maximum pressure should not exceed 150 psi.

VELOCITY

1. During normal demand conditions up to and including PHD, the velocity of water in a water main should be less than 5 feet per second (fps).
2. During emergency conditions such as a fire, and for sizing purposes, the velocity of water in a water main may exceed 5 fps, but may not exceed 8 fps in transmission and distribution mains. Fire hydrant laterals are exempt from this standard.
3. Higher velocities may be acceptable within PRV stations or pump stations, at the discretion of the City.

STORAGE

1. Storage must be of sufficient capacity to supplement supply when system demands are greater than the supply capacity (equalizing storage), and still maintain sufficient storage for proper pump operation (operational storage), fire suppression (fire flow storage), and other emergency conditions (standby storage).
2. Standby storage must be located above the elevation that yields a 20 psi service pressure to all services in the zone under PHD conditions.
3. The City will provide sufficient standby storage for an emergency condition in which a major supply source is out of service. The volume of storage will be sufficient to maintain uninterrupted supply to the system during an emergency condition of reasonable duration.
4. Fire flow storage must be located above the elevation that yields a 20 psi service pressure to all services in the zone under MDD conditions.
5. The City will provide sufficient storage for a fire condition equal to the system's maximum fire protection water demand and the required duration.

6. A water level indicator will be located at each reservoir.
7. Storage facilities will be located where they will satisfy the following requirements:
    a. Minimize fluctuations of system pressure during normal demands;
    b. Maximize use of the storage facilities during fires and peak demands;
    c. Improve the reliability of supply to the City; and
    d. Provide year-round service truck access.

TRANSMISSION AND DISTRIBUTION

1. Where practical as determined by the City, transmission and distribution mains will be looped to increase reliability, water quality, fire flow capacity, and to decrease head losses.
2. All mains will comply with the generally recognized design criteria from the AWWA and Washington State Department of Health (DOH) guidelines.
3. All new construction will be in accordance with the *City of Cashmere Water System Development Standards*, a copy of which is included in **Appendix N** of this Water System Plan.
4. Distribution system design assumes that adequately-sized service lines will be used.
5. All water mains shall be ductile iron (DI) pipe. The City may allow polyvinyl chloride (PVC), or require poly bagging of DI pipe in areas of high corrosive potential.
6. All new distribution mains will be sized by a hydraulic analysis.
7. All new mains providing fire flow will be sized to provide the required fire flow at a minimum residual pressure of 20 psi and maximum pipeline velocity of 8 fps during MDD conditions. In general, new water mains that will carry fire flow in residential areas shall be a minimum of 8 inches in diameter and looped for multi-family residential developments. New water mains in commercial, business park, industrial, and school areas shall be a minimum of 12 inches in diameter and looped.
8. Valve installations will satisfy the following criteria:
    a. Zone valves will be located at all pressure zone boundaries to allow future pressure zone realignment without the need for additional pipe construction.
    b. Isolation valves will be installed on all lines to allow individual pipelines to be shut down for repair or installation services. Unless it is impractical to do so, the distance between isolation valves will not exceed 800 feet. A minimum of three valves will be provided per cross, and two valves per tee. The City may, at their discretion, require valves on all tee and cross legs.
9. One-inch minimum combination air release and vacuum valves will be placed at all high points, or “crowns,” in all pipelines. Larger air valves may be required on 12-inch and larger mains at the City’s discretion. Vacuum valves may be required at the top of slopes exceeding 10-percent grade and 100 feet in length (or at the discretion of the City) to protect against collapse during a line break or emergency demand.
10. Blowoff assemblies shall be located at low points (at the City’s discretion) and main dead ends where there is not a fire hydrant.
11. If a water main extension is expected in the future, the dead-end main shall have a valve at the end the same size as the main, with appropriate thrust restraint.

FIRE HYDRANTS

1. See Cashmere Municipal Code 15.09.120 for fire hydrant information.
2. Fire hydrants serving detached single-family dwellings or duplex dwellings on individual lots will be located not more than 500 feet on center. All single-family lots shall be within 300 feet from a fire hydrant, as measured along the path of vehicular access.
3. Unless approved by the Fire Department, fire hydrants serving any use other than detached single-family dwellings or duplex dwellings on individual lots will be located not more than 300 feet on center and will be located so that at least one hydrant is located within 150 feet, but no closer than 50 feet, of all structures unless approved by the Fire Department.
4. Hydrants located in dead-end areas or cul-de-sacs shall service an area of no more than 110,000 square feet.
5. Fire hydrants shall be installed near intersections when practical.
6. The Fire Department will review all proposed fire hydrant installations to determine the minimum number and spacing of fire hydrants for each project.

WATER SERVICES

1. The customer shall request the service size; however, the City retains the right to size the meter as it deems appropriate.
2. The meter service shall be installed at a location agreeable to the City.
3. The customer shall hire a licensed contractor with relevant experience to install the entire service line from the main including the meter chamber. The customer shall install the service line from the meter chamber to their place of use. The City will install the meter.
4. If public water mains are extended or relocated adjacent to the customer’s property, it is the practice of the City that the customer’s water service meter will be relocated to a location abutting the customer’s property.
5. All residential service lines will be 1-inch diameter or larger. Service lines will be the same size as the meter or larger.
6. Each service shall have its own dedicated main tap. Double services are not allowed, except at the discretion of the City.
7. Individual PRV’s must be installed by the customer in all new customer services where pressure exceeds 80 psi.

BOOSTER PUMP STATIONS (BPS)

All future BPSs will be constructed to comply with the following minimum standards:

1. All structures will be non-combustible, where practical;
2. All buildings will have adequate heating, cooling, ventilation, insulation, lighting, and work spaces necessary for on-site operation and repair;
3. Sites will be fenced for security and to reduce vandalism and City liability, where appropriate;
4. Each station will be equipped with a flow meter, pressure gauges, and all necessary instrumentation to assist personnel in operating and troubleshooting the facility;
5. Emergency power connection equipment will be provided to at least one BPS per pressure zone;

6. Pumps will be operated automatically, with remote control systems fully compatible with the City's remote system;
7. Stations will be operated with the provision for at least two methods of control, to minimize system vulnerability;
8. Manual override of stations will be provided for, and located at the operations and maintenance office using the City's telemetry and supervisory control system;
9. Stations will be monitored with alarms for the following conditions:
    a. Power phase failure;
    b. Communication failure;
    c. Water in structure;
    d. Fire;
    e. Low suction pressure;
    f. High discharge pressure; and
    g. Intrusion.
10. Stations will have the following indicators:
    a. Pump started automatically or manually;
    b. Local flow rate and totalizing;
    c. Flow rate and totalizing at the Operations and Maintenance office;
    d. Recording of combined supply flow to the system; and
    e. Local and remote indication of suction and discharge pressure.
11. Stations will be placed wherever necessary to fulfill the following criteria:
    a. Provide supply redundancy to a pressure zone;
    b. Improve the hydraulic characteristics of a pressure zone;
    c. Maximize storage availability and transmission capacity; and
    d. Improve water quality (i.e., increase circulation) and quantity.

PRESSURE REDUCING VALVE STATIONS

1. All PRVs will be placed in vaults that are large enough to provide ample workspace for field inspection and valve repair.
2. Vaults will drain to daylight or will be equipped with sump pumps to prevent vault flooding.
3. Where directed by the City, pressure relief valves will be provided on the low-pressure side of the PRVs to prevent system over-pressurizing in case of a PRV failure.
4. At the discretion of the City, stations may be required to be constructed above-grade.

CONTROL SYSTEMS

1. The City's control system must be capable of efficiently operating the water system's components in accordance with this water system plan, and in response to reservoir levels, system pressures, abnormal system conditions, electrical power rate structure, and water costs.

EASEMENTS

1. Where, at the discretion of the City, facilities are not practical to locate on right-of-way or City property, an easement shall be provided of sufficient width to allow for installation, maintenance, operations and replacement of the facility. The width and conditions on the easement shall be directed by the City. City access to the easement shall be available at all times without need for notification.

SUBMITTAL EXCEPTION PROCESS

Under the conditions of WAC 246-290-125, the City wishes to reserve the right to perform its own review of project reports and construction documents for distribution main projects, without requiring approval of said documents by DOH. The City’s design and construction standards are included in this chapter and the related appendices.

5 | WATER SOURCES AND QUALITY

INTRODUCTION

The basic objectives of a water system are to provide a sufficient quantity of water to meet customer usage demands and to provide high-quality water. **Chapter 6** discusses the City of Cashmere's (City) physical ability to supply a sufficient quantity of water and identifies future source requirements. This chapter discusses the City's existing water sources, water rights, water quality regulations, and water quality monitoring results.

EXISTING WATER SOURCES

All water supplied to the City's system is provided by two groundwater wells and one surface water source. These three active sources that currently provide water to the system are Well No. 4, Well No. 10, and the Water Treatment Plant (WTP). Additional information on each of the City's existing sources is presented in **Chapter 6**.

SOURCE CHARACTERISTICS AND FORESEEABLE IMPACTS

The existing water supply is from two groundwater wells and an intake from the Wenatchee River (River). Well Nos. 4 and 10 have been in operation for 76 and 40 years respectively, and the River intake for 30 years. The original water rights for the two wells are 400 gallons per minute (gpm) instantaneous (Qi) each, however, the capacity is currently physically limited by the well drawdown to 230 gpm for Well No. 4, and 140 gpm for Well No. 10. Well No. 10 has been redeveloped in the past with an improvement to over 200 gpm, but has reverted back to lower values after a few years. No change in water quality or quantity is anticipated for these wells, based on historical performance. There has been no measurable change in the static water levels in these wells over the years, nor complaints from other local well owners, indicating no detrimental impact to the water source. The WTP draws directly from the Wenatchee River with a water right of up to 5,410 gpm Qi if all water rights conditions are met. The City's typical withdrawal rate from the River is 1,200 gpm. The City's peak hour demand is approximately 1,500 gpm, though the difference is currently accommodated by using reservoir equalizing storage or other wells. The current River withdrawal ranges from 150 gpm to 200 gpm (depending on how much water is pumped from Wells 4 and 10) when averaged over the entire year. The physical River intake pumping capacity is 2,400 gpm. Future 20-year water withdrawal projections for all sources combined range between a 40-percent increase if no Water Use Efficiency (WUE) measures are realized, or a 4-percent increase if all WUE goals are achieved.

The Wenatchee River historical average flow ranges from 700 cubic feet per second (cfs) (300,000 gpm) in September to 10,000 cfs (4,500,000 gpm) in June, as measured at the Peshastin United States Geological Society (USGS) gauging station. The 2015 drought resulted in river flows lower than had been seen for many years, with the lowest flow of 350 cfs in early October compared to the normal 800 cfs. The City measured approximately 18 inches of water over the intake screen in July, and may have dropped as low as 13 inches by October (based on the USGS gauge at Peshastin). The only year with a lower flow since construction of the WTP was in 2005 at 300 cfs, although no detrimental effects to the water system are known to have occurred that year. The lowest flow recorded since records began in 1930 was 250 cfs in 1988, just before the WTP was commissioned.

Based on this data, it appears that barring a historic low river event, water supply to the WTP should be reliable.

Under the lowest River flows in a drought year, the City's peak withdrawal accounts for approximately 0.7-percent of the streamflow. Future increases in withdrawal rate due to growth may be partially offset by transfer of existing water rights to the City, which would result in no net change to the River. Reclaimed water may also be used to mitigate low streamflow periods in the future, if necessary. Any further withdrawal needs have been addressed in the Water Resource Inventory Area (WRIA) 45 Plan as an allocated water reserve. This is discussed further in the Water Rights Planning section of this chapter.

WATER RIGHTS

OVERVIEW

This is a planning document only, it is not intended as a definitive statement or analysis of the full scope of all water rights held by the City, or in which the City may have an interest. As noted later in this chapter, the Washington State Department of Ecology (Ecology) and the City do not agree regarding the scope of the City's water rights. While the parties agree that there are currently 15 valid water rights, the City asserts that the annual volumes associated with some of the water rights are additive in nature. Please see the Water Right Self Assessment in **Appendix I**. Nothing herein shall be interpreted or used as a statement against the interests of, or binding upon, the City in any future proceeding or analysis concerning the scope of the water rights held by the City or in which the City may have an interest.

A water right is a legal authorization to use a specified amount of public water for specific beneficial purposes. The water right amount is expressed in terms of instantaneous withdrawal rate and annual withdrawal volume (Qa). Washington State law requires users of public water to receive approval from Ecology prior to actual use of the water. This approval is granted in the form of a Water Right Permit or Certificate. However, a water right is not required for certain purposes (typically individual residences) that use 5,000 gallons per day (gpd) or less of groundwater from a well.

The process for obtaining a water right involves obtaining a Water Right Permit first, then a Water Right Certificate. A Water Right Permit provides permission to develop a water right by constructing, developing, and testing a water source. A Water Right Permit remains in effect until a Water Right Certificate is issued (if all terms of the Water Right Permit are met) or the permit has been canceled. A Water Right Certificate is issued by Ecology following a review process and determination that the amount of water put to beneficial use is consistent with the amount and conditions indicated on the Water Right Permit.

A Water Right Permit is issued by Ecology only if the proposed use meets the following requirements.

- Water will be put to beneficial use.
- There is impairment to existing or senior water rights.
- Water is available for appropriation.
- The use of water is not detrimental to the public welfare.

The water right decision process also considers existing basin management plans, stream closures, instream flows, hydraulic continuity (surface water interconnected to groundwater), seawater intrusion, utilization of existing water sources, water conservation, and availability of alternative water supplies, among other factors. The water right decision process is complex and time consuming, due to the many competing interests for water, environmental issues, and regulatory requirements.

EXISTING WATER RIGHTS

The City currently holds several Water Right Permits and certificates for its sources of municipal water supply, plus several pending applications. A summary of the City's Water Rights is presented in the Water Rights Self-Assessment found in **Appendix I**. Existing sources being used by the City for municipal water supply include Well No. 4, Well No. 10, and the WTP. The City has acquired Water Right Certificates for all of its sources. Based on Ecology's interpretation (see **Appendix I**), the City's use of several Water Right Certificates is limited to a total annual quantity of 800 acre-feet per year (afy), resulting in a total annual volume for water system planning purposes available to the City of 2,440 afy (this excludes the 10 afy associated with CS4-SWC9658(A))

WATER RIGHTS EVALUATION

A comprehensive review of the City's water rights was not performed for this WSP update. The following is an update to the water rights listed as in-progress from the prior WSP.

The City obtained additional water rights from John Lysaker (a portion of Certificate Number 9658). This process was initiated in August 2002 when the City began working with the Water Conservancy Board and Ecology to identify water rights that may be available to the City and to determine the transferability of these rights. The Water Conservancy Board forwarded its decision to Ecology in March 2003. Ecology issued a decision on January 26, 2004, and no appeal was taken from this decision.

The approved change application for that portion of Certificate 9658(B) acquired by the City includes an instantaneous water right of 655 gpm (1.46 cfs) that is in addition to the City's existing instantaneous rights. The approved change application also authorizes a total annual water right of 200 afy, of which, 52 afy is consumptive and available to the City continuously throughout the year. The remaining 148 afy is available for consumptive use by the City when instream flows are met in the Wenatchee River, or for non-consumptive use when instream flows in the Wenatchee River are not met, which will be accomplished by demonstrating that discharge from the City's wastewater treatment plant meets or exceeds 148 afy during these periods.

It is the intent of the City to fully utilize Certificate 9658(B) during periods when instream flows in the Wenatchee River are satisfied. This will result in a reduction in the Qi available to the City during periods when instream flows in the Wenatchee River are not satisfied in an amount equal to the instantaneous diversion amount associated with Certificate 9658(B) (or pro-rata portion by taking into consideration that 52 afy is available year round for consumptive use, whether or not instream flows are being met). Alternatively, the City will monitor the discharge from the City's wastewater treatment plant to ensure that the discharge meets or exceeds 148 afy during periods when instream flows in the Wenatchee River are not met. The net result is that the City will be able to fully withdraw and make available for its customers and users the entire water supply available to the City, as interpreted by Ecology and shown in **Appendix I**, in the amount of 1,374 afy.

As the City begins to use the Lysaker water right, the City will monitor the use of the water right to demonstrate that the provisions of the water right are being met. If necessary, data from the City's water and wastewater systems will be compared to ensure that the use of the 148 afy of Certificate

9658 does not exceed the volume of effluent that is discharged into the River from the City's wastewater treatment plant during periods in which instream flows are not met to verify that the water is being used consistent with the terms of the change application. As part of the compliance with the terms of the change application, the City will monitor instream flows in the Wenatchee River and evaluate the use of Well No. 4 and Well No. 10 for water supply to the extent possible when minimum instream flows are not met.

Water Right S4-23547C was transferred from the Cashmere Development Group to the City in 2008 in the amount of 0.06 cfs Qi at 12 afy. Of the 12 afy, 8.7 afy is consumptive, and 3.3 afy is non-consumptive. The amount is subject to instream flows of the Wenatchee River from October 1 through April 30. It is the intent of the City to fully utilize this water right during peak demands in the summer months (i.e., the water right will be fully utilized outside of the winter time instream flow restrictions associated with this water right).

The *2006 WRIA 45 Wenatchee Watershed Management Plan* proposed that 4 cfs (1,800 gpm) reserve was available for additional domestic and municipal purposes, of which 3 to 3.5 cfs is allocated for use in the lands between Leavenworth and Wenatchee. The reserve value was determined based on maintaining adequate water for current and proposed uses, and wildlife habitat. In 2013, a coordinated process began between the City of Cashmere, City of Leavenworth, Alpine Water District, and Chelan County to address this additional water allocation. This process was recently completed, resulting in the approval of the City's application associated with S4-35243(B) on September 27, 2019, authorizing 1,076 afy withdrawn at peak rate of 4.16 cfs (or 1,867 gpm)

Water Right CS4-SWC9658(A) transferred a portion of the right from the Port of Chelan County to the City, with approval on December 9, 2011. This right has been put to use at a new well located at Riverside Park. The total quantity is Qi of 0.108 cfs (48.5 gpm) and Qa of 10 afy. This water right is included under the heading "other water rights" in **Appendix** I.

An evaluation of the City's existing water rights was performed to determine the sufficiency of the water rights to meet both existing and future water demands. **Table 5.1** compares the combined maximum instantaneous (Qi) water right amounts of the sources with the maximum daily demand (MDD) of the system and the combined maximum annual (Qa) water right amounts of the sources with the average daily demand (ADD) of the system. As shown in **Table 5.1**, the City has sufficient water rights (both Qi and Qa) to meet the demands of the existing customers.

Table 5.1
Water Rights Evaluation – Current Demands

	Qi (MDD)		Qa (ADD)
	cfs	gpm	afy
Water Right Conditions Satisfied			
Total Certificated Water Rights	15.2	6,811	2,440
2018 Water Demand (estimate)	3.5	1,570	705
Surplus (or Deficit) Rights	11.7	5,241	1,735
Water Right Conditions Not Satisfied			
Total Certificated Water Rights	13.7	6,128	2,289
2018 Water Demand (estimate)	3.5	1,570	705
Surplus (or Deficit) Rights	10.2	4,558	1,583

Table 5.1 outlines the use of Certificates 9658(B) and S4-23547C entirely during periods when both the water rights conditions are satisfied, which include meeting instream flows in the Wenatchee River, and when the water rights conditions are not satisfied. **Table 5.1** assumes that the City fully utilizes Certificates 9658(B) and S4-23547C during periods when water rights conditions are satisfied and does not take into consideration the alternative of matching withdrawals of water with discharges from the City's wastewater treatment plant.

Table 5.2 summarizes the results of the future water rights evaluation, which compares the water rights of the existing sources with the future 6-year and 20-year demand projections of the system. The analysis considered future demand projections with and without water use reductions from planned conservation efforts.

Table 5.2
Future Water Rights Evaluation – Water Rights Conditions Not Satisfied

	Qi (MDD)		Qa (ADD)
	cfs	gpm	afy
Total Certificated Water Rights	13.7	6,128	2,289
2024 Without Conservation			
2024 Water Demand	3.5	1,570	899
Surplus (or Deficit) Rights	10.2	4,558	1,390
2024 With Conservation			
2024 Water Demand	3.5	1,570	722
Surplus (or Deficit) Rights	10.2	4,558	1,567
2039 Without Conservation			
2039 Water Demand	3.5	1,570	994
Surplus (or Deficit) Rights	10.2	4,558	1,295
2039 With Conservation			
2039 Water Demand	3.5	1,570	730
Surplus (or Deficit) Rights	10.2	4,558	1,559

Chart 5.1 illustrates the historical and protected MDD and peak hour demand (PHD) compared to the existing water rights peak instantaneous withdraw. The series labeled “MDD” represents the County’s adopted growth rate. The series “MDD (High)” represents the Office of Financial Management (OFM) high growth rate projection. Qi appears to be sufficient to meet MDD for the foreseeable future.

Chart 5.1
Existing Water Rights Qi Compared to MDD and PHD Forecasts

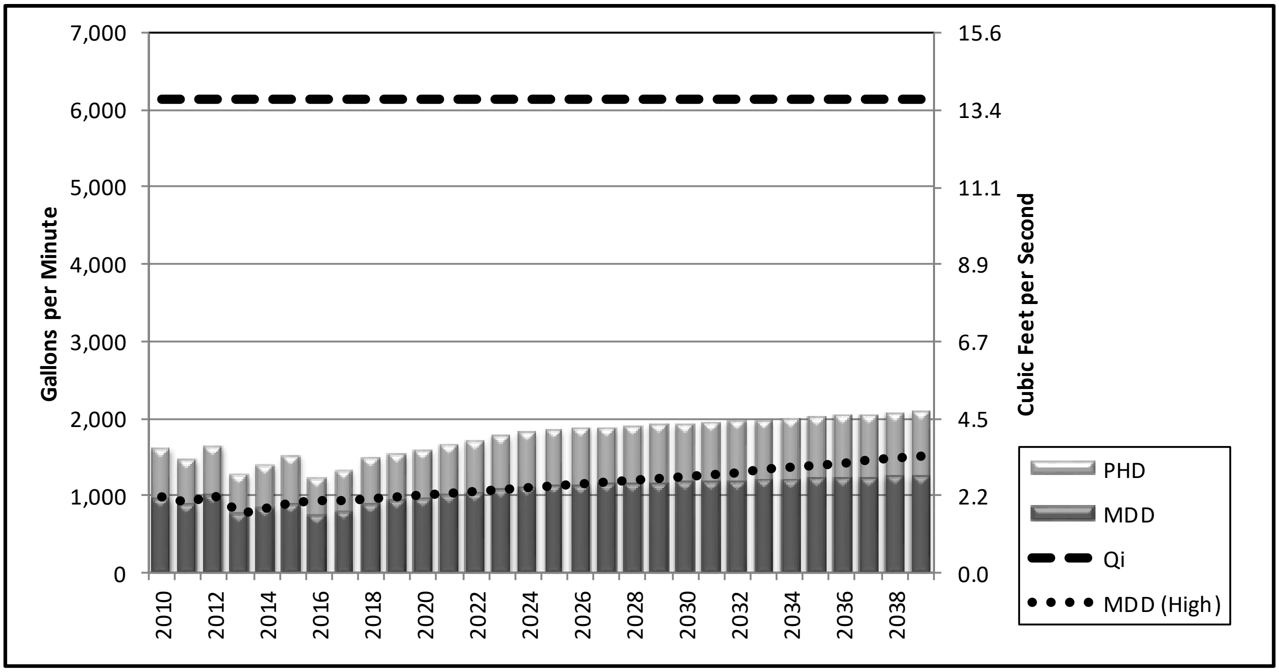
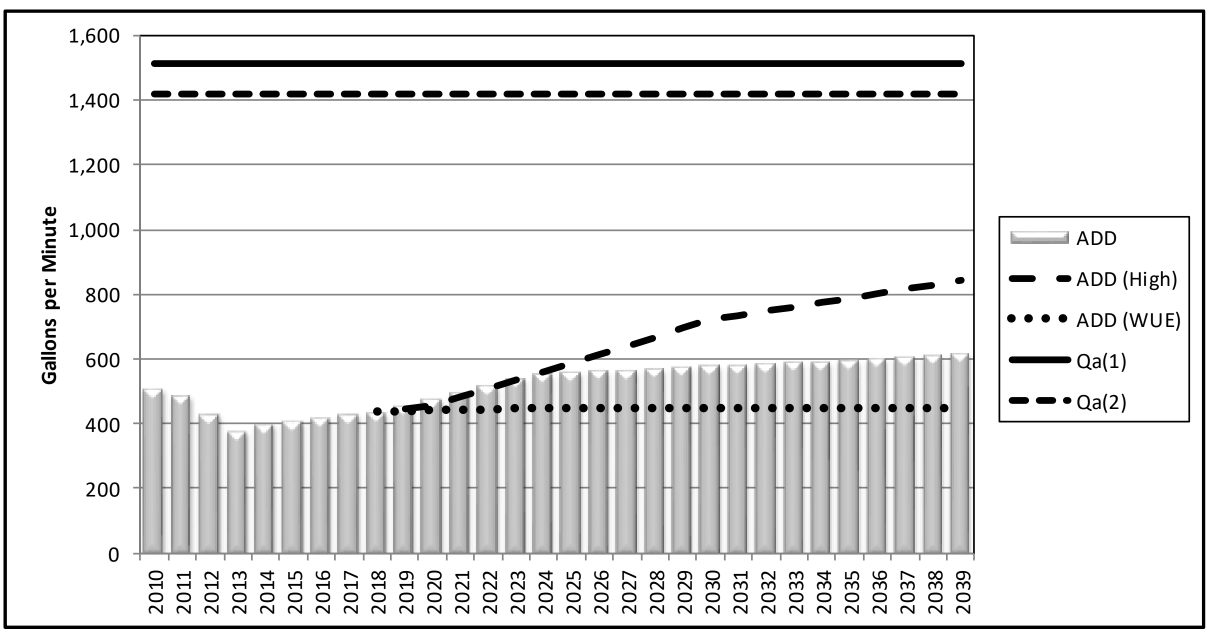


Chart 5.2 focuses on Qa against ADD. Three projections are shown. The chart series labeled "ADD (WUE)" shows the projected average day demands (ADD) if all WUE goals are met and population growth is slow. The series "ADD (High)" assumes the high OFM growth rate and the addition of a large industrial customer. The series "ADD" assumes the County's adopted growth rates, and no new large industrial customer.

Chart 5.2
Existing Water Rights Qa Compared to ADD Forecasts



Qa(1) Water rights conditions satisfied; Qa(2) Water rights conditions not satisfied

Tables 5.1 and **5.2** and **Charts 5.1** and **5.2** summarize water supplied to the domestic water system and as such, do not include 9658(A) because it is currently be used at the Riverside Park well for irrigation. The City reserves the right use 9658(A) in the future in any way that is consistent with the conditions of 9658(A).

The results of the future water rights evaluation indicate that even during periods when instream flows are not met in the Wenatchee River and the City has fully utilized Certificate 9658 during the period when flows are met, the City has a surplus of instantaneous rights through the current planning period, with or without conservation. The annual rights may be sufficient to meet the demands for the next 40 years, but this forecast is sensitive to the rate of both residential and industrial development. The future outcome depends on the actual size of the customer base, corresponding demand and the amount of water conservation achieved. Additional annual water rights may be needed in the future to meet the demands of the City beyond 40 years. A formal determination of Certificate 731-D should also be pursued.

WATER RIGHTS PLANNING

The City's policy is to obtain additional water rights by various methods to assure adequate water for future development of the City. The City's Comprehensive Land Use Plan specifies policies that require water rights to be transferred to the City as part of an annexation approval process. Within the city limits, water rights are obtained as part of the subdivision process as addressed in Title 13.10 of the Cashmere Municipal Code.

Reclaimed Water

Completion of the new wastewater treatment facility (WWTF) in 2015 reduced the amount of water lost to evaporation by elimination of the large open water lagoons. A water right impairment analysis was performed, which determined that 47.9 afy of previously evaporated water may be reclaimed and put to a consumptive use. Ecology concurred with this evaluation via correspondence on June 29, 2011. The City applied for, and was granted, a reclaimed Water Use Permit on October 25, 2012 for exclusive right to 47.9 afy, see **Appendix I**. The uses of that water include general municipal purposes, irrigation of City-owned property, streamflow augmentation of the Wenatchee River as mitigation for obtaining a new water right in the future, and for offsetting uses of water rights with instream flow limitations. The volume of reclaimed water authorized is limited to not more than 2.6 million gallons per day (MGD) and is limited by not only the total annual volume (47.9 afy or 15.6 million gallons (MG)) but is also limited by the volume of water that can be reclaimed and consumptively used each month, consistent with the reduction in evaporation realized by the elimination of the large open-water lagoons.

Requests for Additional Rights

This WSP assumes current zoning within the Urban Growth Area (UGA) will remain unchanged for projecting future water use. However, as the City Limits expand into the UGA, it is very likely that the zoning designations and allowed development density will change. This may result in a larger ultimate number of customers in the City's service area. The City's pursuit of additional water rights reflects this potential higher density development.

The City is currently evaluating additional water rights to be transferred for use within the City's water system to sufficiently meet future demands. In addition to pursuing additional rights, the City will strive to use its existing water sources efficiently by continuing current water conservation measures and implementing proposed measures, as outlined in the City's *Water Conservation Plan*, which is included in **Appendix H**.

Future Action Items

The Report of Examination (ROE) for CS4-SWC9658(A) requires the water to be put to beneficial use by December 31, 2031. As this date approaches, the City should evaluate the use of this right and determine whether a request for an extension is necessary.

The ROE for S4-35243(B) requires the water to be put to beneficial use by the year 2067. As this date approaches, the City should evaluate the use of this right and determine whether a request for an extension is necessary.

EXISTING WATER TREATMENT

The City provides water treatment on a system-wide basis. Gas chlorine is utilized continuously as a disinfectant at each of the City's sources. The WTP provides additional treatment for the surface water it withdraws from the Wenatchee River through a slow sand filter process. Historically, the water quality from Well No. 10 and the WTP has been excellent. High levels of manganese were detected at Well No. 4 in the past, but have since been eliminated, and the well now produces high-quality water.

In some communities, groundwater is fluoridated to assist in the prevention of tooth decay. The City has chosen not to fluoridate its water at this time. Wells Nos. 4 and 10 and the WTP all show trace amounts of natural fluoride.

DRINKING WATER REGULATIONS

OVERVIEW

The quality of drinking water in the United States is regulated by the Environmental Protection Agency (EPA). Under provisions of the Safe Drinking Water Act (SDWA), the EPA can delegate primary enforcement responsibility for water quality control to each state. In the State of Washington, the Washington State Department of Health (DOH) is responsible for implementing and enforcing drinking water regulations. For the State of Washington to maintain primacy (delegated authority to implement requirements) under the SDWA, the state must adopt drinking water regulations that are at least as stringent as the federal regulations. In meeting these requirements, the state, in cooperation with DOH, has published drinking water regulations that are contained in Chapter 246-290 of the Washington Administrative Code (WAC).

EXISTING REGULATIONS

The SDWA was enacted in 1974, as a result of public concern about water quality. The SDWA sets a standard for the quality of drinking water and requires water treatment if these standards are not met. The SDWA also sets water testing schedules and methods that water systems must follow. In 1986, the SDWA was amended as a result of additional public concern and frequent contamination of groundwater from industrial solvents and pesticides. The 1986 amendments to SDWA require water systems to monitor and treat for a continuously increasing number of water contaminants identified in the new federal regulations. The EPA regulated approximately 20 contaminants between 1974 and 1986. The 1986 SDWA amendments identified 83 contaminants that the EPA was required to regulate by 1989. Implementation of the new regulations was marginally successful due to the complexity of the regulations and the associated high costs. To rectify the slow implementation of the new regulations, the SDWA was amended again and re-authorized in August 1996.

In response to the 1986 SDWA amendments, the EPA established six rules known as the Phase I Rule, the Phase II and IIb Rules, the Phase V Rule, the Surface Water Treatment Rule, the Total Coliform Rule, and the Lead and Copper Rule. The EPA regulates most chemical contaminants through the Phase I, II, IIb and V Rules. Additional drinking water regulations have been published since these six rules were first established, and the EPA is continually proposing new rules for promulgation. The City's currently active surface water source is affected by these rules.

The EPA set two limits for each contaminant regulated under the rules. The first limit is a health goal, referred to as the Maximum Contaminant Level Goal (MCLG). The MCLG is zero for many contaminants, especially known cancer-causing agents (carcinogens). The second limit is a legal limit, referred to as the Maximum Contaminant Levels (MCL). The MCLs are equal to or higher than the MCLGs. However, most MCL and MCLGs are the same, except for contaminants that are regulated as carcinogens. The health goals (MCLGs) for these are typically zero because it is assumed that any amount of exposure may pose some risk of cancer.

A summary of each rule follows. To fully understand the discussion that follows, a brief definition of several key terms is provided below.

- Organic Chemicals – Animal or plant produced substances containing carbon and other elements such as hydrogen and oxygen.
- Synthetic Organic Chemicals (SOCs) – Manmade organic substances, including herbicides, pesticides, and various industrial chemicals and solvents.
- Volatile Organic Chemicals (VOCs) – Chemicals, as liquid, that evaporate easily into the air.
- Inorganic Chemicals (IOCs) – Chemicals of mineral origin that are naturally occurring elements. These include metals such as lead and cadmium.

Phase I Rule

The Phase I Rule, which was the U.S. EPA's first response to the 1986 SDWA amendments, was published in the Federal Register on July 8, 1987, and became effective on January 9, 1989. This rule provided limits for eight VOCs that may be present in drinking water. VOCs are used by industries in the manufacture of rubber, pesticides, deodorants, solvents, plastics, and other chemicals. VOCs are found in everyday items such as gasoline, paints, thinners, lighter fluid, mothballs, and glue, and are typically encountered at dry cleaners, automotive service stations, and elsewhere in industrial processes. The City currently complies with all contaminant monitoring requirements under this rule.

Phase II & IIb Rules

The Phase II and IIb Rules were published in the Federal Register on January 30, 1991, and July 1, 1991, and became effective on July 30, 1992, and January 1, 1993, respectively. These rules updated and created limits for 38 contaminants (organics and inorganics), of which 27 were newly regulated. Some of the contaminants are frequently applied agricultural chemicals (nitrate), while others are more obscure industrial chemicals. The City currently complies with all contaminant monitoring requirements under these rules.

Phase V Rule

The Phase V Rule was published in the Federal Register on July 17, 1992, and became effective on January 17, 1994. This rule set standards for 23 additional contaminants, of which 18 are organic chemicals (mostly pesticides and herbicides) and five are IOCs (such as cyanide). The City currently complies with all contaminant monitoring requirements under this rule.

Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) was published in the Federal Register on June 29, 1989, and became effective on December 31, 1990. Surface water sources such as rivers, lakes, and reservoirs (which are open to the atmosphere and subject to surface runoff), and groundwater sources that are under the direct influence of surface water (referred to as GWI sources), are governed by this rule. The SWTR seeks to prevent waterborne diseases caused by the microbes Legionella and Giardia lamblia, which are present in most surface waters. The rule requires disinfection of all surface water and GWI sources. All surface water and GWI sources must also be filtered unless a filtration waiver is granted. A filtration waiver may be granted to systems with pristine sources that continuously meet stringent source water quality and protection requirements. Currently, the Wenatchee River source is classified as a surface water source and is subject to the SWTR. The City currently complies with all requirements under this rule.

Interim Enhanced Surface Water Treatment Rule

The EPA proposed the Interim Enhanced Surface Water Treatment Rule (IESWTR) on July 29, 1994. The final rule was published in the Federal Register on December 16, 1998, and became effective on February 16, 1999, concurrent with the Stage 1 Disinfectants/Disinfection By-products Rule. The rule primarily applies to public water systems that serve 10,000 or more people and use surface water or GWI sources. The rule also requires primacy agencies (e.g., DOH) to conduct sanitary surveys of all surface water and GWI systems, regardless of size. The rule is the first to directly regulate the protozoan Cryptosporidium and has set the MCLG for Cryptosporidium at zero. Water systems affected by this rule needed to comply by December 16, 2001. The City currently complies with all requirements under this rule.

Revised Total Coliform Rule

The Total Coliform Rule was published in the Federal Register on June 29, 1989, and became effective on December 31, 1990. The rule set both health goals (MCLGs) and legal limits (MCLs) for total coliform levels in drinking water, and the type and frequency of testing that is required for water systems. The rule requires more monitoring than prior requirements, especially for small systems. In addition, every public water system is required to develop a coliform monitoring plan, subject to approval by DOH.

On February 13, 2013, the EPA published revisions to the rule in the Federal Register, and the rule was renamed to the Revised Total Coliform Rule. This rule eliminated the coliform MCL, sets an MCL for *Escherichia Coli (E. coli)*, and specifies the frequency and timing of coliform testing based on population served, public water system type, and source water type. When total coliform is detected, this is now known as a treatment technique trigger, and public notice is no longer required. Instead, the water system must conduct an assessment of their water system facilities and operations and fix any sanitary defects. For confirmed *E. coli* incidents, now known as an *E. coli* MCL violation, the water system must perform a Level 2 assessment and provide public notice within

24 hours. If a positive sample is collected on a consecutive system, the City will also need to collect source samples.

Coliform is a group of bacteria, some of which live in the digestive tract of humans and many animals, and are excreted in large numbers with feces. Coliform can be found in sewage, soils, surface waters, and vegetation. The presence of any coliform in drinking water indicates a potential health risk and potential waterborne disease outbreak, which may include gastroenteric infections, dysentery, hepatitis, typhoid fever, cholera, and other infectious diseases. *E. coli* is a member of the coliform group which is almost exclusively of fecal origin, and their presence can lead to increased health risks.

A copy of the City's *Water Quality Monitoring Plan*, including the *Coliform Monitoring Program* and *E. coli Response Plan*, is contained in **Appendix J**.

Lead & Copper Rule

The Lead and Copper Rule was published in the Federal Register on June 7, 1991, and became effective on December 7, 1992. On January 12, 2000, the EPA published minor revisions to the rule in the Federal Register that primarily improved the implementation of the rule. On June 29, 2004, additional minor revisions and clarifications on several requirements of the Lead and Copper Rule were published by the EPA. On October 10, 2007, additional short-term regulatory revisions and clarifications were published by the EPA. The rule identifies action levels for both lead and copper. An action level is different from an MCL in that an MCL is a legal limit for a contaminant, and an action level is a trigger for additional prevention or removal steps. The action level for lead is greater than 0.015 milligrams per liter (mg/L). The action level for copper is greater than 1.3 mg/L. If the 90th percentile concentration of either lead or copper from the group of samples exceeds these action levels, a corrosion control study must be undertaken to evaluate strategies and make recommendations for reducing the lead or copper concentration below the action levels. A corrosion control study is also required if a new source is added to the water system or if a permanent treatment change is made to an existing source. The rule requires systems that exceed the lead level to educate the affected public about reducing lead intake. Consumer Confidence Reports (CCR) must now also provide information regarding lead in drinking water regardless of detected samples. Systems that continue to exceed the lead action level after implementing corrosion control and source water treatment may be required to replace piping in the system that contains the source of lead. Corrosion control is typically accomplished by increasing the water's pH to make it less corrosive, which reduces its ability to break down water pipes and absorb lead or copper.

Lead is a common metal found throughout the environment in lead-based paint, air, soil, household dust, food, and certain types of pottery, porcelain, pewter, brass, and water. Lead can pose a significant risk to health if too much of it enters the body. Lead builds up in the body over many years and can cause damage to the brain, red blood cells, and kidneys. The greatest risk is to young children and pregnant women. Lead can slow normal mental and physical development of growing bodies.

Copper is a common, natural, and useful metal found in our environment. It is also a trace element needed in most human diets. The primary impact of elevated copper levels in water systems is stained plumbing fixtures. At certain levels (well above the action levels), copper may cause nausea, vomiting and diarrhea. It can also lead to serious health problems in people with Wilson's disease. Long-term exposure to elevated levels of copper in drinking water could also increase the risk of liver and kidney damage. The City currently complies with all contaminant monitoring and treatment requirements under this rule.

Radionuclides Rule

The EPA established interim drinking water regulations for radionuclides in 1976 under the SDWA. MCLs were established for alpha, beta, and photon emitters, and radium 226/228. Radionuclides are elements that undergo a process of natural decay and emit radiation in the form of alpha or beta particles and gamma photons. The radiation can cause various kinds of cancers, depending on the type of radionuclide exposure from drinking water. The regulations address both manmade and naturally occurring radionuclides in drinking water.

The 1986 amendments to the SDWA finalized the regulations for radionuclides by eliminating the term “interim.” The amendments also directed the EPA to promulgate health-based MCLGs, as well as MCLs. The EPA failed to meet the statutory schedules for promulgating the radionuclide regulations, which resulted in a lawsuit. In 1991, the EPA proposed revisions to the regulations, but a final regulation based on the proposal was never promulgated. The 1996 amendments to the SDWA directed the EPA to revise a portion of the earlier proposed revisions, adopt a schedule, and review and revise the regulations every 6 years, as appropriate, to maintain or improve public health protection. After the 1996 amendments, a 1996 court order required the EPA to either finalize the 1991 proposal for radionuclides or ratify the existing standards by November 2000.

The final rule was published in the Federal Register on December 7, 2000 and became effective on December 8, 2003. The rule established an MCLG of zero for the four regulated contaminates and MCLs of 5 picoCuries per liter of air (pCi/L) for combined radium-226 and radium-228; 15 pCi/L for gross alpha (excluding Radon and Uranium); 4 mrem/year for beta particle and photon radioactivity; and 30 μg/L for uranium. The City currently complies with all contaminant monitoring requirements under this rule.

Consumer Confidence Report

The final rule for the CCR was published in the Federal Register on August 19, 1998, and became effective on September 18, 1998. Minor revisions were posted in the Federal Register on May 4, 2000. The CCR is the centerpiece of the right to know provisions of the 1986 amendments to the SDWA. All community water systems, like the City, were required to issue the first report to customers by October 19, 1999. The annual report must be updated and re-issued to all customers by July 1st of each year thereafter.

The CCR is a report on the quality of water that was delivered to the system during the previous calendar year. The report must contain certain specific elements but may also contain other information that the purveyor deems appropriate for public education. Some, but not all, of the information that is required in the reports includes the source and type of the drinking water, type of treatment, contaminants that have been detected in the water, potential health effects of the contaminants, identification of the likely source of contamination, violations of monitoring and reporting, and variances or exemptions to the drinking water regulations. A copy of the City’s 2009 CCR is contained in **Appendix L**.

Stage 1 Disinfectants/Disinfection By-products Rule

Disinfection Byproducts (DBP) are formed when free chlorine reacts with organic substances, most of which occur naturally. These organic substances (called precursors) are a complex and variable mixture of compounds. The DBPs themselves may pose health risks. Trihalomethanes is a category of DBPs that had been regulated prior to this rule. However, systems with groundwater sources that serve a population of less than 10,000 were not previously required to monitor for trihalomethanes.

The EPA proposed the Stage 1 Disinfectants/Disinfection By-products Rule (D/DBPR) on July 29, 1994. The final rule was published in the Federal Register on December 16, 1998, and became effective on February 16, 1999. The rule applies to the City and most other water systems that add a chemical disinfectant to the drinking water during any part of the treatment process. The rule reduced the MCL for total trihalomethanes, which are a composite measure of four individual trihalomethanes, from the previous interim level of 0.10 mg/L to 0.08 mg/L. The rule established MCLs and requires monitoring of three additional categories of DBPs: 1) 0.06 mg/L for five haloacetic acids; 2) 0.01 mg/L for bromated; and 3) 1.0 mg/L for chlorite. The rule also established maximum residual disinfectant levels (MRDLs) for chlorine (4.0 mg/L), chloramines (4.0 mg/L) and chlorine dioxide (0.8 mg/L). The rule requires systems using surface water or groundwater directly influenced by surface water to implement enhanced coagulation or softening to remove DBP precursors unless alternative criteria are met. Compliance with this rule must have been satisfied by December 16, 2001 for large surface water systems (those serving more than 10,000 people) and by December 16, 2003 for smaller surface water systems and all groundwater systems. The City currently complies with all contaminant monitoring requirements under this rule.

Stage 2 Disinfectants/Disinfection By-products Rule

This rule is the second part of the D/DBPR, of which the Stage 1 D/DBPR became effective in February 1999. The Stage 2 Disinfectants/Disinfection By-products Rule (Stage 2 D/DBPR) was published on January 4, 2006 in the Federal Register and became effective March 6, 2006. The EPA implemented this rule simultaneously with the Long Term 2 Enhanced Surface Water Treatment Rule.

Similar to the Stage 1 D/DBPR, this rule applies to most water systems that add a disinfectant to the drinking water other than ultraviolet light, or those systems that deliver such water. The Stage 2 D/DBPR changes the calculation procedure requirement of the MCLs for two groups of DBPs total trihalomethanes (TTHM) and five haloacetic acids (HAA5) by requiring each sampling location to determine compliance with MCLs based on individual annual average DBP levels (termed the Locational Running Annual Average), rather than utilizing a system-wide annual average. The rule also proposes new MCLGs for chloroform (0.07 mg/L), trichloroacetic acid (0.02 mg/L) and monochloroacetic acid (0.03 mg/L).

Additionally, the rule requires systems to document peak DBP levels and prepare an initial distribution system evaluation (IDSE) report to identify Stage 2 D/DBPR compliance monitoring sites. IDSEs require each water system to prepare a separate IDSE plan and report, except for those systems who obtain a 40/30 Certification or a Very Small System (VSS) Waiver. To qualify for the 40/30 Certification, all samples collected during Stage 1 monitoring must have TTHM and HAA5 levels less than or equal to 0.040 mg/L and 0.030 mg/L, respectively. The first stage of the IDSE schedule required systems serving 100,000 or more people to submit IDSE plans by October 1, 2006. Systems serving 50,000 to 99,999 people had to submit IDSE plans by April 1, 2007, while systems serving 10,000 to 49,999 people had to submit plans by October 1, 2007. Systems serving fewer than 10,000 people had to submit an IDSE plan by April 1, 2008 if they did not qualify for 40/30 Certification or a VSS Waiver. The City's IDSE Standard Monitoring Plan was submitted to the EPA on August 11, 2008. The City currently complies with all contaminant monitoring requirements under this rule and will begin sampling two sites per quarter in the year 2013.

Arsenic

The EPA established interim drinking water regulations for arsenic in 1976 under the SDWA. Arsenic is highly toxic, affects the skin and nervous system, and may cause cancer. The 1986 SDWA amendments require the EPA to conduct research to assess health risks associated with exposure to low levels of arsenic. The EPA issued a proposed arsenic regulation on June 22, 2000 and allowed a 90-day public review period. The final rule, which was published in the Federal Register on January 22, 2001, was to become effective on March 23, 2001, except for certain amendments to several sections of the rule. However, because of the national debate regarding the science and costs related to the rule, the EPA announced on May 22, 2001, that it was delaying the effective date for the rule to allow time to reassess the rule and afford the public a full opportunity to provide further input. On October 31, 2001, the EPA reaffirmed the final rule as published on January 22, 2001. The Arsenic Rule subsequently became effective on February 22, 2002.

The rule sets the MCLG of arsenic at zero and reduces the MCL from the previous standard of 0.05 mg/L to 0.01 mg/L. Arsenic's monitoring requirements are consistent with the existing requirements for other inorganic contaminants. The regulation required the City to begin monitoring by January 23, 2006. The City currently complies with all contaminant monitoring requirements under this rule.

Filter Backwash Recycling Rule

The 1996 SDWA Amendments required the EPA to promulgate a regulation governing the recycling of filter backwash water within public water systems' treatment processes. Public water systems using surface water or groundwater under the direct influence of surface water that utilize filtration processes and recycling must comply with this rule. The rule aims to reduce risks associated with recycling contaminants removed during filtration. The EPA issued a proposed regulation on June 22, 2000 and allowed a 90-day public review period. The final rule was published in the Federal Register on June 8, 2001 and became effective on August 7, 2001.

The rule requires filter backwash water be returned to a location that allows complete treatment. In addition, filtration systems must provide detailed information regarding the treatment and recycling process to the state. The regulation requires water systems to have complied with the rule starting December 8, 2003, if filter backwash water was recycled. The WTP does not backwash water as part of their slow sand filtration process; therefore, this rule does not apply to the City.

Long Term 1 Enhanced Surface Water Treatment Rule

The Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) is the follow-up rule to the IESWTR, which became effective in December 1998. The LT1ESWTR was published in the Federal Register on January 14, 2002, and the final rule became effective on February 13, 2002. This rule, which was proposed in conjunction with the Filter Backwash Recycling Rule, addresses water systems such as the City's system that serve fewer than 10,000 people and use surface water sources or GWI sources.

This rule dictates that filtered systems must achieve at least a 2-log removal of Cryptosporidium through meeting strengthened combined filter effluent turbidity limits and must continuously monitor individual filter turbidity by January 11, 2005. Unfiltered systems are required to improve Cryptosporidium control through enhanced watershed control plans by January 14, 2005. Additionally, the LT1ESWTR mandates that systems serving fewer than 500 people commence development of a disinfection profile by January 1, 2004 and complete the profile by January 1, 2005. Systems that serve a population between 500 and 9,999 people must commence the development of a disinfection profile and complete their profiles by July 1, 2003 and July 1, 2004, respectively. Lastly, the LT1ESWTR mandates that water systems provide covers for all reservoirs constructed after March 15, 2002.

Long Term 2 Enhanced Surface Water Treatment Rule

Following the publishing of the IESWTR, the EPA introduced the LT1ESWTR to supplement the preceding regulations. The second part of the regulations of the LT1ESWTR, which became effective in February 2002 are mandated in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The final rule was published in the Federal Register on January 5, 2006 and became effective on March 6, 2006. The final rule was implemented simultaneously with the Stage 2 D/DBPR described in the previous section. This rule applies to all systems that use surface water or GWI sources.

This rule establishes treatment technique requirements for filtered systems based on risk level for contamination calculated from the system's average Cryptosporidium concentration. Requirements include up to 2.5-log Cryptosporidium treatment in addition to existing requirements under the IESWTR and LT1ESWTR. Filtered systems that demonstrate low levels of risk will not be required to provide additional treatment. Unfiltered systems under this rule must achieve at least a 2-log inactivation of Cryptosporidium if the mean levels in the source water remain below 0.01 oocysts/L. If an unfiltered system elects not to monitor, or the mean level of Cryptosporidium exceeds 0.01 oocysts/L, the LT2ESWTR requires the system to provide a minimum 3-log inactivation of Cryptosporidium. All unfiltered systems are also required to utilize a minimum of two disinfectants in their treatment processes.

The LT2ESWTR also addresses systems with unfinished water storage facilities. Under this rule, systems must either cover their storage facilities or achieve inactivation and/or removal of 4-log virus, 3-log Giardia lamblia and 2-log Cryptosporidium on a state-approved schedule. Lastly, the rule extends the requirement of the disinfection profiles mandated under the LT1ESWTR to the proposed Stage 2 D/DBPR. The City complied with these requirements prior to the publication of this rule, and currently complies with all contaminant monitoring requirements under this rule.

Unregulated Contaminant Monitoring Regulation Revisions

The EPA established the Unregulated Contaminant Monitoring Regulation (UCMR) to generate data on contaminants that are being considered for inclusion in new drinking water standards. The information collected by select public water systems will ensure that future regulations established by the EPA are based on sound science. The rule was first published in the Federal Register on September 17, 1999, and was subsequently amended on March 2, 2000, and January 11, 2001. The UCMR became effective on January 1, 2001.

Three separate lists of unregulated contaminants are maintained under the UCMR: List 1, List 2, and List 3. Contaminants are organized on the tiered lists based on the availability of standard testing procedures and the known occurrence of each contaminant, with List 1 containing contaminants that have established standard testing procedures and some, but insufficient, information on their occurrence in drinking water. Monitoring for contaminants on the three lists is limited to a maximum of 30 contaminants within a 5-year monitoring cycle, and the EPA is required to publish new contaminant monitoring lists every 5 years. As new lists are published, contaminants will be moved up in the lists if adequate information is found to support additional monitoring. All public water systems serving more than 10,000 people and a randomly selected group of smaller water systems are required to monitor for contaminants. The City currently monitors for some unregulated contaminants.

Watershed Control Program

The Washington State mandate for watershed protection and the required elements of a Watershed Control Program are contained in WAC 246-290-135, Source Protection, which became effective in July of 1994. In Washington State, DOH is the lead agency for the development and administration of the State's Watershed Control Program.

A Watershed Control Program is a proactive and ongoing effort of a water purveyor to exercise surveillance over the conditions and activities within the watershed affecting source water quality to protect the health of its customers, as outlined in WAC 246-290-668, Watershed Control. All federally defined Group A public water systems that use surface water or groundwater as their source are required to develop and implement a watershed control program. All required elements of a Watershed Control Program must be documented and included in the purveyor's WSP (applicable to the City) or Small Water System Management Program (not applicable to the City) at least every 6 years. A copy of the City's *Watershed Control Program* is contained in **Appendix G**.

Wellhead Protection Program

Section 1428 of the 1986 SDWA Amendments mandates that each state develops a Wellhead Protection Program. The Washington State mandate for wellhead protection, and the required elements of a Wellhead Protection Program, is contained in WAC 246-290-135, Source Protection, which became effective in July of 1994. In Washington State, DOH is the lead agency for the development and administration of the State's Wellhead Protection Program.

A Wellhead Protection Program is a proactive and ongoing effort of a water purveyor to protect the health of its customers by preventing contamination of the groundwater that it supplies for drinking water. All federally defined Group A public water systems that use groundwater as their source are required to develop and implement a Wellhead Protection Program. All required elements of a local Wellhead Protection Program must be documented and included in either the WSP (applicable to the City) or a Small Water System Management Program document (not applicable to the City). A copy of the City's Wellhead Protection Program is contained in **Appendix G**.

Groundwater Rule

The EPA promulgated the Groundwater Rule (GWR) to reduce the risk of exposure to fecal contamination that may be present in public water systems that use groundwater sources. The GWR also specifies when corrective action (which may include disinfection) is required to protect consumers who receive water from groundwater systems from bacteria and viruses. The GWR applies to public water systems that use groundwater and to any system that mixes surface and ground waters if the groundwater is added directly to the distribution system and provided to consumers without treatment equivalent to surface water treatment. The final rule was published in the Federal Register on November 8, 2006 and became effective on January 8, 2007.

The rule targets risks through an approach that relies on the four following major components.

1. Periodic sanitary surveys of groundwater systems that require the evaluation of eight critical elements and the identification of significant deficiencies (such as a well located near a leaking septic system). States must complete the initial survey for most community water systems by December 31, 2012, and for community water systems with outstanding

performance and all non-community water systems by December 31, 2014. DOH conducted its most recent sanitary survey of the City's water system on September 28, 2010 under the state's existing sanitary survey program.

2. Source water monitoring to test for the presence of *E. coli*, enterococci, or coliphage in the sample. There are two monitoring provisions.
    a. Triggered monitoring for systems that do not already provide treatment that achieves at least 99.99-percent (4-log) inactivation or removal of viruses and that have a total coliform positive routine sample in the distribution system under the Total Coliform Rule.
    b. Assessment monitoring is a complement to triggered monitoring. A state has the option to require systems to conduct source water assessment monitoring at any time to help identify high risk systems.
3. Corrective actions are required for any system with a significant deficiency or source water fecal contamination. The system must implement one or more of the following corrective action options:
    a. Correct all significant deficiencies;
    b. Eliminate the source of contamination;
    c. Provide an alternate source of water; or
    d. Provide treatment that reliably achieves 99.99-percent inactivation or removal of viruses.
4. Compliance monitoring to ensure that treatment technology installed to treat drinking water reliably achieves at least 99.99-percent inactivation or removal of viruses.

The compliance date for requirements of this rule other than the sanitary survey was December 1, 2009. The City is currently providing system-wide chlorination and therefore is not significantly impacted by the GWR.

FUTURE REGULATIONS

Drinking water regulations are continuously changing in an effort to provide higher quality and safer drinking water. Modifications to the existing rules described above and implementation of new rules are planned for the near future. A summary of upcoming drinking water regulations that will most likely affect the City is presented below.

Radon

In July 1991, the EPA proposed a regulation for radon, as well as three other radionuclides. The 1996 SDWA amendments required the EPA to withdraw the 1991 proposal due to several concerns that were raised during the comment period. A new proposed regulation was published in the Federal Register on November 2, 1999. Comments on the proposed rule were due to the EPA by February 4, 2000. Final federal requirements for addressing radon were delayed until 2008, but have not yet been published. The rule proposes a 300 pCi/L MCL for community water systems that use groundwater or an alternative, less stringent MCL of 4,000 pCi/L for water systems where their state implements an EPA-approved program to reduce radon risks in household indoor air and tap water. It is not currently known when or what a radon regulation may require as adopted by the EPA or what the rule's implementation schedule will be. Because the final radon rule requirements are uncertain, the impact of this rule on the City is currently unknown.

Unregulated Contaminant Monitoring Regulation Revisions

In accordance with the original UCMR, the EPA is proposing an updated contaminant monitoring list for the next 5-year monitoring cycle, in addition to other minor revisions to the UCMR. The proposed rule was published August 22, 2005, in the Federal Register, and the comment period for the proposed revisions closed on October 21, 2005. The revisions include a list of 26 chemicals that will be monitored during the 2007 through 2011 monitoring cycle and approves several new testing methods to conduct the monitoring. For this cycle, all systems serving more than 100,000 people and a larger representative sample of smaller water systems than mandated under the original rule will be required to monitor for unregulated contaminants. The rule also requires additional water system data to be reported with the monitoring results, establishes a procedure for determining minimum reporting levels, and proposes several revisions to the implementation of the monitoring program.

SOURCE WATER QUALITY

This section presents the current water quality standards for surface and ground water sources and the results of the City's recent source water quality monitoring efforts. A discussion of the water quality requirements and monitoring results for the City's distribution system is presented in the sections that follow.

DRINKING WATER STANDARDS

Drinking water quality is regulated at the federal level by the EPA and at the state level by DOH. Drinking water standards have been established to maintain high-quality drinking water by limiting the levels of specific contaminants (i.e., regulated contaminants) that can adversely affect public health and are known or are likely to occur in public water systems. Unregulated contaminants do not have established water quality standards and are generally monitored at the discretion of the water purveyor and in the interest of customers.

The regulated contaminants are grouped into two categories: primary standards and secondary standards. Primary standards are drinking water standards for contaminants that could affect health. Water purveyors are required by law to monitor and comply with these standards and notify the public if water quality does not meet any one of the standards. Secondary standards are drinking water standards for contaminants that have aesthetic effects, such as unpleasant taste, odor, or color (staining). The national secondary standards are unenforceable federal guidelines or goals where federal law does not require water systems to comply. However, states may adopt their own enforceable regulations governing these contaminants. The State of Washington has adopted regulations that require compliance with some of the secondary standards. Water purveyors are not required to notify the public if water quality does not meet the secondary standards.

SOURCE MONITORING REQUIREMENTS AND WAIVERS

The City is required to perform water quality monitoring at each active source for inorganic chemical and physical substances, organic chemicals, and radionuclides. The monitoring requirements that the City must comply with are specified in WAC 246-290-300. A description of the source water quality monitoring requirements and procedures for each group of substances is contained in the City's *Water Quality Monitoring Plan* that is included in **Appendix J** of this plan.

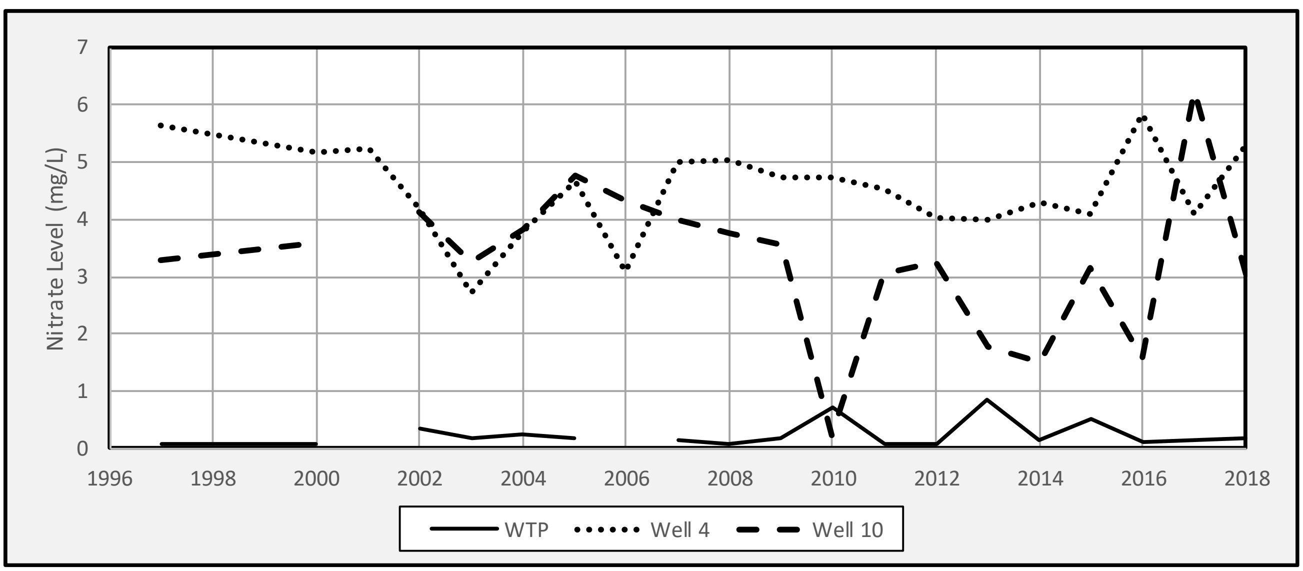
In 1994, DOH developed the Susceptibility Assessment Survey Form for water purveyors to complete for use in determining a drinking water source's potential for contamination. The results of the susceptibility assessment may provide monitoring waivers that allow reduced source water quality monitoring. DOH assigned high susceptibility ratings to Well Nos. 4 and 10 and the WTP, based on the results of the susceptibility assessment survey for each source.

SOURCE MONITORING RESULTS

The quality of the City's two groundwater sources and its sole surface water source has been good and meets or exceeds all drinking water standards. The City currently has 9-year IOC waivers for all sources. IOCs and physical substances were last monitored at Well No. 4 in 2004, Well No. 10 in 2013, and the WTP in 2018. The City currently has 6-year VOC waivers for all sources. VOCs were last monitored at Well No. 4 in 2009, Well No. 10 in 2009, and the WTP in 2017. Monitoring for radionuclides has been completed for all sources at the standard schedule; Well No. 4 was tested for gross alpha in 2014 and radium 228 in 2018, Well No. 10 was tested for both gross alpha and radium 228 in 2016, and the WTP was tested for both gross alpha and radium 228 in 2016.

Nitrate monitoring has been performed annually at each source. Nitrate concentrations at Well No. 4 have ranged between 4.1 to 5.86 mg/L, Well No. 10 nitrate concentrations have ranged between 1.56 to 6.26 mg/L, and nitrate concentrations at the WTP have been consistently under 1 mg/L. No long-term discernable trend for nitrates has been observed, though tests for the last two years are higher than average for Well Nos. 4 and 10 (**Chart 5.3**). Nitrate concentrations in both wells should be monitored in the near future and the City should plan for nitrate mitigation if future concentrations show an upward trend.

Chart 5.3
Historical Source Nitrate-N Test Results



The results of IOC (including nitrate) and VOC monitoring for the City's sources indicate that all primary and secondary standards were met.

The most recent source water test results are presented in **Table 5.3** for Well No. 4, **Table 5.4** for Well No. 10, and **Table 5.5** for the WTP. In the following tables, "ND" means the analyte was not detected in the test. SRL is the state reporting limit, which is the minimum value that the laboratory equipment must be able to detect.

Table 5.3
Well No. 4 Water Quality Test Results

Monitored Analyte	No. of Samples	Period	Last Sample	Result	MCL	SRL	Units	Next Sample
Nitrate	1	1 Year	7/9/2018	5.32	10	0.5	mg/L	7/9/2019
Coliform/E.Coli	n/a		7/29/2016	ND	Presence		none	
Volatile Organic (VOC)	**1**	**Waiver**						**7/1/2019**
Chloroform			7/9/2009	0.6	70	0.5	µg/L	
Dibromochloromethane			7/9/2009	0.6	60	0.5	µg/L	
Total Trihalomethane			7/9/2009	1.2	80		µg/L	
All others			7/9/2009	ND	Varies	Varies	Varies	
Complete Inorganic (IOC)	**1**	**Waiver**						**7/1/2019**
Antimony			10/6/2004	ND	0.006	0.003	mg/L	
Arsenic			10/6/2004	ND	0.01	0.1	mg/L	
Barium			10/6/2004	0.055	2	0.1	mg/L	
Beryllium			10/6/2004	ND	0.004	0.0003	mg/L	
Cadmium			10/6/2004	ND	0.005	0.001	mg/L	
Calcium			10/6/2004	53	n/a	0.05	mg/L	
Chloride			10/6/2004	12.5	250	20	mg/L	
Chromium			10/6/2004	ND	0.1	0.007	mg/L	
Color			10/6/2004	ND	15	15	CU	
Conductivity			10/6/2004	519	700	70	Umhos/cm	
Copper (action level)			10/6/2004	0.005	1.3	0.02	mg/L	
Cyanide			10/6/2004	ND	0.2	0.05	mg/L	
Disolved Solids			10/6/2004	288	500	100	mg/L	
Fluoride			10/6/2004	0.18	4	0.2	mg/L	
Hardness			10/6/2004	229	n/a	10	mg/L	
Iron	1	3 Year	10/6/2004	0.017	0.3	0.1	mg/L	6/1/2019
Lead (action level)			10/6/2004	0.0051	0.015	0.001	mg/L	
Magnesium			10/6/2004	23.4	n/a	0.1	mg/L	
Manganese			10/6/2004	ND	0.05	0.01	mg/L	
Mercury			10/6/2004	ND	0.002	0.0002	mg/L	
Nickel			10/6/2004	ND	0.1	0.005	mg/L	
Selenium			10/6/2004	ND	0.05	0.002	mg/L	
Silver			10/6/2004	ND	0.1	0.1	mg/L	
Sodium			10/6/2004	19.5	n/a	5	mg/L	
Sulfate			10/6/2004	22.2	250	50	mg/L	
Thallium			10/6/2004	ND	0.002	0.001	mg/L	
Turbidity			10/6/2004	ND	n/a	0.1	NTU	
Zinc			10/6/2004	ND	5	0.2	mg/L	
Synthetic Organic (SOC)								
Herbicides	1	3 Year	7/29/2015	ND	Varies	Varies	Varies	7/1/2019
Pesticides	1	3 Year	7/29/2015	ND	Varies	Varies	Varies	7/1/2019
Soil Fumigants (EDB/DBCP)	0	n/a	7/8/2009	ND	Varies	Varies	Varies	Now in VOC test
Radionuclides								
Gross Alpha	1	6 Year	7/16/2014	ND	15	3	pCi/L	7/16/2020
Radium 228	1	6 Year	7/9/2018	0.399	5	1	pCi/L	7/9/2024

Table 5.4
Well No. 10 Water Quality Test Results

Monitored Analyte	No. of Samples	Period	Last Sample	Result	MCL	SRL	Units	Next Sample
Nitrate	1	1 Year	7/9/2018	3.01	10	0.5	mg/L	7/9/2019
Coliform/E.Coli	n/a				Presence		none	
Volatile Organic (VOC)	**1**	**Waiver**						**7/1/2019**
Chloroform			7/9/2009	ND	70	0.5	μg/L	
Dibromochloromethane			7/9/2009	ND	60	0.5	μg/L	
Total Trihalomethane			7/9/2009	ND	80		μg/L	
All others			7/9/2009	ND	Varies	Varies	Varies	
Complete Inorganic (IOC)	**1**	**Waiver**						**12/21/2022**
Antimony			10/21/2013	ND	0.006	0.003	mg/L	
Arsenic			10/21/2013	0.0006	0.01	0.1	mg/L	
Barium			10/21/2013	0.0309	2	0.1	mg/L	
Beryllium			10/21/2013	ND	0.004	0.0003	mg/L	
Cadmium			10/21/2013	ND	0.005	0.001	mg/L	
Calcium			10/21/2013	37.8	n/a	0.05	mg/L	
Chloride			10/21/2013	9.3	250	20	mg/L	
Chromium			10/21/2013	0.0021	0.1	0.007	mg/L	
Color			10/21/2013	ND	15	15	CU	
Conductivity			10/21/2013	341	700	70	Umhos/cm	
Copper (action level)			10/21/2013	0.0014	1.3	0.02	mg/L	
Cyanide			10/21/2013	ND	0.2	0.05	mg/L	
Disolved Solids			10/21/2013	182	500	100	mg/L	
Fluoride			10/21/2013	0.12	4	0.2	mg/L	
Hardness			10/21/2013	145	n/a	10	mg/L	
Iron			10/21/2013	ND	0.3	0.1	mg/L	
Lead (action level)			10/21/2013	0.0004	0.015	0.001	mg/L	
Magnesium			10/21/2013		n/a	0.1	mg/L	
Manganese			10/21/2013	0.0005	0.05	0.01	mg/L	
Mercury			10/21/2013	ND	0.002	0.0002	mg/L	
Nickel			10/21/2013	ND	0.1	0.005	mg/L	
Selenium			10/21/2013	0.0006	0.05	0.002	mg/L	
Silver			10/21/2013	ND	0.1	0.1	mg/L	
Sodium			10/21/2013	9.95	n/a	5	mg/L	
Sulfate			10/21/2013	11.4	250	50	mg/L	
Thallium			10/21/2013	0.0007	0.002	0.001	mg/L	
Turbidity			10/21/2013	0.25	n/a	0.1	NTU	
Zinc			10/21/2013	0.005	5	0.2	mg/L	
Synthetic Organic (SOC)								
Herbicides	1	Waiver	7/9/2012	ND	Varies	Varies	Varies	7/1/2021
Pesticides	0		7/25/2007	ND	Varies	Varies	Varies	n/a
Soil Fumigants (EDB/DBCP)	0		7/9/2009	ND	Varies	Varies	Varies	Now in VOC tests
Radionuclides								
Gross Alpha	1	6 Year	10/10/2016	ND	15	3	pCi/L	10/10/2022
Radium 228	1	6 Year	10/10/2016	ND	5	1	pCi/L	10/10/2022

Table 5.5
Water Treatment Plant Water Quality Test Results

Monitored Analyte	No. of Samples	Period	Last Sample	Result	MCL	SRL	Units	Next Sample
Nitrate	1	1 Year	7/9/2018	0.17	10	0.5	mg/L	7/9/2019
Coliform/E.Coli (Raw water)	n/a		10/3/2018	790	Presence		none	
Volatile Organic (VOC)	**1**	**Waiver**						**3/20/2023**
Chloroform			3/20/2017	6.4	70	0.5	µg/L	
Bromodichloromethane			3/20/2017	0.7		0.5	µg/L	
Total Trihalomethane			3/20/2017	7.1	80		µg/L	
All others			3/20/2017	ND	Varies	Varies	Varies	
Complete Inorganic (IOC)	**1**	**Waiver**						**3/16/2020**
Antimony			3/16/2011	ND	0.006	0.003	mg/L	
Arsenic			3/16/2011	ND	0.01	0.1	mg/L	
Asbestos			10/15/2009	ND	7		mg/L	none
Barium			3/16/2011	0.012	2	0.1	mg/L	
Beryllium			3/16/2011	ND	0.004	0.0003	mg/L	
Cadmium			3/16/2011	Nd	0.005	0.001	mg/L	
Calcium			3/16/2011	6.14	n/a	0.05	mg/L	
Chloride			3/16/2011	2.8	250	20	mg/L	
Chromium			3/16/2011	ND	0.1	0.007	mg/L	
Color			3/16/2011	ND	15	15	CU	
Conductivity			3/16/2011	78	700	70	Umhos/cm	
Copper (action level)			3/16/2011	ND	1.3	0.02	mg/L	
Cyanide			3/16/2011	ND	0.2	0.05	mg/L	
Disolved Solids			3/16/2011	26	500	100	mg/L	
Fluoride			3/16/2011	0.05	4	0.2	mg/L	
Hardness			3/16/2011	28.6	n/a	10	mg/L	
Iron			3/16/2011	ND	0.3	0.1	mg/L	
Lead (action level)			3/16/2011	ND	0.015	0.001	mg/L	
Magnesium			3/16/2011	3.23	n/a	0.1	mg/L	
Manganese			3/16/2011	ND	0.05	0.01	mg/L	
Mercury			3/16/2011	ND	0.002	0.0002	mg/L	
Nickel			3/16/2011	ND	0.1	0.005	mg/L	
Selenium			3/16/2011	ND	0.05	0.002	mg/L	
Silver			3/16/2011	ND	0.1	0.1	mg/L	
Sodium			3/16/2011	2.4	n/a	5	mg/L	
Sulfate			3/16/2011	2.92	250	50	mg/L	
Thallium			3/16/2011	ND	0.002	0.001	mg/L	
Turbidity			3/16/2011	0.25	n/a	0.1	NTU	
Zinc			3/16/2011	ND	5	0.2	mg/L	
Synthetic Organic (SOC)								
Herbicides	1	3 Year	1/27/2015	ND	Varies	Varies	Varies	2/1/2019
Pesticides	0	3 Year	1/27/2015	ND	Varies	Varies	Varies	2/1/2019
Soil Fumigants (EDB/DBCP)	0		8/11/1998	ND	Varies	Varies	Varies	Now in VOC tests
Radionuclides								
Gross Alpha	1	6 Year	10/10/2016	ND	15	3	pCi/L	10/10/2022
Radium 228	1	6 Year	10/10/2016	ND	5	1	pCi/L	10/10/2022

DISTRIBUTION SYSTEM WATER QUALITY

MONITORING REQUIREMENTS

The City is required to perform water quality monitoring within the distribution system for coliform bacteria, disinfectant (chlorine) residual concentration, lead and copper, asbestos, and disinfection byproducts in accordance with WAC 246-290. A description of the distribution system water quality monitoring requirements and procedures are contained in the City's *Water Quality Monitoring Plan* that is included in **Appendix J** of this plan.

A summary of the results of distribution system water quality monitoring within the City's system follows.

Coliform Monitoring

The City is required to collect a minimum of three coliform samples per month from different locations throughout the system, based on an estimated population of 3,075. Samples are taken at each of the City's three sources of supply and at locations that are representative of the entire system. The samples are collected during the first week of each month and are tested by the Chelan-Douglas County Health District. City's coliform monitoring program is on a monthly schedule, allowing collection of samples from each of the City's nine sampling locations throughout the year. Additional information on the City's coliform monitoring requirements and procedures is contained in the City's Water Quality Monitoring Plan that is included in **Appendices J** of this plan.

Disinfectant Residual Concentration Monitoring

In accordance with WAC 246-290-662, the minimum residual disinfectant concentration entering the City's distribution system must be at least 0.2 mg/L. The maximum residual disinfectant level for chlorine must not exceed 4.0 mg/L. Samples taken within the distribution system are required to have a residual disinfectant concentration that is detectable in at least 95-percent of the samples taken each calendar month. Disinfectant residual concentrations are monitored and recorded continuously at the WTP and at the two wells. Additionally, residual concentrations are also checked monthly at the City's coliform monitoring sites.

Lead and Copper Monitoring

The Lead and Copper Rule identifies the action level for lead as being greater than 0.015 mg/L and the action level for copper as being greater than 1.3 mg/L.

Asbestos

Asbestos monitoring is required if sources are vulnerable to asbestos contamination or if more than 10-percent of the distribution system contains asbestos cement pipe. Although asbestos cement pipe is not present in the City's water system, the City is vulnerable to asbestos contamination through its surface water source. Therefore, the City must monitor for asbestos in the distribution system. The current MCL for asbestos is 7-million fibers per liter and greater than 10 microns in length. Monitoring must be accomplished during the first 3-year compliance period of each 9-year compliance cycle. The water sample must be taken at a tap that is served by an asbestos cement pipe under conditions where asbestos contamination is most likely to occur.

Disinfectants/Disinfection By-products Monitoring

TTHM and HAA5 are disinfection by-products that are formed when free chlorine reacts with organic substances (i.e., precursors), most of which occur naturally. Formation of TTHM and HAA5 is dependent on such factors as amount and type of chlorine used, water temperature, concentration of precursors, pH, and chlorine contact time. TTHM and HAA5 have been found to cause cancer in laboratory animals and are suspected to be human carcinogens.

The City is required to monitor for trihalomethanes because the Wenatchee River source is classified as surface water and requires disinfection.

To meet Stage 2 D/DBPR requirements the City is performing standard monitoring as proposed in the Standard Monitoring Plan included in **Appendix J**.

MONITORING RESULTS

The City has complied with all distribution system water quality monitoring requirements for the past several years.

Coliform

Samples taken from the City's water system have never tested positive for coliform since 1997.

Disinfectant Residual

The City's chlorination target is to maintain a residual disinfectant concentration of at least 0.4 mg/L at all active parts of the distribution system. Actual chlorine concentrations usually range between 0.7 to 0.8 mg/L at the far reaches of the system and between 1.0 to 1.2 mg/L in the water leaving the WTP. Experience has yielded higher numbers of taste and odor complaints when the initial chlorine residuals from the WTP drop to 0.6 to 0.8 mg/L and system residual concentrations are approximately 0.4 mg/L (break-point chlorination). The chorine levels at the City's wells are generally set to produce chlorine residuals of 0.8 mg/L when they are operating. Residual concentrations have been within DOH's limits. The City complies with disinfection regulations.

Lead and Copper

The results of the tests from the City's 2017 monitoring, which included 10 sample sites, indicate a range of less than 0.0005 mg/L to 0.0043 mg/L for lead and 0.016 mg/L to 0.652 mg/L for copper. These results have all been satisfactory, since the 90th percentile concentration of either lead or copper from each group of samples has not exceeded the action levels.

Asbestos

The City's most recent sample in 2013 did not detect asbestos.

Disinfectants/Disinfection By-products

The City currently has an approved IDSE monitoring plan and has maintained compliance with quarterly monitoring. May is the month where disinfection byproduct concentrations are at the highest, and monitoring in 2018 resulted in haloacetic acid concentrations being less than the 0.06 mg/L MCL and TTHM concentrations less than the 0.08 mg/L MCL at four sample locations. Therefore, the City complies with these regulations.

Results of the most recent distribution system tests are show in **Table 5.6**.

Table 5.6
Distribution System Water Quality Test Results

Monitoring Group	No. of Samples	Period	Last Sample	Result (max)	MCL	SRL	Units	Next Sample
Coliform	3	1 Month	10/3/2018	ND	Presence		none	Monthly
Lead	10	3 Year	9/20/2017	0.0043	0.015	0.001	mg/L	9/1/2020
Copper	10	3 Year	9/20/2017	0.652	1.3	0.02	mg/L	9/1/2020
Asbestos	1	9 Year	6/11/2013	ND	7	7	MFL	6/11/2022
Disinfection Byproducts	**2**	**3 Month**						**Quarterly**
Total Trihalomethane			8/8/2018	16.22	80		µg/L	
Chloroform			8/8/2018	15.35	70	0.5	µg/L	
Bromodichloromethane			8/8/2018	0.87		0.5	µg/L	
Dichloroacetic Acid			8/8/2018	6.8		1	µg/L	
Trichloroacetic Acid			8/8/2018	8.9	20	1	µg/L	
HAA(5)			8/8/2018	15.7	60	6	µg/L	
All others			8/8/2018	ND	Varies	Varies	µg/L	

6 | WATER SYSTEM ANALYSIS

INTRODUCTION

This chapter presents the analysis of the City of Cashmere's (City) existing water system. Individual water system components were analyzed to determine their ability to meet policies and design criteria under both existing and future water demand conditions. The policies and design criteria are presented in **Chapter 4** and the water demands are presented in **Chapter 3**. The last section of this chapter presents the existing system capacity analysis that was performed to determine the maximum number of equivalent residential units (ERU) that can be served by the City's existing water system.

FACILITY EVALUATION

Chapter 1 presents a general physical description of the system facilities. In this section we describe the condition or performance of the facilities and any deficiencies noted.

PRESSURE ZONES

The ideal static pressure of water supplied to customers is between 40 and 80 pounds per square inch (psi). Pressures within a water system's distribution system can be over 100 psi, requiring pressure regulators on individual service lines to reduce the pressure to 80 psi or less. It is not economically practical for the City's current water system to maintain distribution pressures between 40 and 80 psi everywhere due to the topography within the water service area.

Table 6.1 lists each of the City's five pressure zones, the highest and lowest elevation currently served in each zone, and the minimum and maximum distribution system pressures within each zone, based on maximum and minimum operational conditions.

Table 6.1
Pressure Zone Ranges

Pressure Zone	895	1000	1050	1114	1310
Highest Elevation	807 ft	865 ft	908 ft	1,024 ft	1,230 ft
Lowest Elevation	756 ft	803 ft	821 ft	823 ft	1,020 ft
Highest HGL	902 ft	1,000 ft	1,050 ft	1,114 ft	1,310 ft
Lowest HGL (PHD)	885 ft	990 ft	1,046 ft	1,098 ft	1,305 ft
Highest Pressure	63 psi	85 psi	99 psi	126 psi	126 psi
Lowest Pressure	34 psi	54 psi	60 psi	32 psi	32 psi

HGL = Hydraulic Grade Line

The City is currently providing water at a pressure of at least 30 psi to all customer services at peak hour demand (PHD). The lowest pressures in the 895 Zone occur in the higher elevations near the railroad. Similar to the 895 Zone, the lower pressures in the 1114 Zone occur in the higher elevations near the Kennedy Reservoir. Although these pressures do not fall within the ideal pressure range due to system constraints in the area, they adequately meet Washington State Department of Health (DOH) minimum pressure requirement of 30 psi.

The highest pressure in the system occurs along Chapel Street, just north of Valley View Drive, in the 1114 Zone. The service at this location and most of the other services in this 1114 zone has static pressures greater than 80 psi. Therefore, pressure regulators have been installed on the service lines to reduce the pressures to acceptable levels. Any future services in these lower elevation areas of the 1114 Zone should also be equipped with pressure regulators to control pressures.

PRESSURE REDUCING STATIONS

The City has seven pressure reducing stations. Five of the stations transfer water from the 1114 Zone to the intermediate pressure zones of the system. Except for the Chapel Street station, which serves the 1000 Zone, each of these stations are located below grade and some are periodically flooded due to high groundwater. All five pressure reducing stations that transfer water to the intermediate pressure zones are sufficiently sized to meet fire flow and other demands of the zones that they serve. However, the 8-inch Natatorium pressure reducing valve (PRV) is served by only a 4-inch main, which restricts supplemental fire flow to the west portion of the 895 Zone.

There are no PRV’s in the system, except for one in the Sherman Booster Pump Station (BPS). Should a PRV to a closed zone fail in the open position, the downstream pressure would rise to the level of the upper pressure zone’s hydraulic grade. Pressure could rise by 50 psi in the 1000 Zone and 30 psi in the 1050 Zone if a PRV failed open.

Table 6.2
PRV Failure Pressure

Pressure Zone	Lowest Elevation	Normal Pressure	Supply Zone	PRV Failure Pressure
1000	821 ft	78 psi	1,114 ft	127 psi
1050	803 ft	107 psi	1,114 ft	135 psi

Although two PRVs discharge into the 895 Zone, hydraulic modeling shows that excess pressure due to a PRV failure would be absorbed into the Sherman Reservoir and should not cause a significant pressure rise. However, if the failed PRV stays open for an extended time, it is possible that the Sherman Reservoir will overflow.

The 1050 Zone is supplied by only the single 6-inch Sherman PRV. Should this valve fail in the closed position, there would be no water supply to the pressure zone. This relatively large PRV is also not ideal for serving normal domestic demands as it has a minimum recommended flow of 10 gallons per minute (gpm). This large valve could give inconsistent performance at low flows, though the City has not noted poor performance to date.

Four of the PRV vaults are normally flooded due to high groundwater. These are the Fisher, Tigner, Oak, and Natatorium stations. If a flooded station needs service, the City first must pump out the water. This is typically only an inconvenience, though it could be a liability if a PRV in a flooded station fails and needs to be shut off quickly. As expected in the flooded stations, the valve and piping exterior are badly corroded, though perhaps not yet to a point where there is a structural concern. Should corrosion penetrate a pipe or pilot line, a low-pressure event could pull the flooded water into the system. The stations should either be raised above grade, waterproofed, or provided with sump pumps.

SUPPLY FACILITIES

Wells

Well Nos. 4 and 10 lack security fencing and engine generators that would provide backup power supply in the event of a power outage. Both well buildings are generally in good condition.

Both wells are operated manually, there is no automatic control. The operational status (on/off) is logged in the supervisory control and data acquisition (SCADA) system. Flow meters are read manually, they are not connected to the SCADA system.

Well No. 10

The capacity of Well No. 10 has steadily dropped from 250 gpm to 130 gpm since the last redevelopment in 2006. It is believed the casing perforations clog over time with a combination of sand and mineral deposits. The result is excessive water drawdown which causes the pump to pull air into the system. The City manually throttles the pump discharge valve to reduce flow, but the resulting high pressure on the pump side of the valve limits throttling to no less than 130 gpm.

The pump control valve is currently not functional. Because the motor starter is an across-the-line style, the pump must be started and stopped with manual throttling of the discharge valve to prevent water hammer.

Well No. 4

Well No. 4 was originally tested in 1944 at up to 650 gpm with 55 feet of drawdown. It currently operates throttled at 230 gpm to prevent drawing air, similar to Well No. 10. The well configuration makes is less prone to clogging than Well No. 10, but verbal records indicate capacity has slowly declined over time.

A 2-inch PRV was added in 2019 due to the Sherman Reservoir roof damage. The valve is intended to help operate the well if the reservoir is taken offline. The valve may remain in place permanently, though that has not yet been decided. The 2-inch valve has a 210 gpm maximum flow rating.

Water Treatment Plant

The water treatment plant (WTP) can experience decreases in production largely due to varying environmental conditions which affect the intake screens in the river. Mountain snow packs and seasonal ambient temperatures and rain water greatly influence the surface water elevations of the WTP's source of supply, the Wenatchee River. Adverse water elevations impact supply capabilities in that a lower groundwater table decreases the WTP's pumping capabilities by increasing the required lift, and lower surface water elevations in the Wenatchee River equates to poorer quality of raw water due to high temperatures, larger algal growths, and elevated coliform concentrations. One possible improvement would be to construct a settling basin between the river pumps and the filter cells to remove large particulate. A further evaluation of the practicality of this option should be reviewed before budgeting.

Naturally occurring conditions, such as large algal growths within the river basin or winter frazil ice conditions (small shards of ice throughout the river), can temporarily plug the WTP's intake screens and cause supply deficiencies. Though these conditions are largely uncontrollable, they do accentuate deficiencies that are inherent in the present configuration. Water must first pass through intake screens and gravity flow to intake caissons before it can be treated for potable use. Therefore, any blockage at the intake screens has a rippling effect on the quantity of water produced through the WTP. Currently, plumbing is in place to pump compressed air out to the intake screens for cleaning purposes. The City modified this plumbing so the compressed air could also push a column of water back out through the intake screens. During periods of poor Wenatchee River water quality, the flushing may be needed up to five times per day. These measures are moderately successful in most conditions; however, they are inadequate when Wenatchee River flows cause rock and sand to completely fill the intake screen area. After such occurrences, manual removal of the rock and sand appear to be the only remedy for the intake screen clogging, which is only practical at low Wenatchee River flow level times.

The floats in the river intake caissons tended to freeze in the winter. The City has added a blower to provide warm air to the sensor casings. This system has worked adequately to date.

The river intake facilities do not have a convenient means to remove the existing pumps. The existing rail lift does not extend the full height of the casings and there is no rail system for removal of the pumps from the building.

The WTP flow rate is measured only between the filter cells and the wet well. Neither supply from the river to the ponds, nor flow from the WTP directly to the system is metered. This makes it difficult to estimate daily water use or evaluate pump condition. A meter installed on the downstream side of the WTP pumps would improve record keeping. Another advantage to having a discharge flow meter would be to periodically check the pump performance to see if they require service or nearing their useful life.

In 2016, Gray and Osborne estimated the WTP pump flow rates using drawdown times in the clearwell. The results are included on the pump curves in **Appendix P**, and indicate the pumps may be operating well outside of their recommended range. The pump nameplates state the design points are 192 feet of head, though the actual operating head is approximately 150 feet. It may also be that the nameplates are incorrect, but further testing would be required for verification. Without a flow meter, such testing will be difficult.

To RH2 Engineering, Inc.s (RH2) knowledge, removal of WTP Pump Nos. 1, 2 and 3 has never been attempted. The motors can be removed with the overhead crane rail, but the ability to remove the pumps using the same system is unknown. The addition of roof hatches would allow use of a crane truck for pump removal.

The facility is not currently equipped with an engine generator that would provide backup power supply in the event of a power outage.

A 3-inch PRV was added in 2019 due to the Sherman Reservoir roof damage. The valve is intended to help operate the plant if the reservoir is taken offline. The valve may remain in place permanently, though that has not yet been decided. The 3-inch valve has a 460 gpm maximum flow rating.

Proposed improvements to resolve some facility deficiencies are identified in **Chapter 8**.

TREATMENT

The WTP has operated adequately to date. The operators regularly check the filter bed headloss and clean it when necessary. The cells were cleaned in 2006, 2007, 2008, and 2012. By 2018, caking had reduced the filter performance dramatically to less than half. The City cleaned the cells in early 2019, bringing the plant back to full capacity. Water quality parameters (chlorine residual, turbidity, pH, temperature, filter bed headloss) are measured and logged locally, but not monitored remotely.

The WTP and Well Nos. 4 and 10 each have gas chlorination systems which are operating adequately. The City prefers these systems over liquid chlorine due to their simplicity and reliability.

DISTRIBUTION

Some areas of the system have water mains that are more than 50 years old, which is nearing the average life expectancy of some pipe materials. Although sufficient information is not available to determine the age of all water mains in the system, the City has been monitoring water mains to identify inadequate pipe. The City will continue to monitor the integrity of water mains by recording water main leaks, breaks, and other problems that may be related to the age of the water main to effectively plan and budget water main replacements in advance of further problems. The following mains have a history of regular service requirements.

1. Sullivan Street: Many of the original leaded joints in this cast iron (CI) main have failed. The City repacks the joints when leaks are discovered.
2. Chapel Street: Many of the original leaded joints in this CI main have failed. The City repacks the joints when leaks are discovered. This main will be replaced in 2019.

PUMP STATIONS

The 1114 Zone is fed primarily by the Sherman BPS, with Well No. 10 used only in the summer or during maintenance. Because the Sherman pumps are physically inside of the reservoir, loss of the Sherman Reservoir will also disable the pump station. The Sherman pumps are removed via sling and cable. Removal is difficult due to the weight, limited access, no working platform, and no line of sight to a crane operator.

An alternate source for transferring water from the 895 Zone to the 1114 Zone and the other two zones that it serves would support non-interrupted service if the Sherman BPS is out of service. Proposed improvements for these facilities are identified in **Chapter 8**.

All pump station flow meters are read manually, once each day. This can result in inconsistent data if the reads are taken at different times of the day. A SCADA system was installed in 2015 which records pump start and stop times, but the flow meters are not currently connected to the system.

The Vista Heights station is generally in good working order. The flow meter register head is malfunctioning. The City does not currently record water use at this pump station. However, all water that is pumped through this station is being recorded through other flow meters.

RESERVOIRS

No interior inspection of either the Sherman or Kennedy Reservoirs has been performed for at least 15 years. A diving company may be contacted for inspection and cleaning.

Kennedy

The 2.0 million gallon (MG) Kennedy Reservoir was repainted in 2003, and is not expected to need another coating for at least 15 years, based on experience with other coating systems and assuming the City is thorough with inspections and touchups.

The Kennedy Reservoir does not include any seismic restraint systems. RH2 performed a seismic calculation in 2019 using American Society of Civil Engineers (ASCE) 7-16 criteria and assuming the reservoir was built to American Water Works Association (AWWA) D100 standards. No field measurements of dimensions or steel thickness were performed. It was determined that the Kennedy

Reservoir meets current criteria for overturning, sliding, and plate buckling. The calculated sloshing wave height is 3.5 feet. A reservoir can be damaged by wave action of the stored water during an earthquake. The vertical wall is 30 feet tall (3 rows of 10 foot plates). The overflow is at 32.0 feet, and maximum design water height is 31.5 feet, placing the water level into the roof knuckle. In older ASCE codes, it was acceptable to use volume in the roof area to accommodate wave action, but under the ASCE 7-16 code (expected to be adopted in 2019 or 2020) the sloshing wave height would measured down from the bottom of the roof framing members, which is estimated to reduce the maximum water level to 26.5 feet. This reduces usable volume by 0.3 MG, or about 15-percent. Based on current growth projections, there is sufficient excess capacity in the reservoir to accommodate the volume reduction for the foreseeable future, see **Table 6.9**. The City is not required to adjust the operational water level to accommodate possible wave action, but should consider it. Additional calculations can be performed to determine if the existing reservoir can withstand the wave action without damage. To perform these calculations, the rafter depth, number of rafters, and rafter/roof shell connection style are needed.

Sherman

Around the year 1990, leakage was detected from the Sherman Reservoir. The tank was drained, and a buried joint on the inlet/outlet pipe in the center of the floor was found to have separated. The City removed that portion of the floor, repaired the fitting joint, and repaired the floor. No significant leakage from the underdrain system has been noted since. The underdrain manhole was checked in 2019, and no water was seen, though it is possible the underdrain system is plugged. The underdrain could be inspected with a camera to check condition.

The center portion of the wood and steel roof trusses collapsed in March 2019, though the roofing elastomer remained intact. As of the writing of this Water System Plan (WSP), the City is pursuing replacement of the entire roof structure. An inspection of the reservoir interior will be performed during roof replacement.

CONTROLS

A Mission Communications SCADA system was installed in 2015 which records reservoir levels and transmits alarms, replacing the previous reservoir cable float gauges and Gronel remote controllers. The reservoir levels are used to operate the WTP and Sherman pumps. Well Nos. 4 and 10 are still operated manually. The SCADA system currently has minimal data logging and alarm functions enabled, but has been reasonably reliable since installation.

HYDRAULIC MODELING

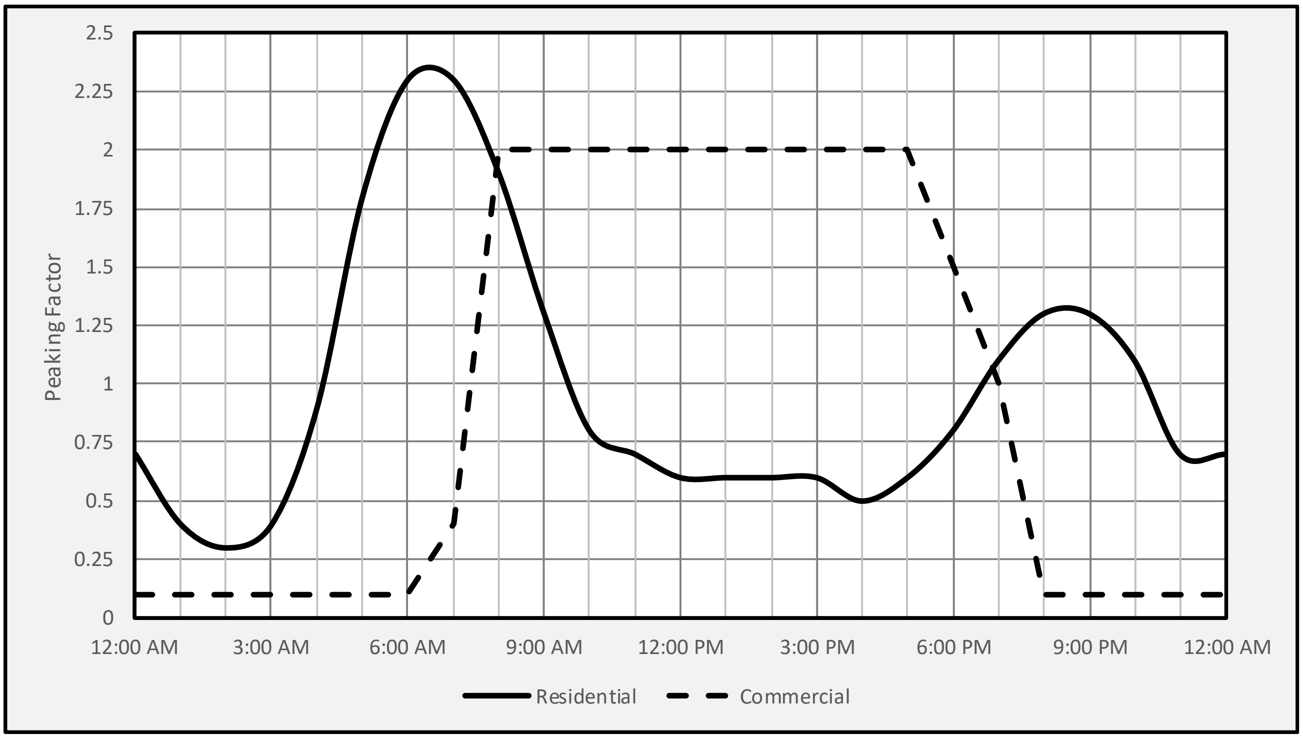
MODEL DESCRIPTION AND SETUP

A computer-based hydraulic model of the existing water system was created using version V8i of the WaterCAD® program, developed by Bentley Systems. All known facilities and water mains in the City’s water system, including dead-end mains, were modeled using available data. The water mains were entered from an AutoCAD water system map provided by the City. The junction node elevations were electronically extracted from the City's digital contour maps. A hydraulic model node diagram that provides a graphical representation of the model of the water system is contained in **Appendix Q**, though given the scale, the text is only legible in PDF format.

DEMAND DATA

The hydraulic model of the existing system contains 2017 average day demand (ADD) and maximum day demand (MDD) data. Supply data from the 2017 ADD was distributed throughout the junction nodes of the model based on approximated consumption patterns of the system, as represented by the water use in each pressure zone. Concentrated demands were added at Crunch Pak and Bluestar due to the high industrial use. Because there is limited continuous data available, average day diurnal curves were developed from comparable pressure zones in the nearby East Wenatchee Water District. Commercial demand is assumed to be constant during daytime working hours. These modeling curves are shown on **Chart 6.1**.

Chart 6.1
ADD Diurnal Curve (Analogous System Estimate)



For MDD, the reservoir level and pump operational data for the actual maximum supply days in 2016 and 2017 were used to develop diurnal curves for the high and low pressure zones. Those diurnal curves are shown on **Chart 6.2** and **Chart 6.3**.

Chart 6.2
Low Pressure Zone MDD Diurnal Curve

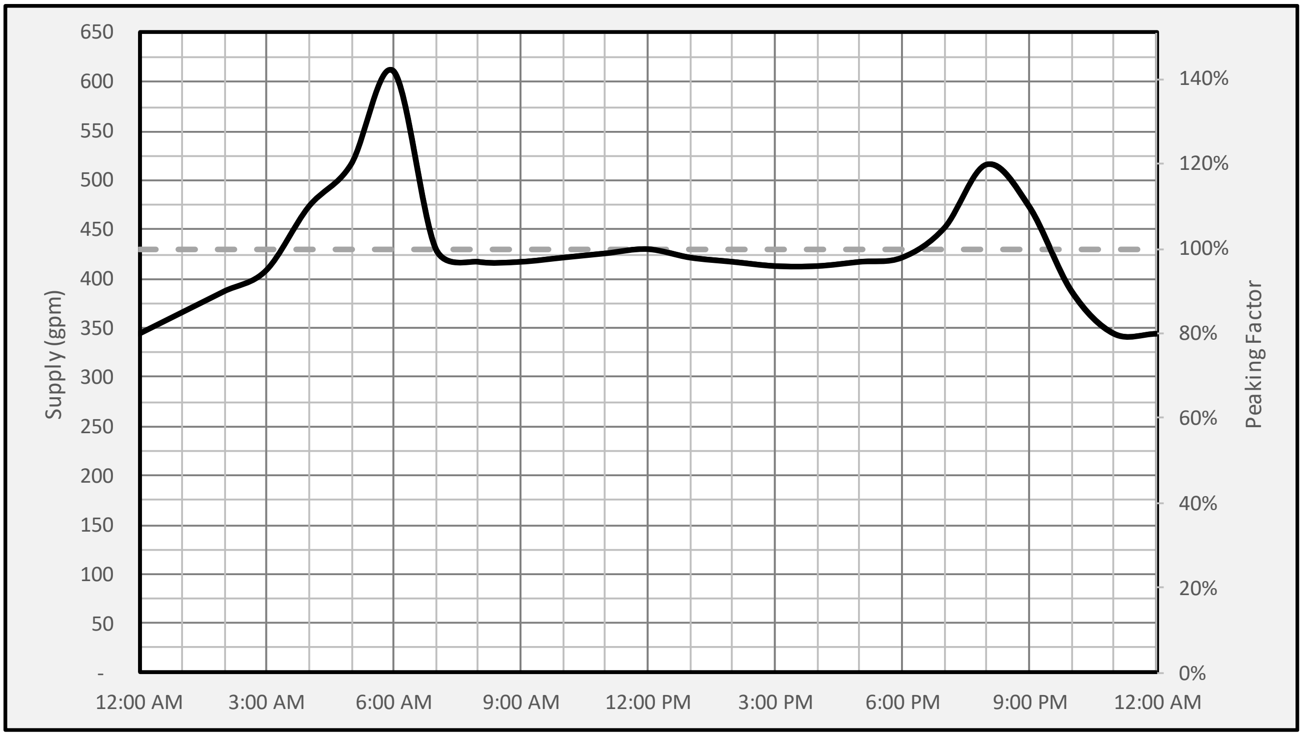
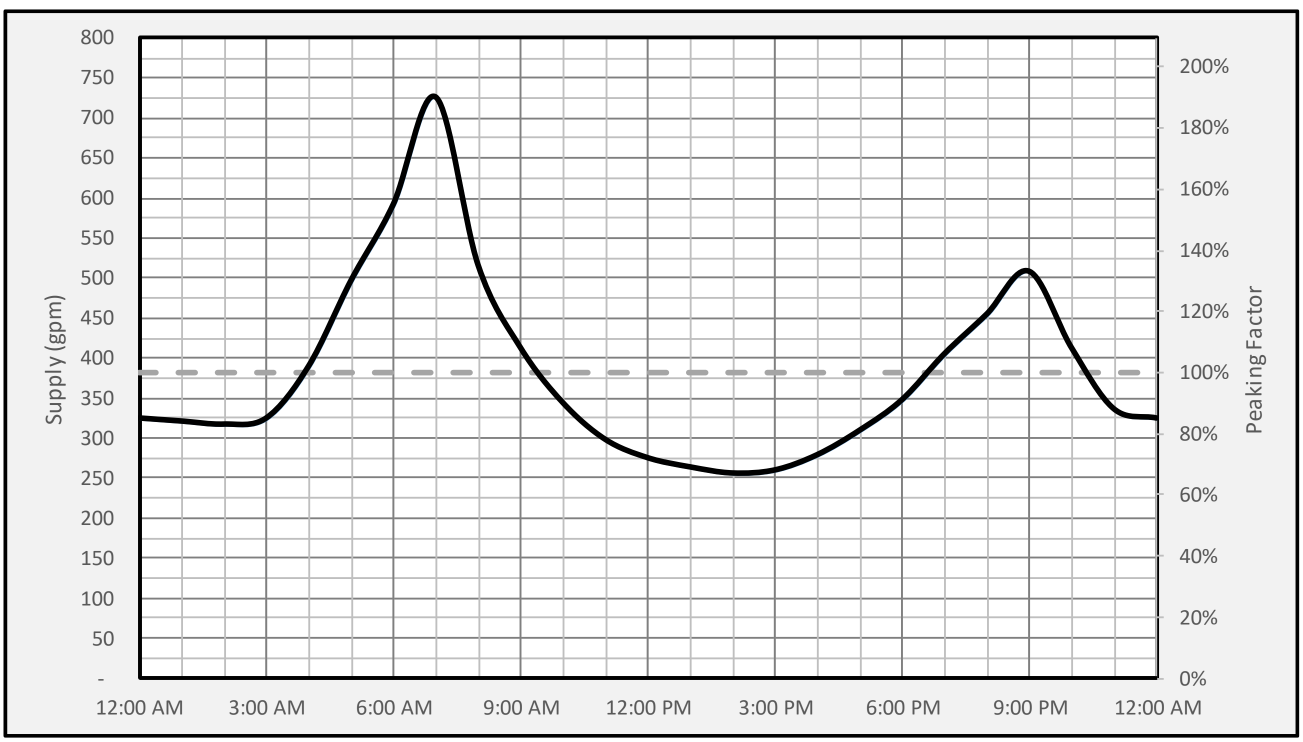


Chart 6.3
High Pressure Zones MDD Diurnal Curve



One interesting point is that on peak days, customer demand never drops much below 80-percent of the daily average even in the middle of the night. This is likely due to lawn watering and industrial night-shift processing work.

The hydraulic model of the proposed system contains current and 20-year demand levels that are projected for the year 2038. The distribution of demands is based on estimated future demand levels in each pressure zone.

FACILITIES

The hydraulic model of the existing system contains all active existing system facilities with settings that correspond to the actual operational settings expected during the relevant time periods. All sources of supply were operating at their normal pumping rates.

PEAK HOUR DEMAND

The Sherman BPS was modeled with the smaller pump operating, which is consistent with its current operational method. The reservoir levels were modeled to reflect full utilization of operational and equalizing storage. All active pressure reducing stations were modeled as being in service, and at their normal set points.

FIRE FLOW

The hydraulic model of the existing system for the fire flow analyses contains all active existing system facilities with settings that correspond to MDD events. The model is configured with the following settings:

- All pumps were modeled at their normal pumping rates.
- To be consistent with DOH criteria, the largest pump in each pressure zone is out of service.
- Well Nos. 4 and 10 are modeled out of service because they are operated manually and might not be running when a fire starts.
- The reservoir levels were modeled to reflect full utilization of operational, equalizing, and fire flow storage. Fire flow storage, based on the maximum requirement of 3,500 gpm for 3 hours or 630,000 gallons, for the entire system was provided by the Kennedy Reservoir in the upper zone.
- All active pressure reducing stations were modeled as being in service and at their normal set points.
- General planning level fire flow capacities by land use are shown in **Chapter 4**.

20 YEAR

The hydraulic model of the proposed system in the year 2038 contains all active existing system facilities and proposed system improvements that are identified in capital improvement project list. All supply sources were operating at their normal rates of supply.

CALIBRATION

Hydraulic model calibration is the process of using field pressure and flow data to improve the accuracy of the hydraulic model data. Hydraulic model calibration is achieved by adjusting the roughness coefficients and demand loading of the water mains in the model, so the resulting pressures and flows from the hydraulic analyses closely match the pressures and flows from actual field tests under similar demand and operating conditions. Calibration may also involve adjusting facility sizing and elevations, as new information is obtained. Initial Darcy-Weisbach roughness coefficients were entered in the model based on estimates of the coefficients from available pipe age and material data. For example, older water mains were assigned higher roughness coefficients than new water mains; thereby assuming that the internal surface of water pipe becomes rougher as it gets older. Elevations were extracted from highly accurate Light Detection and Ranging (LIDAR) data sets. Actual manufacturer's pump curves were entered when known, or estimated using field measurements. No further calibration has been performed on this model since the model is not currently used for high system stress analyses, such as establishing legal fire flow availability. The model may be used to get a cursory range of expected fire flow, but field testing should be performed if accurate fire flow values are required.

DISTRIBUTION SYSTEM ANALYSIS

This section evaluates the City's existing distribution and transmission system (i.e., water mains) to determine if they are sized and looped adequately to provide the necessary flow rates and pressures to meet the existing and future requirements of the system.

Distribution and transmission water mains must be capable of adequately and reliably conveying water throughout the system at acceptable flow rates and pressures. The criteria used to evaluate the City's distribution and transmission system are the state mandated requirements for Group A water systems contained in Washington Administrative Code (WAC) 246-290-230 Distribution Systems.

Hydraulic analyses of the existing system were performed under existing peak hour demand (PHD) conditions to evaluate its current pressure capabilities, and to identify existing system deficiencies. The existing system was also analyzed under existing MDD conditions to evaluate the current fire flow capabilities and to identify additional existing system deficiencies. Additional hydraulic analyses were then performed with the same hydraulic model, but under future MDD and PHD demand conditions and with proposed improvements to determine if the identified improvements will eliminate the current deficiencies while meeting the requirements within the planning period.

FIRE FLOW

A set of analyses was performed to determine the capability of the existing water system to provide fire flow throughout the existing water system under MDD conditions. A separate fire flow analysis was performed for each node in the model to determine the available fire flow at that location. The nodes in the model do not necessarily represent actual fire hydrant locations. The results indicate the predicted flow available within the water main, and not that available from a single hydrant. A single fire hydrant may produce between 500 gpm and 1,500 gpm depending on the available system pressure and water main size. For facilities that require more flow, additional hydrants may be required. The following criteria are used to determine available fire flow within the water mains.

- Maintain a minimum residual pressure of 20 psi at the fire draw location.
- Maintain a minimum of 20 psi at all customer services.
- Maintain positive pressure in all water mains.
- The system is experiencing the average of the MDD.
- Do not exceed 8 feet per second (fps) in water mains (excluding BPS and PRV stations).

Dead-end mains 4-inch and smaller were generally excluded from the analyses. For each node analyzed, the resulting fire flow was compared to its general fire flow requirement, which was assigned according to the largest adjacent land use classification, as shown in **Table 4.1**. A summary of the results of the analyses for representative system nodes is presented in **Table 6.3**.

Table 6.3
Select Fire Flow Sites

Description	Location	Model Node	Zone	Target Fire Flow (gpm)	Existing Fire Flow (gpm)	2038 Fire Flow (gpm)
Blue Star Growers	100 Blue Star Way	J22	895	3,500	1,950	3,710
Tree Top	Tichenal Way	J3	895	3,500	3,710	3,760
Grace Lutheran Church	Vine & Elberta	J37	895	3,000	3,030	3,070
Downtown	Woodring & Cottage	J42	895	3,500	4,400	4,540
Commercial Area	Prospect & Aplets	J55	895	3,500	4,250	4,800
Crunch Pak	Sunset Hwy & Angier	J96	895	3,500	3,460	4,080
Mill Site Industrial	Sunset Hwy & Mill Rd	J-90	895	3,500	2,910	3,380
Apartments	Independence Way	J62	895	3,500	1,860	4,590
Cashmere Convalescent	817 Pioneer Ave	J111	1000	2,500	1,860	1,970
Cashmere Middle School	300 Tigner Rd	J172	1000	3,500	2,410	2,710
Vale Elementary School	101 Pioneer Ave	J-32	1000	3,500	1,800	3,160
Single Family Area	Chase & Olive	J82	1050	1,500	1,280	2,310
Single Family Area	S. Division St	J95	1050	1,500	950	2,160
Single Family Area	Mission View Pl	J117	1114	1,500	1,360	1,240
Single Family Area	Valley View & Skyline	J145	1114	1,500	1,080	1,310
School Track	Chapel St	J147	1114	3,500	2,160	2,240
Cashmere High School	329 Tigner Rd	J148	1114	3,500	2,160	2,190
Airport	Southeast Corner	J183	1114	3,500	1,860	1,940

The Existing Fire Flow and 2038 Fire Flow columns in **Table 6.3** represent the modeled available fire flow while meeting 20 psi residual pressure and 20 psi minimum zone pressure. These do not use the maximum velocity constraint. The analyses were performed to determine the minimum water main improvements necessary to improve the fire flow to within a reasonable proximity of the fire flow targets by land use. This was done because all current structures are grandfathered under the fire flow code current at the time of construction. Any proposed new construction with a high fire flow requirement should be analyzed under the current velocity constraint.

An extended period simulation (EPS) was run at 3,500 gpm for 3 hours in the low zone to verify reservoir performance. For a fire in the western half of the 895 Zone, the PRVs open rapidly in response to the drop in local system pressure, resulting in water supplemented to the low zone from the high zone reservoir. However, if the fire is in the eastern portion of the 895 Zone, especially east of the Wenatchee River, the PRV operation is delayed until the Sherman Reservoir is nearly or completely empty.

PRESSURE

DOH pressure analysis criteria states that the distribution system "…shall be designed with the capacity to deliver the design peak hour demand quantity of water at 30 psi under peak hour demand flow conditions measured at all existing and proposed service water meters."

The first analysis was performed to determine the pressures throughout the system under existing (i.e., 2018) PHD conditions. The second analysis was performed to determine the pressures throughout the system under future (i.e., 2038) PHD conditions. The results of these analyses were used to identify locations of low and high pressures. To satisfy the minimum pressure requirements, the pressure at all water service locations must be at least 30 psi during these demand conditions. In addition, the system should not have widespread areas with high pressures (generally considered to be more than 100 psi) if reasonably avoidable. There were no areas of customer service that dropped below 30 psi.

RESULTS

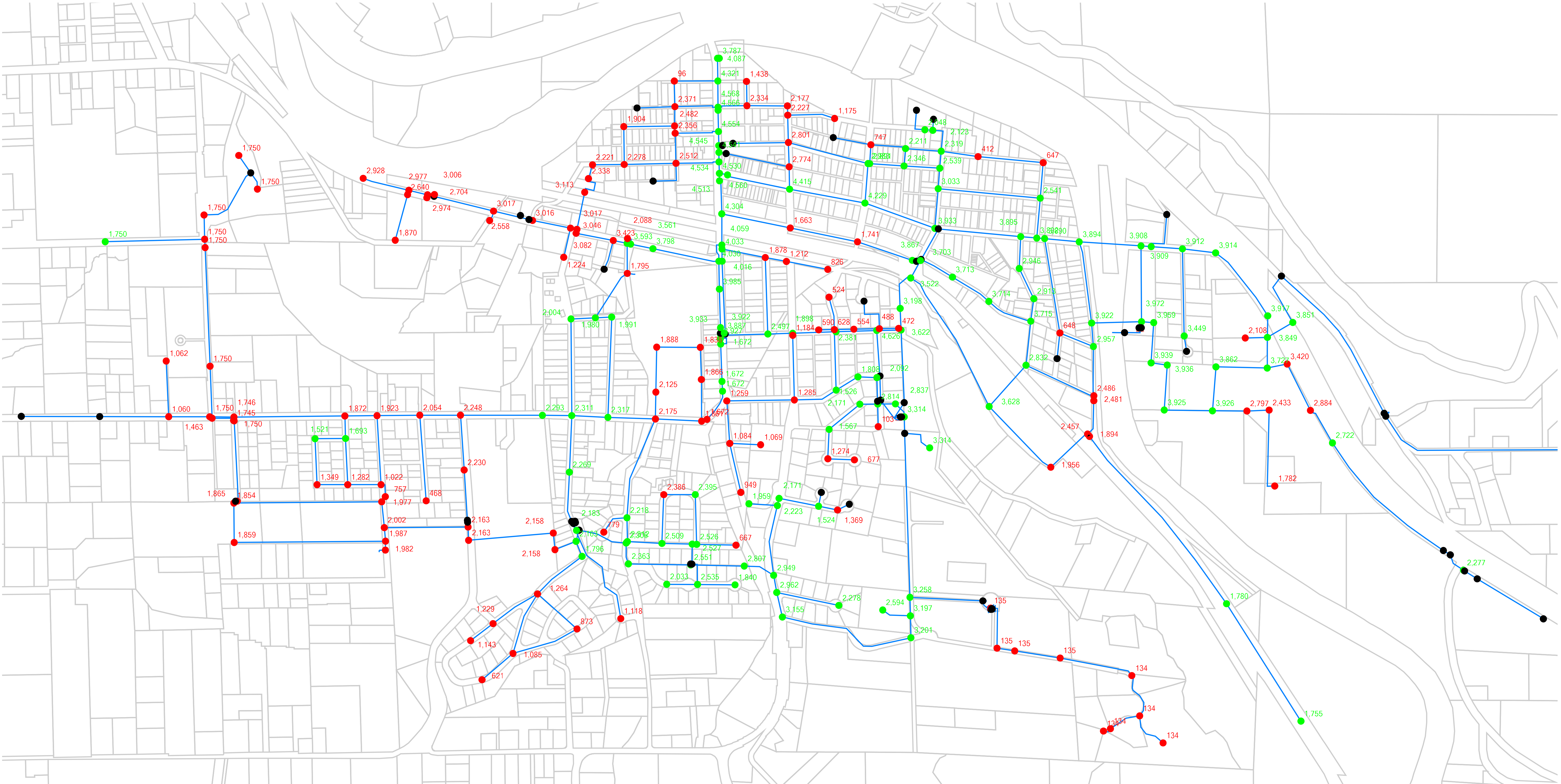
All water mains with pressures greater than 100 psi, as identified from the analyses, were in the 1114 Zone, where the services are equipped with pressure regulators to reduce high pressures to acceptable levels. Future services in this area will also be equipped with pressure regulators on their service lines, thus high pressures in the 1114 Zone were not identified as system deficiencies.

Figures 6.1 and **6.2** show the fire flow availability of the existing water system. Green nodes represent available fire flow that meets the goals shown in **Table 4.1**, while red nodes do not meet those goals. **Figure 6.1** constrains the analysis to maintaining 20 psi residual pressure and 20 psi to all services. **Figure 6.2** includes the maximum 8 fps velocity constraint in addition to the 20 psi requirement.

Once all deficiencies were identified, proposed water main improvements were included in the model, with pressure and fire flow analyses performed throughout the system to determine if the improvements will diminish the deficiencies and meet the flow and pressure requirements. These analyses were modeled under projected year 2038 MDD conditions to size the improvements to meet the needs of the planning period. A summary of the results of the fire flow analyses is shown in **Table 6.3** for the same areas that were summarized from the existing water system analyses. The results of the analyses indicate that many fire flow deficiencies will be resolved with the proposed improvements. It was not the objective of this evaluation to bring all areas up to current land use fire flow goals, but only to provide the system improvements to strengthen select areas and provide a framework for future improvements. It is assumed that as old mains will be periodically replaced, and future developments install their required infrastructure, the system performance will improve. A description of improvements and a figure that shows their locations are presented in **Chapter 8**. A brief description of the deficiencies identified from the hydraulic analyses is presented in the following section.

Figure 6.3 represents the model with 2024 demands and a small number of water system improvements, including the expansion of the 1050 Zone. The available fire flow shown does not include the velocity constraint.

Figure 6.4 represents the model with 2038 demands and all distribution Capital Improvement Projects identified in **Chapter 8**. The available fire flow shown does not include the velocity constraint. The goal of this evaluation was not to meet all fire flow goals, but to provide a strong infrastructure backbone.

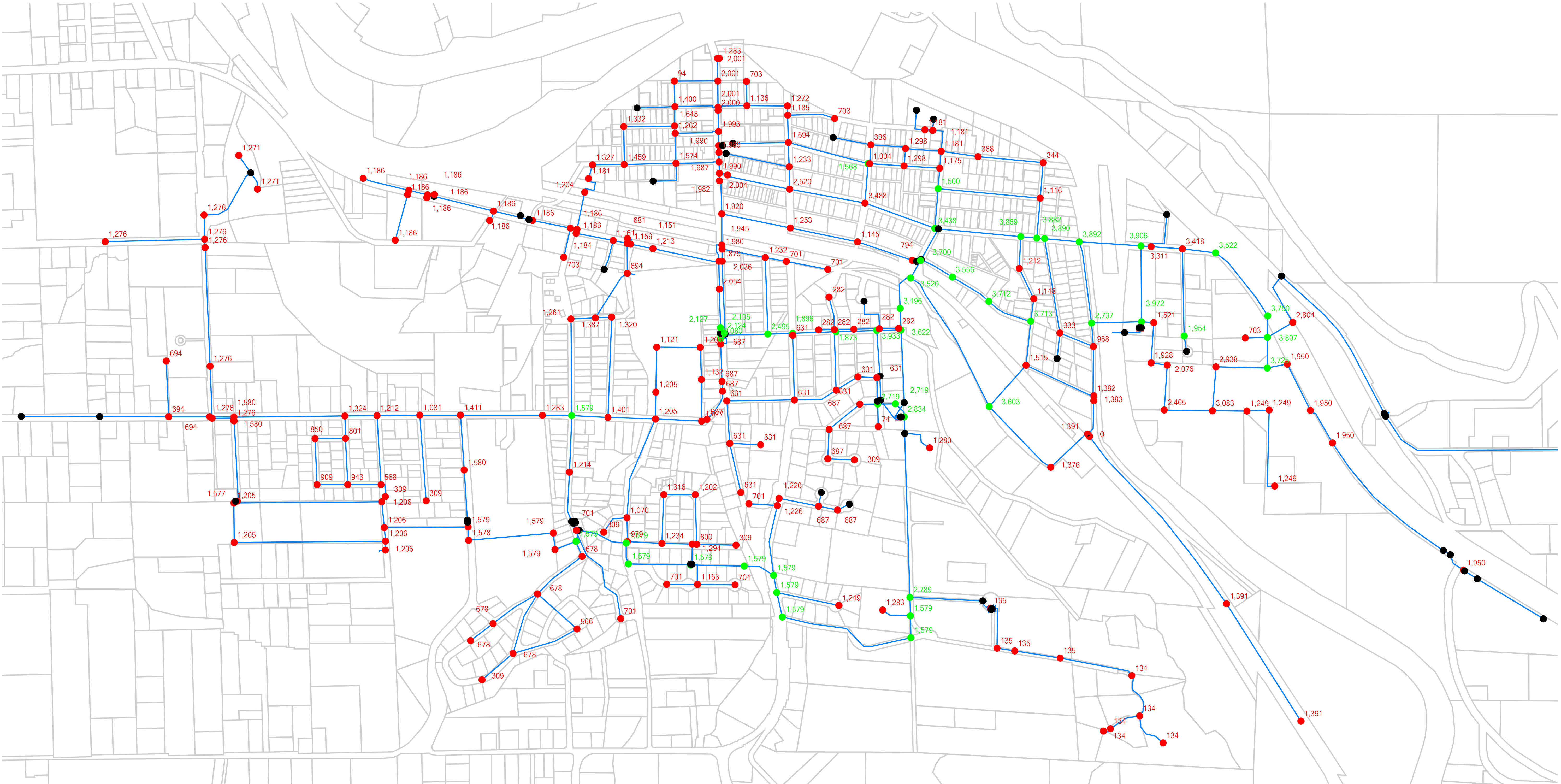


LEGEND

Green Text: Meets land use goal.

Red Text: Does not meet land use goal.

FIGURE 6.1
2018 Water System
Fire Flow at 20 psi Residual Pressure

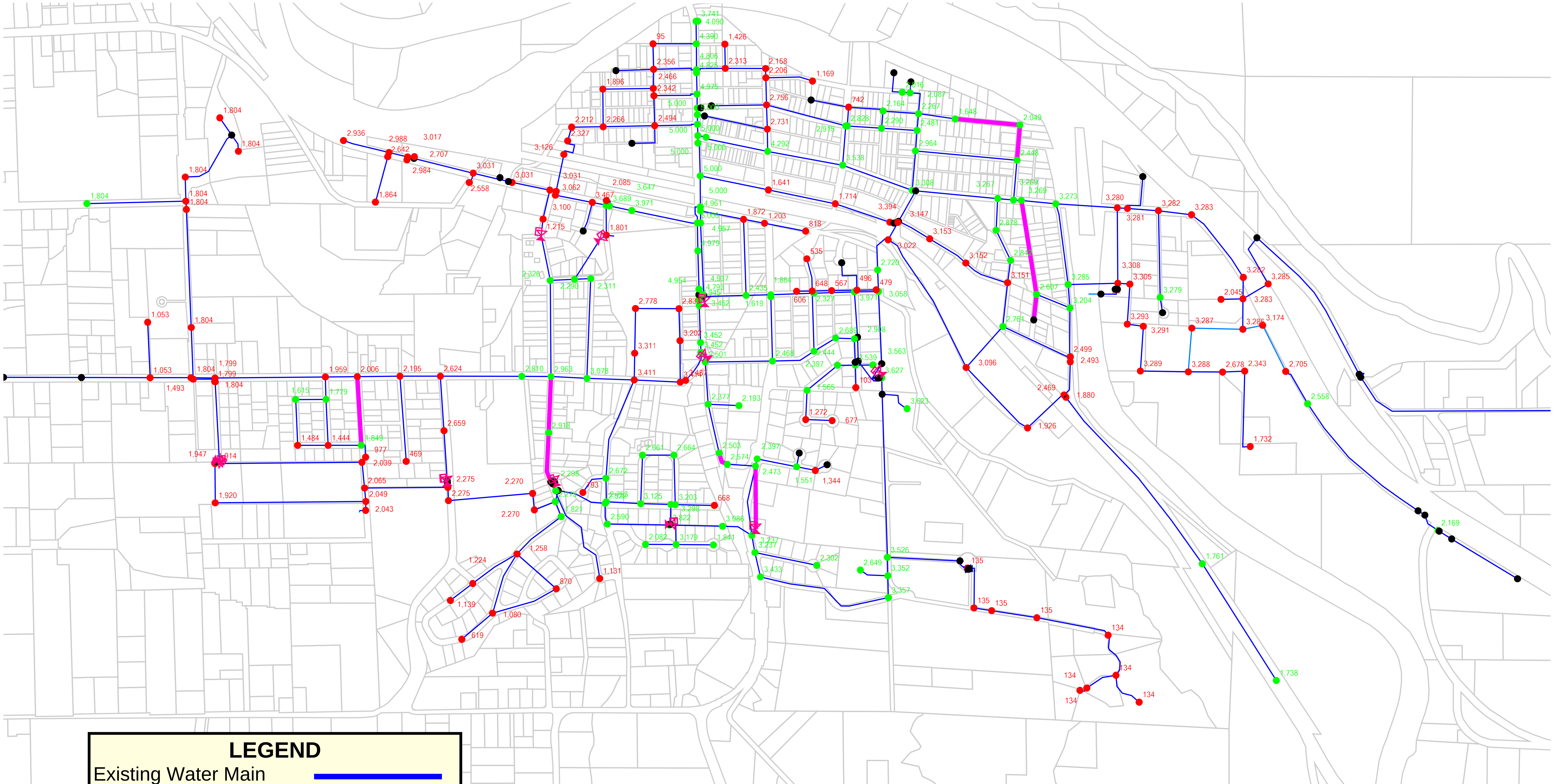


LEGEND

Green Text: Meets land use goal.

Red Text: Does not meet land use goal.

FIGURE 6.2
2018 Water System
Fire Flow at 20 psi Residual Pressure and 8 fps Maximum Velocity



LEGEND

Existing Water Main

Proposed Improvement

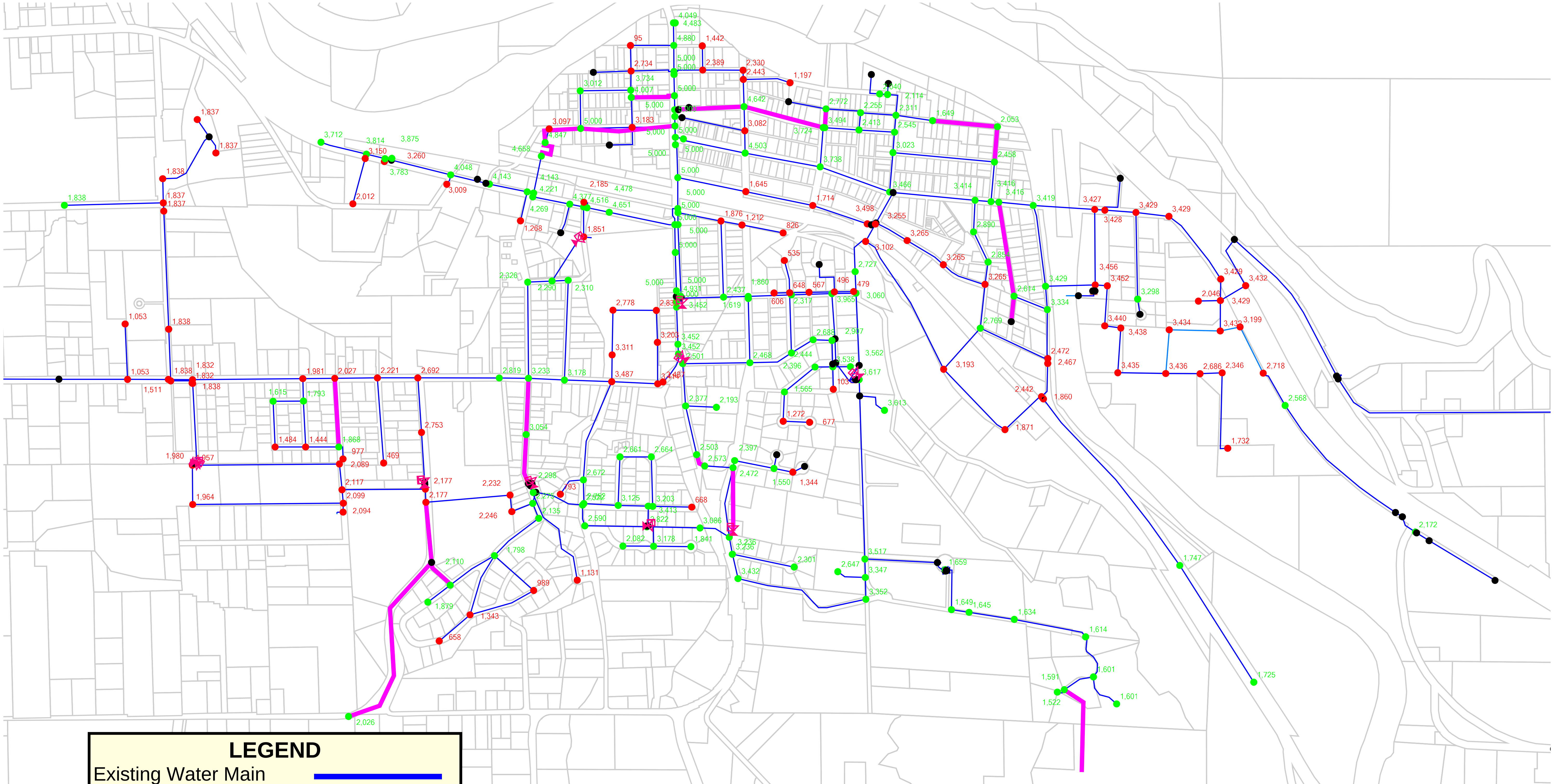
Green Text: Meets land use goal.

Red Text: Does not meet land use goal.

FIGURE 6.3

2024 Water System

Fire Flow at 20 psi Residual Pressure



LEGEND

Existing Water Main

Proposed Improvement

Green Text: Meets land use goal.

Red Text: Does not meet land use goal.

FIGURE 6.4

2038 Water System
Fire Flow at 20 psi Residual Pressure

Reliability Issues

1050 Zone

The 1050 Zone is supplied solely by the 6-inch Sherman PRV. A second PRV station will improve reliability. The zone boundary should be adjusted to include Mission View Place, which would change the pressure along that street from 90 psi to 65 psi. A small main installation along Philips Place is needed for the second PRV and will also eliminate two existing dead-end mains.

1000 and 1114 Zone

The 1114 Zone and 1000 Zone are served exclusively by a single 40-year old 10-inch ductile iron (DI) transmission main extending from Kennedy Road to Tigner Road where it reduces to an 8-inch main, finally ending at Fisher Street, for a total distance of approximately 1.3 miles. A failure in this main could result in termination of service to many, or all, customers in these zones. In addition, the relatively small main diameter causes high headloss during fire flow conditions. The preferred improvement would be to install a second main. However, the lack of available corridors makes this a difficult proposition, as does the high cost. Adding a PRV between the 1050 and 1000 Zones would be a relatively low cost improvement for reliability to the 1000 Zone.

895 Zone

Currently there are two CI mains crossing the Wenatchee River. A 12-inch main at the Cottage Avenue Bridge, and a 10-inch main at the WTP. Although it has been some time since anyone has investigated the exact location of the 10-inch main, two river crossings provide a reasonable level of reliability, though a third main would add redundancy. One possible route is to connect the dead-end 8-inch main near the City’s industrial wastewater treatment plant (WWTP) to the new dead-end 12-inch main in Riverfront Drive serving the new WWTP. Construction would be challenging given that the ground below the river is likely a boulder mix, making directional drilling difficult, and the high groundwater would be an impediment to boring or auguring.

Fire Flow Issues

Sherman Reservoir Refill

The storage analysis presented later in this chapter assumes that the Kennedy Reservoir can supply the fire flow storage needed for the Sherman 895 Zone. However, this only works if local pressure at the Natatorium and Division PRV stations drops enough to activate those valves. In addition, the current control system will cause the Sherman BPS to turn on to refill the Kennedy Reservoir, making the problem worse by pulling water back out of the Sherman Reservoir. A project to install a control valve at the Sherman Reservoir to correct this issue is discussed in **Chapter 8**.

Sunset Highway Industrial Land

The industrial land along Sunset Highway is served by a new 16-inch main, but supply to this main is restricted by smaller pipes. Available fire flow does not meet the 3,500 gpm goal, which could lead to higher costs of industrial and commercial construction to mitigate with sprinkler systems. While this is not a critical issue, the City may want to prioritize a project to encourage economic development. Three projects have been identified that would increase fire flow.

1. Replace the existing 6-inch CI main in River Street from Aplets Way to the railroad tracks. Additional benefit is to increase fire flow in the multi-family zoned area.

2. Install a new main on Chapel Street or Paton Street from Angier Avenue to Sunset Highway. A PRV station and crossing of Mission Creek would be required, increasing the project cost significantly. An additional benefit is eliminating the 4-inch Natatorium PRV main which is in an unknown route through private properties.
3. Construct a tank and transmission main west of the City. This project is described in **Chapter 8** under Future Projects.

General Fire Flow

Several areas throughout the system have sufficient fire flow but would result in high water velocities in the distribution system due to undersized water mains. Operating with high water velocities can potentially damage the system due to the high surge pressures that can occur with rapid changes in velocity, such as closing a hydrant valve. High velocity can also scour the inside of the pipes, releasing corroded metal and biofilms, leading to customer complaints, clogged plumbing fixtures, and reduced pipe life. The City will replace water mains in the future based on criticality, concurrent with street projects, or as leak repairs become excessive. All new water mains are required to be sized and installed in accordance with the City's Water System Standards.

SYSTEM CAPACITY ANALYSIS

This section evaluates the capability of the City's existing facilities to meet the overall existing and future demands of the system.

ANALYSIS CRITERIA

Source facilities must be capable of adequately and reliably supplying high quality water to the system. In addition, source facilities must provide a sufficient quantity of water at pressures that meet the requirements of WAC 246-290-230. The evaluation of the combined capacity of the sources in this section is based on the criteria that they provide supply to the system at a rate that is equal to or greater than the MDD of the system.

The evaluation of inter-zone supply facilities to determine if they have adequate capacity is based on one of two criteria, as follows.

1. If the pressure zone that the facility supplies has storage, then the amount of supply required is equal to the MDD of the zone.
2. If the pressure zone that the facility supplies does not have storage, such as the 1310 Zone, then the amount of supply required must be equal to the PHD of the zone.

The higher supply requirement of the latter criteria is due to the lack of equalizing storage that is typically utilized to provide short-term supply during times of peak system demands.

The pumping capacity of the City is shown in **Table 6.3**. For the supply analyses, we assume that the largest pump supplying each pressure zone is out of service. The capacity of the remaining pumps will be based on a 22-hour pumping day, to provide approximately 10-percent safety factor.

Table 6.4
Pump Capacities (gpm)

WTP Supply		895 Pressure Zone				1114 Pressure Zone			1310 Pressure Zone		
River Lift 1	River Lift 2	WTP 1	WTP 2	WTP 3	Well 4 (1)	Well 10 (1)	Sherman 1	Sherman 2	Vista Heights 1	Vista Heights 2	Vista Heights 3
1,200	1,200	550	830	1,220	230	140	400	680	15	53	53

(1) Throttled to prevent overpumping of well.

Also included in the supply capacity analysis is the flow required to refill the reservoirs after a fire event. The City's maximum fire flow standard is 3,500 gpm for three hours, or 630,000 gallons. Refilling this quantity over 3 days would require 146 gpm, which will be added to the system demands in these analyses.

PRESSURE ZONE FACILITIES

895 Zone

Well No. 4 and the WTP provide water supply to the 895 Zone and indirectly to the higher zones through the Sherman BPS.

1114 Zone

Well No. 10 and the Sherman BPS provide all water supply to the 1114 Zone and indirectly to the lower 1000 Zone and 1050 Zone through a series of pressure reducing stations. Water is also pumped through the zone to supply the 1310 Zone with the Vista Heights BPS.

1310 Zone

The Vista Heights BPS is the sole supply to the 1310 Zone. The system currently supplies ten homes, though an additional two water services were installed for future development and the BPS was sized for 14 lots total. This was based on an estimated consumption per household of 455 gallons per day (gpd) for ADD, 780 gpd for MDD, and 1 gpm for PHD, assuming that City water would be used for landscape irrigation. The ten existing homes are all served by a separate irrigation system, so the actual consumption is significantly less. Records from 2015 through 2017 indicate average sales of 140 gpd ADD and 260 gpd MDD per account. Although all future lots may also have separate irrigation systems, this supply analysis assumes that lots built after 2019 will use City water for irrigation.

All services are above the overflow elevation of the Kennedy Reservoir, meaning there is no backup supply of water should the BPS be offline.

SOURCE AND SUPPLY CAPACITY ANALYSIS RESULTS

The capability of the City's active sources to meet both existing and future demand requirements, based on existing pumping capacities of the individual supply facilities, is presented below in **Table 6.5**. The future demands used in the evaluation are projections without reductions from conservation efforts. Therefore, if additional reductions in water use are achieved in the future through water conservation efforts, the total source capacity required in the future may be less than that shown in the table. Wheeling MDD is the flow necessary to pass (or "wheel") through the pressure zone to serve an upper pressure zone. Data for 2015 is included because it had the largest MDD of the last five years.

Included in the table are calculations with all pumps in services (All Pumps), and with the largest pump supplying the pressure zone out of service (Derated). The Derated capacity will be used to determine the available supply capacity. The supply capacity must be able to meet MDD plus refill depleted emergency storage in three days.

Table 6.5
Supply Capacity Analysis (All Values in gpm Except for ERUs)

	2015	2017	2019	2024	2039	Buildout
Sources to Overall System (River Lift, Well 4, Well 10)						
Number of ERUs	2,131	2,224	2,363	2,900	3,220	6,835
MDD	903	806	924	1,124	1,263	2,669
Fireflow Refill	146	146	146	146	146	146
All Pumps Supply	2,770	2,770	2,770	2,770	2,770	2,770
All Pumps Surplus (Deficit)	**1,721**	**1,818**	**1,700**	**1,328**	**1,328**	**1,328**
Supply (Derated) [1]	1,439	1,439	1,439	1,439	1,439	1,439
Derated Surplus (Deficit)	***390***	***488***	***369***	***169***	***30***	***(1,376)***
895 Pressure Zone (WTP, Well 4)						
Number of ERUs	1,183	1,280	1,416	1,834	1,904	4,409
MDD	410	438	478	622	646	1,507
Fireflow Refill	146	146	146	146	146	146
Wheeling MDD	354	229	308	367	491	1,036
All Pumps Supply	2,830	2,830	2,830	2,830	2,830	2,830
All Pumps Surplus (Deficit)	**1,920**	**2,017**	**1,898**	**1,695**	**1,546**	**141**
Supply (Derated) [1]	1,476	1,476	1,476	1,476	1,476	1,476
Derated Surplus (Deficit)	***566***	***663***	***544***	***340***	***192***	***(1,214)***
1000, 1050, and 1114 Pressure Zones (Sherman BPS, Well 10)						
Number of ERUs	944	939	942	1,056	1,290	2,400
MDD	493	368	446	502	617	1,162
Fireflow Refill	146	146	146	146	146	146
Wheeling MDD	1	1	2	6	15	15
All Pumps Supply	1,220	1,220	1,220	1,220	1,220	1,220
All Pumps Surplus (Deficit)	**580**	**705**	**626**	**567**	**443**	**(102)**
Supply (Derated) [1]	495	495	495	495	495	495
Derated Surplus (Deficit)	***(145)***	***(20)***	***(99)***	***(158)***	***(282)***	***(827)***
1310 Pressure Zone (Vista Heights BPS)						
Number of ERUs	4	5	6	10	26	26
MDD	1	1	2	6	15	15
PHD	21	22	23	35	62	62
Supply (Derated) [1]	62	62	62	62	62	62
Derated Surplus (Deficit)	***41***	***40***	***39***	***28***	***1***	***1***

(1) Derated supply is with the largest pump offline, and the remaining pumps operating for 22 hours per day.

The results of the analysis indicate that the existing derated supply to the system as a whole and the 895 Zone should be sufficient for the next 20 years, but shortly after that may be deficient.

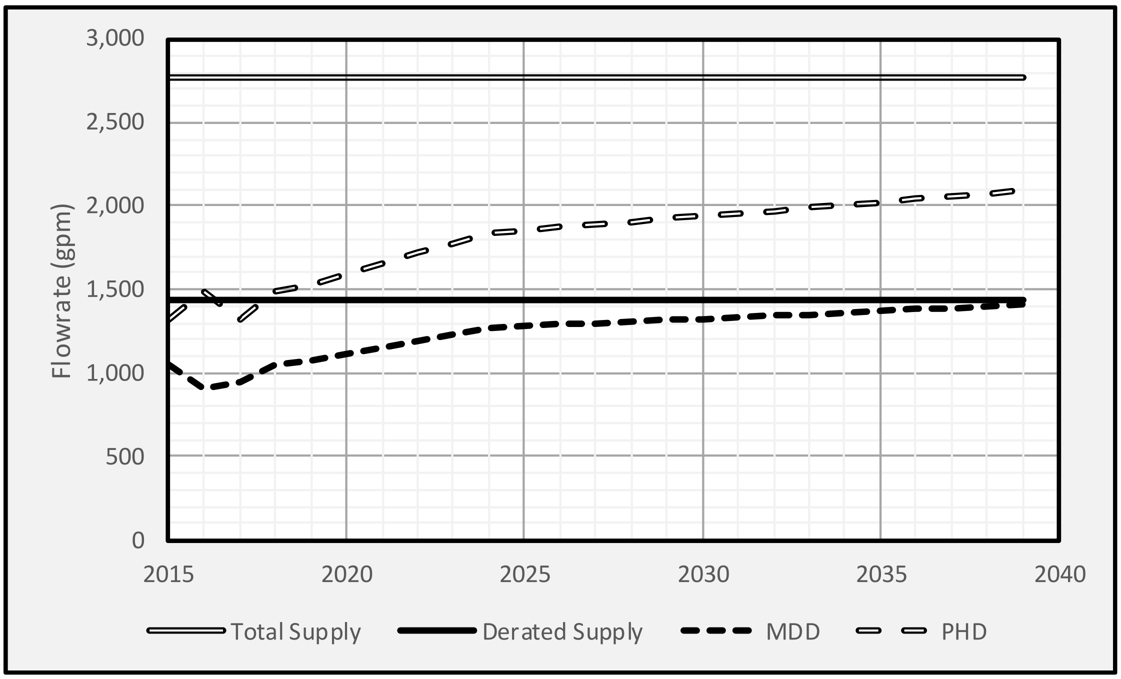
Derated supply to the upper pressure zones is currently deficient if the largest Sherman booster pump is out of service, the weather is unusually hot, and a fire depletes the emergency storage.

An increase in capacity at the Sherman booster pump station is included in the capital improvement program.

The existing Vista Heights booster station may have capacity to serve up to 26 ERUs. However, conditions in the 2007 WSP amendment call for new gravity storage after 14 homes are served.

The results of the analysis indicate that the City has approximately 400 gpm of derated surplus source capacity after meeting existing demands. Derated source capacity may equal system demand by the year 2039. The City should not need to increase source capacity in this planning period, but should plan on evaluating ways to increase capacity in the next WSP. This is also illustrated in **Chart 6.4**.

Chart 6.4
Supply Capacity Compared to System Demand with Emergency Refill



PUMP ENERGY USE ANALYSIS

A brief evaluation of energy use was performed using the hydraulic model. Using the 2018 Public Utility District No. 1 of Chelan County (District) electrical rate of $0.027 per kWh, RH2 estimates the following average per unit costs.

- WTP Pump 1: $16 to $17 per 1 MG
- WTP Pump 2: $15 to $16 per 1 MG
- WTP Pump 3: $16 to $17 per 1 MG
- Well No. 4: $24 to $25 per 1 MG due to throttling
- Well No. 10: $90 to $100 per 1 MG due to throttling
- Sherman Pump 1: $27 to $28 per 1 MG
- Sherman Pump 2: $25 to $26 per 1 MG
- Vista Heights: $30 to $200 per 1 MG due to variable speed

WTP Pump 2 is the least expensive pump to run because it appears to be operating near its best efficiency point. Though the total difference in cost compared to running WTP Pump 1 may be less than $200 per year.

The Vista Heights station pumps very little water almost continuously using variable frequency drives (VFD) into a closed zone. There is little that can be done to improve efficiency without constructing storage, which is not currently economically practical. The high cost for Well Nos. 4 and 10 is due mainly to the throttling required to prevent over pumping of the wells and the higher lift compared to the WTP. The Sherman BPS pumps lift a higher distance than the WTP pumps, hence the higher unit cost.

If Well No. 4 is operated by VFD, the energy cost may reduce from $24 to $19 per 1 MG. The energy savings may be approximately $50 per month of operation. Cost alone does not warrant the expense of installing a VFD.

If Well No. 10 is operated by a VFD, the energy cost may reduce from $95 to $63 per 1 MG. The energy savings may be approximately $200 per month of operation. Because Well No. 10 is operated only a few months each year, this alone does not appear to warrant the expense of installing a VFD. However, a VFD could provide other operational benefits such as eliminating manual starting/stopping, mitigating well drawdown, delaying well redevelopment by slowing clogging, and reducing water hammer.

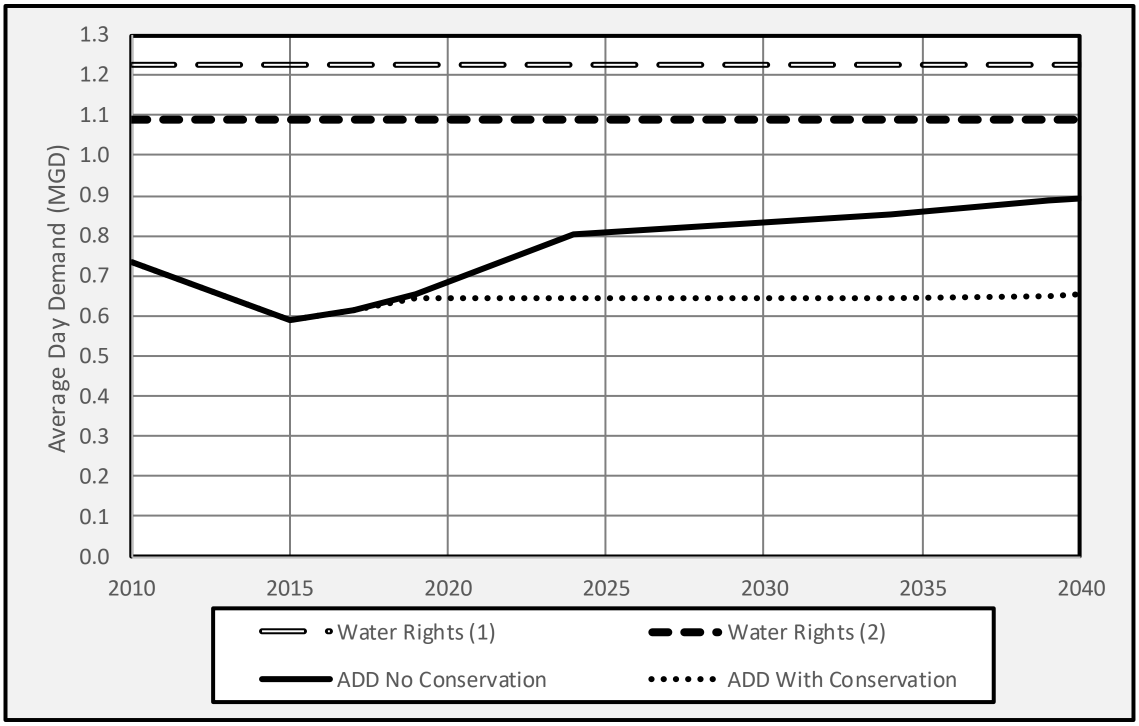
TREATMENT PLANT CAPACITY ANALYSIS

The treatment plant is rated at 1,200 gpm per filter train, or 2,400 gpm total when working at optimal condition. Within 15 years, MDD may exceed the capacity if one filter train and both wells are out of service.

WATER RIGHTS CAPACITY ANALYSIS

The historical and projected water demand from **Chapter 3** are also shown graphically in **Chart 6.5** compared to the City's current water rights. The line titled "ADD With Conservation" represents the forecast if all conservation goals are met, population growth is slower than anticipated, and industrial consumption remains unchanged. Annual water rights are anticipated to be sufficient for the current planning period, but changes in population growth or usage patterns may affect this forecast.

Chart 6.5
Annual Water Rights Capacity Forecast



(1) Water Right if all water rights conditions are met.

(2) Water Right if all water rights conditions are not met.

As shown in **Chapter 3**, if the Urban Growth Area (UGA) is fully built out to the density allowed by current zoning, water demand may be 1.89 million gallons per day (MGD) ADD (or 2,120 acre-feet per year (afy)) and 3.84 MGD MDD (or 5.95 cubic feet per second (cfs)). The City's existing unconditioned water rights of annual quantity (Qa) of 1.23 MGD (1,374 afy) are insufficient for full buildout of the UGA. The City's existing unconditioned water rights of maximum instantaneous quantity (Qi) of 9.78 cfs may be sufficient. See **Chapter 5** for a detailed discussion of water rights.

STORAGE ANALYSIS

This section evaluates the City's existing water storage tanks to determine if there is sufficient capacity to meet the existing and future storage requirements of the system. **Table 6.6** shows the physical tank characteristics.

Table 6.6
Reservoir Physical Data

Name	Kennedy	Sherman
Pressure zone	1114	895
Year Built	1979	1973
Material	Steel	Concrete
Overall Height (ft)	34.0	18.0
Inside Diameter (ft)	105	106
Floor elev (ft)	1,082.0	877.0
Overflow elev (ft)	1,114.0	895.0
Dead storage (ft) (1)	2	4
Operational storage (gal) (2)	194,308	198,027
Nominal Capacity (gal)	2,000,000	1,000,000
Usable Capacity (gal)	1,943,081	924,125

(1) Bottom of Sherman is a truncated cone. Water level must stay above Sherman pumps.

(2) Assumes 3 feet of storage for operational volume.

Analysis Criteria

Water storage is typically made up of the following components:

- Operational storage;
- Equalizing storage;
- Standby storage;
- Fire flow storage; and
- Dead storage.

A definition of each storage component and the criteria used to evaluate the capacity of the City's storage tanks is provided below.

Operational Storage

Volume of the reservoir used to supply the water system under normal conditions. Operational storage is the amount of draw down in the reservoir during normal operating conditions, typically between the pump start and stop setpoints. This represents a volume of storage that is not available for equalizing storage, fire flow storage, or standby storage. Operational storage is approximately 3 vertical feet in each tank as shown in **Table 6.6**.

Equalizing Storage

Volume of the reservoir used to supply the water system under peak demand conditions when the system demand exceeds the total rate of supply of the sources. DOH requires that equalizing storage be stored above an elevation that will provide a minimum pressure of 30 psi at all service connections throughout the system under PHD conditions. Because the WTP operates on a "call on demand" basis to fill the reservoirs, the equalizing storage requirements are determined using the standard DOH formula that considers the difference between the system PHD and the combined capacity of the continuously available supply sources. To be conservative, supply provided by Well Nos. 4 and 10 is not included in this calculation as both wells are operated manually. Wheeling demand is set at a rate where pumps drawing water out of the zone are operating at the minimum combination necessary to meet the demands of the upper zone.

Table 6.7
Equalizing Storage

	2017	2019	2024	2039	Buildout
895 Pressure Zone (Sherman Tank)					
PHD (gpm)	621	679	883	918	2,140
Wheeling Demand (gpm)	400	540	540	680	1,220
Supply Required (gpm)	1,021	1,219	1,423	1,598	3,360
Supply Available (gpm)	2,600	2,600	2,600	2,600	2,600
Equalizing Storage (gal)	***0***	***0***	***0***	***0***	***114,011***
1000, 1050, and 1114 Pressure Zones (Kennedy Tank)					
PHD (gpm)	699	847	954	1,172	2,207
Wheeling Demand (gpm)	22	23	35	62	62
Supply Required (gpm)	721	870	988	1,234	2,269
Supply Available (gpm)	1,080	1,080	1,080	1,080	1,080
Equalizing Storage (gal)	***0***	***0***	***0***	***23,060***	***178,361***
1310 Pressure Zone (Closed Zone)					
PHD (gpm)	22	23	35	62	62
Supply Available (gpd)	121	121	121	121	121
Equalizing Storage (gal)	***0***	***0***	***0***	***0***	***0***

Standby Storage

Volume of the reservoir used to supply the water system under emergency conditions when supply facilities are out of service due to equipment failures, power outages, loss of supply, transmission main breaks, and any other situation that disrupts the supply source. DOH requires that standby storage be stored above an elevation that will provide a minimum pressure of 20 psi at all service connections throughout the system. The criteria for determining the standby storage requirements for the City's system is the amount required to supply the system for a 48-hour period when the water system is experiencing ADD, or 200 gallons per connection, whichever is greater. The pumping equipment is assumed to be running for 22 hours per day and the largest pump to each pressure zone is out of service. Even though neither Well Nos. 4 or 10 have automatic controls, they are herein considered to be "continuously available to the system" for the following reasons:

- The wells are used regularly;
- Water is available year-round;
- The wells are not considered emergency or standby sources;
- The City visits each site at least 5 days a week; and
- The City has local full time and on-call maintenance staff.

Standby storage is shown for the 1310 Zone only for the purposes of discussion. Because this is a closed zone, standby storage is not applicable.

Table 6.8
Standby Storage

	2017	2019	2024	2039	Buildout
895 Pressure Zone (Sherman Tank)					
ADD (gpd)	353,630	393,224	509,401	528,974	1,224,736
Supply Available (gpd)	2,125,200	2,125,200	2,125,200	2,125,200	2,125,200
Wheeling Demand (gpd)	261,969	263,252	296,052	365,556	673,824
2 x ADD less Supply (gal)	(894,002)	(812,249)	(514,293)	(336,138)	1,671,921
Number of ERUs	1,280	1,416	1,834	1,904	4,409
200 gal/ERU Minimum (gal)	256,000	283,117	366,764	380,856	881,797
Standby Storage (gal)	***256,000***	***283,117***	***366,764***	***380,856***	***1,671,921***
1000, 1050, and 1114 Pressure Zones (Kennedy Tank)					
ADD (gpd)	260,651	261,585	293,274	358,334	666,602
Supply Available (gpd)	712,800	712,800	712,800	712,800	712,800
Wheeling Demand (gpd)	1,318	1,667	2,778	7,222	7,222
2 x ADD less Supply (gal)	(188,862)	(186,297)	(120,696)	18,313	634,849
Number of ERUs	939	942	1,056	1,290	2,400
200 gal/ERU Minimum (gal)	187,800	188,338	211,154	257,997	479,947
Standby Storage (gal)	***187,800***	***188,338***	***211,154***	***257,997***	***634,849***
1310 Pressure Zone (Closed Zone)					
ADD (gpd)	1,318	1,667	2,778	7,222	7,222
Supply Available (gpd)	69,960	69,960	69,960	69,960	69,960
2 x ADD less Supply (gal)	(67,324)	(66,627)	(64,404)	(55,515)	(55,515)
Number of ERUs	5	6	10	26	26
200 gal/ERU Minimum (gal)	1,000	1,200	2,000	5,200	5,200
Standby Storage (gal)	***1,000***	***1,200***	***2,000***	***5,200***	***5,200***

Fire Flow Storage

Volume of the reservoir used to supply water to the system at the maximum rate and duration required to fight a fire at the building with the highest fire flow requirement. The magnitude of the fire flow storage is the product of the fire flow rate and duration of the system's maximum fire flow requirement established by the local fire authority, the City of Cashmere Fire Department. DOH requires that fire flow storage be stored above an elevation that will provide a minimum pressure of 20 psi at all points throughout the distribution system under MDD conditions. The fire flow storage requirements shown in the analyses that follow are based on a maximum fire flow requirement of 3,500 gpm for a 3-hour duration, or 630,000 gallons. Some jurisdictions allow nesting of storage, which is allowing standby and fire storage to occupy the same space in the reservoir. This can be permitted under the assumption that the likelihood of a fire event and a supply failure occurring at the same time is extremely low. For these analyses, we have not assumed any nesting.

The fire storage is assumed to be stored entirely in the Kennedy Reservoir and available to the lower pressure zones through the PRV stations.

For planning purposes, RH2 has assumed that future homes in the 1310 Zone will require fire storage of 1,500 gpm for two hours.

Dead Storage

Volume of the reservoir that cannot be used for one of the following reasons.

- It is stored at an elevation that does not provide system pressures that meet the minimum pressure requirements established by DOH without pumping. Water that is stored below an elevation that cannot provide a minimum pressure of 20 psi is considered dead storage.
- Space that is above the pump shutoff setpoint.
- Space that is below the outlet silt-stop, if one exists.
- Water in the Sherman Reservoir lower cone section that is necessary to maintain submergence over the Sherman pumps. Four feet of water is assumed.

STORAGE ANALYSIS RESULTS

The storage analyses are based on an evaluation of the existing storage facilities providing water to three supply areas, one being the 895 Zone the second being the combined areas of the 1114, 1050; and 1000 Zones because they all receive storage from the Kennedy Reservoir. The third supply area, 1310 Zone, is a closed pressure zone.

Existing Storage Analysis

The maximum combined storage capacity of the City's reservoirs is approximately 3.0 MG, as shown in **Table 6.6**. However, the total amount of useable storage for operational, equalizing, standby, and fire flow purposes is reduced to 2.86 MG, due to the amount of non-usable storage dedicated to the operating range, freeboard, and maintaining submergence of the Sherman pumps.

Table 6.9
Storage Analysis Summary

	2017	2019	2024	2039	Buildout
895 Pressure Zone (Sherman Tank)					
Fire (stored in Kennedy)	0	0	0	0	0
Standby	256,000	283,117	366,764	380,856	1,671,921
Operational	198,027	198,027	198,027	198,027	198,027
Equalizing	0	0	0	0	114,011
Total Required	454,027	481,144	564,791	578,883	1,983,959
Available	948,591	948,591	948,591	948,591	948,591
Surplus (Deficit)	***494,564***	***467,447***	***383,800***	***369,708***	***(1,035,368)***
1000, 1050, and 1114 Pressure Zones (Kennedy Tank)					
Fire	630,000	630,000	630,000	630,000	630,000
Standby	187,800	188,338	211,154	257,997	634,849
Operational	194,308	194,308	194,308	194,308	194,308
Equalizing	0	0	0	23,060	178,361
Total Required	1,012,108	1,012,647	1,035,462	1,105,365	1,637,518
Available	1,943,081	1,943,081	1,943,081	1,943,081	1,943,081
Surplus (Deficit)	***930,973***	***930,435***	***907,619***	***837,717***	***305,563***
1310 Pressure Zone (Closed Zone)					
Fire	0	0	180,000	180,000	180,000
Standby	1,000	1,200	2,000	5,200	5,200
Operational	0	0	27,300	27,780	27,780
Equalizing	0	0	0	0	0
Total Required	1,000	1,200	209,300	212,980	212,980
Available	50	50	50	50	50
Surplus (Deficit)	***(950)***	***(1,150)***	***(209,250)***	***(212,930)***	***(212,930)***

The results of the existing storage evaluation, as shown in **Table 6.9**, indicate that the City has adequate storage for the next 20 years. **Table 6.9** also shows that the current system is not required to provide any equalizing storage in its reservoirs. This is because the supply capacity exceeds the PHD requirements of the existing system. The 1310 Zone does not currently require any storage because it is a closed zone and was determined by the Fire Department to be exempt from fire flow storage requirements due to the large lot sizes. The future projections for the 1310 Zone are presented to show what storage would be required should a fire flow performance of 1,500 gpm for 2 hours be required in the future. See **Appendix D** for documentation on the requirements for a future reservoir to serve the 1310 Zone.

Future Storage Analysis

Although the 1000, 1050, and 1114 Zones do not require additional storage for the foreseeable future, much of the developable land lies far west of the Kennedy Reservoir. The hydraulic remoteness of the existing tank to the future served land could limit emergency capacity. A future

1114 Zone reservoir in the west portion of the UGA may be a prudent addition, though an evaluation of the hydraulics and water turnover rate is reserved for a future WSP.

PHYSICAL CAPACITY

This section evaluates the capacity of the City's existing water system components (supply, treatment, storage, and transmission) to determine the maximum number of ERUs that can be served. Once determined, physical capacity becomes useful in determining how much capacity is available in the water system to support new customers that apply for water service through the building permit process. The physical capacity information, together with the projected growth of the system expressed in ERUs, also provides the City with a schedule of when additional physical capacity is needed.

Analysis Criteria

The capacity of the City's system was determined from the limiting capacity of the supply, treatment, storage, water rights, and transmission facilities.

Source Capacity is the combined capacity of one half of the WTP, plus the capacity of Well 4 and Well 10.

Treatment is chlorination at each source and matches the source capacity.

Equalizing and Standby Storage is the value obtained by adding the storage available and subtracting the operational and fire storage values.

Distribution system capacity is the ability to convey normal and emergency flows. With the complexity of the distribution system, it is not practical to establish a single criteria value for this component. There are no current deficiencies to providing normal flows. Refer to the Distribution System Analysis section for a discussion of fire flow performance.

Transmission capacity assumes no more than 5 feet per second (fps) velocity in the transmission mains from each source (12-inch for WTP, 8-inch for Well 10, and 6-inch for Well 4).

Water Rights Qi and Qa are described in Chapter 5.

Capacity Analysis Results

A summary of the results of the existing system capacity analysis is shown in **Table 6.10**. The results of the derated supply and treatment portion of the capacity analysis indicate that each system can support up to a maximum of approximately 2,863 ERUs. The results of the analysis of the other water system components indicate that the storage system can support up to a maximum of approximately 4,970 ERUs and the transmission system can support up to a maximum of approximately 5,446 ERUs. Annual water rights, assuming conditions on the rights are not met, can support up to 3,930 ERUs. Therefore, the limiting capacities of the system is supply.

Table 6.10
Physical Capacity Analysis

Average Day Demand per ERU		278 gpd	0.193 gpm	
Maximum Day Demand per ERU		790 gpd	0.548 gpm	
Service Classification	**Total MDD (gpd)**	**Total PHD (gpm)**	**Number of Connections**	**Total ERUs (2)**
Residential	721,362	968	922	914
Multi-Family	61,066	66	250	77
Subtotal Residential	**782,428**	**1,034**	**1,172**	**991**
Industrial	154,678	118	2	196
Commercial	191,348	213	129	242
Public	110,101	82	40	139
Wholesale	8,333	7	1	11
Subtotal Non-Residential	**464,460**	**420**	**171**	**588**
DSL	**46,464**	**32**	**n/a**	**59**
Total	***1,293,352***	***1,486***	***1,343***	***1,638***

Specific Physical Capacity		
Facility	**Capacity Available**	**ERUs (2)**
Source (Derated)	1,570 gpm	2,863
Treatment	1,570 gpm	2,863
Equalizing and Standby Storage	1,869,337 gal	4,970
Distribution	not applicable	
Transmission (1)	2,986 gpm	5,446
Water Rights Qi (conditions of rights not met)	6,128 gpm	11,175
Water Rights Qa (conditions of rights not met)	2,043,080 gpd	7,355
Total System Physical Capacity *(minimum of values above)*		***2,863***
Excess Capacity		***1,225***

(1) Maximum 5.0 feet per second in transmission mains from all sources.

(2) ERUs associated with MDD, not ADD.

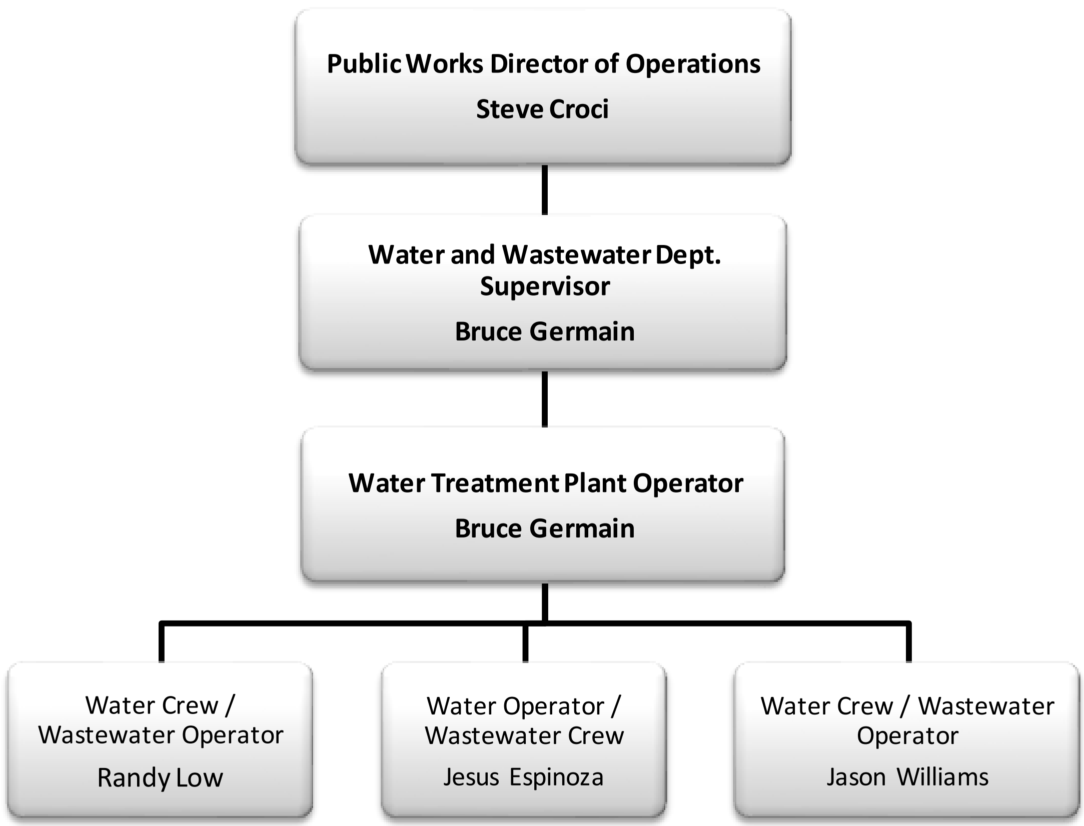
The City’s water system is currently capable of supporting an additional 1,225 ERUs.

7 | OPERATION AND MAINTENANCE

MANAGEMENT AND PERSONNEL

The City of Cashmere (City) Water Department functions under the direction of the Water and Wastewater Department Supervisor, Mr. Bruce Germain. The current water department Operation and Maintenance (O&M) staff consists of several maintenance personnel that function under Mr. Germain, as shown in **Figure 7-1**. The water system tasks that are performed by the O&M staff include inspection, testing, installation, and repair of system facilities, routine operation and preventive maintenance, record keeping, administrative tasks, general clerical work, and corrective or breakdown maintenance required in response to emergencies.

Figure 7.1
Water Department Organization Chart



The Washington Administrative Code (WAC) 246-292 requires that the City's water system is operated by one or more certified operators. In addition, specialty certification is required for backflow device testing. **Table 7.1** shows the current certifications of the City's water O&M staff. It is City policy to maintain a well-qualified, technically trained staff. The City annually allocates funds for personnel training, certification, and membership in professional organizations, such as the American Water Works Association (AWWA). The City believes that the time and money invested in training, certification, and professional organizations are repaid many times over in improved safety, skills, and confidence.

Table 7.1
Personnel Certifications

Name	Position	Certification
Bruce Germain	Water/Wastewater Foreman	WDM II, WTPO II, CCS, WPO II
Randy Low	Water Crew/Wastewater Operator II	WPO II
Jesus Espinoza	Water Treatment Plant Operator/Crew	WDM II, WTPO I
Jason Williams	Water Treatment Plant Operator/Crew	WDM II, WTPO I, BAT, CCS, WW GROUP I
Certification Definitions		
BTO - Basic Treatment Operator		
CCS - Cross Connection Control Specalist		
WDM - Water Distribution Manager		
WPO - Wastewater Plant Operator		
WTPO - Water Treatment Plant Operator		

PERSONNEL RESPONSIBILITIES

The key responsibilities of the water O&M staff are summarized below.

Water and Wastewater Department Supervisor

The Water and Wastewater Department Supervisor plans and directs the construction, maintenance, and operations activities of the water and wastewater systems. Operates heavy and light equipment associated with the construction and maintenance of the distribution systems. Responsible for the safety, training and scheduling of department personnel, responding to public inquiries, and meter reading.

Water Treatment Plant (WTP) Operator

The WTP operator maintains the water production system operations, performs inspections, and assists with water quality analyses. Operates heavy and light equipment associated with the construction and maintenance of the water distribution system.

Water and Wastewater Department Crew

The Water and Wastewater Department crew assists in the repair, maintenance, and construction of water and wastewater systems. Monitors facility operations, reads meters, and assists with water and wastewater laboratory tests. Operates heavy and light equipment associated with the construction and maintenance of the distribution systems.

EQUIPMENT

The City’s Water Department has several types of equipment available for daily routine operation and maintenance of the water system. The equipment is stored at the City Hall and at the Public Works Facility. If additional equipment is required for specific projects, the City will rent or contract with a local contractor for the services needed. A stock of supplies in sufficient quantities for normal system O&M and short-term emergencies is stored at the Public Works Facility and at the WTP. A list of major equipment used in the normal operation of the water system is shown in **Table 7.2**.

Table 7.2
Major Equipment (list changes frequently)

4 - Large Dump Truck
2 - Small Dump Truck
5 - 1 Ton Service Truck
1 - 3/4 Ton Service Truck
1 - 1/2 Ton Pickup Truck
1 - Trailer Mounted Air Compressor
1 - Forklift
1 - Backhoe (1yd Bucket)
1 - Street Sweeper/Vacuum Truck

The City's Water Department utilizes several different types of communications equipment to ensure a reliable and redundant means of communication within the department. All vehicles are equipped with mobile two-way radios that can communicate with similar base radios at City Hall and other departments. The radios also provide the capability for personnel to communicate, as necessary, with other cities and Chelan County. In addition, all Public Works vehicles and equipment are equipped with two-way radios and most Water Department personnel carry pagers, handheld two-way radios, and cell phones.

The representatives shown in **Table 7.3** typically provide chemical or equipment service to the City.

Table 7.3
Suppliers

Type	Company	Address	Phone
Chemicals	OXARC	291 Ohme Garden Rd; Wenatchee, WA 98801	(509) 662-8417
Service	TMG Services, Inc.	3216 E. Portland Ave; Tacoma, WA 98404	(800) 562-2310
Service	Gray's Electric	1183 S. Wenatchee Ave; Wenatchee, WA 98801	(509) 662-6834
Hydraulic Control Valve Service	GC Systems, Inc.	2310 Inter Avenue; Puyallup, WA 98372	(253) 939-8322 (800)-525-9425

RECORDKEEPING AND REPORTING

Washington State Department of Health (DOH) has enacted regulations for recordkeeping and reporting that may be found in WAC 246-290-480. The regulations identify recordkeeping and reporting procedures for operations and water quality testing.

RECORDKEEPING

Washington State Department of Health Required Records

Records shall be kept for chlorine residual and other information as specified by DOH, as well as retention of critical records dealing with facilities and water quality issues as summarized below.

1. Bacteriological analysis results: 5 years;
2. WTP flows, chemicals used, and treatment results: 3 years;
3. Chlorine residual: 3 years;
4. Chemical analysis results: for as long as the system is in operation;
5. Daily source meter readings: 10 years;
6. Other records of operation and analyses as may be required by DOH: 3 years;
7. Documentation of actions to correct violations of primary drinking water standards: 10 years after last corrective action;
8. Records of sanitary surveys: 10 years; and
9. Project reports, construction documents and drawings, inspection reports, and approvals: life of the facility.

The City's recordkeeping procedure is as follows.

1. The field technicians provide information to the foreman, who must review the information prior to it being filed.
2. The information is given to the secretary for their input before it is filed at City Hall.

Facilities Operations and Maintenance Manuals

O&M manuals are available for staff members' reference. All equipment and O&M manuals required for the WTP may be found in the WTP *Operation & Maintenance Manual* kept both at City Hall and at the WTP. The *Equipment and Operational Maintenance* manuals required for all wells and equipment therein, PRV stations and equipment therein, BPSs and equipment, and reservoirs are maintained and housed in the equipment maintenance file at City Hall. The City intends to maintain its policies of requiring complete O&M manuals for all new equipment.

Mapping and As-Built Drawing Records

Maintenance of drawings is essential to maintenance crews, city planners, developers, and anyone else needing to know how the water system is laid out throughout the City. The City maintains a comprehensive mapping and recordkeeping system of the City's water system. This mapping is comprised of physical maps, historical data books, and computer-generated maps in AutoCAD® and GIS formats. Mapping of the system is a continuous process of incorporating new data from surveys, sketches, and digital pictures. Recordkeeping includes all known information regarding water quality, quantity, equipment maintenance, maintenance and operation of facilities, emergency preparedness plans, safety programs and procedures, and Material Safety and Data Sheets (MSDS). All records are kept in data files at City Hall.

O&M Records

Records are stored at either the WTP or City Hall for the following items:

1. Water usage;
2. Bacteriological tests;
3. Backflow and cross-connections;
4. Inorganic chemical tests;
5. Volatile organic compound tests;
6. Synthetic organic compound tests;
7. Water samples from new developments;
8. Lead and copper tests;
9. Chlorination levels;
10. Water used for construction;
11. Hydrant repairs;
12. Hydrant meter forms;
13. Hydrant databases;
14. Water system maintenance;
15. Confined spaces;
16. Vandalism reports; and
17. Customer complaints.

REPORTING

1. The City must report the following to DOH:
    a. Within 48 hours: A failure to comply with the primary standards or treatment technique requirements specified in WAC 246-290-480 and 246-290-485(2).
    b. Within 48 hours: A failure to comply with the monitoring requirements specified in WAC 246-290-480 and 246-290-485(2).
    c. Within 48 hours: A violation of a primary Maximum Contaminant Level (MCL).
    d. Within one business day: A backflow incident, per WAC 246-290-490(8)f.
2. The City must submit to DOH all applicable reports required by WAC Chapter 246-290. Monthly reports are due by the tenth day of the following month, unless otherwise specified.
3. Source meter readings must be made available to DOH upon request.
4. Total annual water production records for each source must be made available to DOH on request.
5. Water facilities inventory and report form (WFI) must be submitted to DOH within 30 days of any change in name, category, ownership, or responsibility for management of the water system.
6. The City must notify DOH of the presence of:
    a. Coliform in a sample within 10 days of notification by the testing laboratory.
    b. Fecal coliform or *E. coli* in a sample by the end of the business day in which the City is notified by the testing laboratory.

7. When a coliform MCL violation is determined, the City must:
    a. Notify DOH within 24 hours of determining acute coliform MCL violations.
    b. Notify DOH before the end of the next business day when a non-acute coliform MCL is determined.
    c. Notify water customers in accordance with WAC 246-290-320(1)(ii).
8. If volatile organic chemical (VOC) monitoring is required, a copy of the results and any public notice must be sent to DOH within 30 days of receipt of the test results.

Other Reports

Other reports are required for state agencies, including the Department of Revenue, Department of Labor and Industries, Department of Social and Health Services, Department of Ecology, and the Employment Security Department. These reports are completed according to their instructions.

OPERATION AND CONTROL

A water system is comprised of a series of individual components, each requiring some level of routine maintenance and/or observation. Some of the tasks are related to the physical assets of the system such as valves, water mains, air/vacuum and blowoff valves, and fire hydrants. Other tasks are service-related and are driven by customer or external requests.

Periodically, emergency equipment and spare parts inventory necessary for distribution system repair, spare parts for pumps, and repair items for pumps, valves, and pipelines should be checked. A master list of minimum inventory should be maintained.

The major activities comprising the operation of the City’s water system are summarized below.

WATER MAIN ACTIVITIES

Connect New Mains to the Distribution System

All newly installed water mains are connected to the existing distribution system by contract service or City crews, at the discretion of the City.

Repair Main Breaks

Maintenance personnel are on-call 24 hours a day to respond to and repair main breaks. Major broken or leaking sections must first be isolated from the rest of the system, repaired, and then disinfected prior to being put back into service. Small repairs can be made under pressure by use of a clamping device, such as a full-circle repair clamp. All parts used in the repair (pipes, clamps, fittings and gaskets) that contact potable water must be disinfected with a strong solution (20 to 50 parts per million (ppm)) of hypochlorite.

Flush Mains

Water mains are flushed periodically to remove accumulated particulates and stagnant water. Flow tests are also conducted on selected mains to evaluate fire flows and distribution system hydraulics.

VALVE ACTIVITIES

Valve Maintenance, Repair, and Installation

Each valve is operated every 1 to 3 years in both directions (fully closed and fully opened), and the turns to do so are noted on the valve record card. Valves in need of repair are identified. Repair also includes maintenance of valve boxes and adjusting boxes to grade. Valve installation includes excavation, removal of the old valve, and connection of a new valve.

Blowoff Maintenance, Repair, and Installation

Blowoffs are inspected and operated twice per year as part of the main flushing program.

Air Valves

Air valves are inspected for proper operation annually.

SERVICE RELATED ACTIVITIES

New Services

Installation includes the connection to the water main, service line placement up to the property line, and installation of meter chamber.

Service Replacements

Substandard water services that have been identified are replaced with new services. This includes a regular effort to replace galvanized piping when found.

Service Repair

Repairs are usually for leaking services. Water services are also damaged by contractors and customers, requiring immediate repair. This task includes repair of curb stops and meter boxes.

Abandoned Services

Water services that are considered abandoned and not reusable are disconnected and removed from the distribution system.

METER RELATED ACTIVITIES

New Meter Installation

Meters for new services will be installed as required. Installation includes a meter box.

Meter Repair, Replacement, and Relocation

During meter testing and meter reading activities, damaged, leaking, or inaccurate meters are identified for repair or replacement.

Meter Testing

Meters are not routinely tested. Meters are spot tested and replaced at a frequency that depends on the make and model of the meter and based on City records of abnormally low billing or customer reports of high billing.

Meter Reading

Meters are read on a routine basis. Accounts are generally read and billed monthly, except when weather or equipment failures interrupt normal schedules.

HYDRANT RELATED ACTIVITIES

Hydrant Maintenance, Repair, and Installation

Hydrants are painted as needed. Some hydrants require annual clearing (vegetation removal) to keep them accessible. All hydrants and hydrant valves are operated and inspected annually as part of the main flushing program. Repairs are generally minor except for those that result from vehicle accidents. Hydrants that cannot be repaired or have been determined to be substandard are replaced. This can also include new hydrant installation as part of the maintenance program.

CITIZEN SERVICES

Complaint Investigation and Resolution

The most common customer complaints are for “dirty” water, low or no pressure, and evidence of a broken or leaking main or service line. The complaint is investigated, and the customer is notified of the action being taken. A Customer Service Report is filled out for each complaint.

Shut-offs and Turn-ons

This task includes shut-off requests for delinquent, abandoned, and vacant accounts. These tasks are also conducted so that maintenance can be done on private plumbing per customer requests. This task also includes turn-on requests upon installation of water service lines.

Utility Locates

The City participates in the Utility Underground Location Center (“call before you dig”) service. Water main and water service lines are marked to reduce the chance of damage during excavation activities.

OTHER ACTIVITIES

Task 1 – Account Billing and Invoicing

Water bills are sent to customers monthly, and the payments are received and credited to the account.

Task 2 – Water Quality Testing

The City collects and delivers samples to the laboratory for the required water quality tests as necessary.

Task 3 – Backflow Device Inspection and Testing

The City ensures that all backflow devices in the water system are inspected and tested annually by a certified tester.

Task 4 – Flow Tests

Check the condition of certain sections of water main and fire hydrant capacity by request.

Task 5 – Education/Training

State certification as a Water Distribution Specialist with Cross-Connection Control training is required for the operator of the water system. Three continuing education units (CEUs) are required every 3 years (this is equivalent to 30 hours of instruction every 3 years) to maintain state certification. Monthly safety meetings are also conducted. About 40 hours per employee per year is currently planned for education and training needs.

PREVENTIVE MAINTENANCE

Maintenance schedules that meet or exceed manufacturer's recommendations have been established for all critical components in the water system. The following schedule is used as a minimum for preventive maintenance.

Table 7.4
Maintenance Schedules

Storage Facilities	
Daily	Visual and audible inspections.
Weekly	Check security and inspect facilities for proper operation.
Annually	Clean and check interior condition, vents, hatches, etc., on tanks.
As Needed	Repaint interior and exterior as needed on tanks (estimated 10 to 20 year frequency).

Water Treatment Plant	
Daily	Visual and audible inspection.
Weekly	Observe and record motor current draw (three phases); check packing; log and record volume delivered and pump motor hours; check motor oil level; measure and record discharge pressure; check motor noise, temperature, vibration.
Weekly	Change flow, turbidity, chlorine and pH charts and store.
Weekly	Change pH and chlorine analyzer chemicals.
Weekly	Check security.
Annually	Change motor oil.
Annually	Take inventory of parts, pumps, and motors.
Five to Ten Years	Calibrate or replace flow meters.
As Needed	Maintain electrical and mechanical equipment; paint structures and piping; change chlorine cylinders; maintain filters.

Water Mains	
5-Years or As Needed	Leak survey.
Annually	Flush.

Wells	
Daily	Log and record volume delivered and current supply rate.
Weekly	Check security. Check motor oil levels (non-submersible motors)
Annually	Check all valves and screens; check control valve settings.
Five to Ten Years	Calibrate or replace flow meters.
As Needed	Maintain electrical and mechanical equipment; paint structures and piping.

Booster Pump Station	
Daily	Visual and audible inspection.
Weekly	Observe and record motor current draw (three phases); log and record volume delivered and pump motor hours; measure and record discharge pressure; check motor noise, temperature, vibration. Check motor oil levels.
Weekly	Check security.
Annually	Take inventory of parts, pumps, and motors.
As Needed	Calibrate flow meter; maintain electrical and mechanical equipment; paint structures and piping.

Pressure Reducing Stations	
Annually	Flush and check all valves and screens; check pressure settings.
Five-Years or As Needed	Rebuild valve internals and paint.

Isolation Valves	
One to Three Years	Locate valve boxes and check accuracy of measurements and permanence of landmarks in valve record book. Operate full open/closed; uncover where buried; clean out valve boxes and repair as necessary.

Hydrants	
One to Two Years	Check for leakage and visual damage. Operate and flush; check drain rate; lubricate as necessary; measure pressure; paint as necessary. Check nozzle and cap threads, clean and lubricate per manufacturer's recommendations. Replace lost and damaged gaskets. Check and operate auxiliary valve in accordance with the valve maintenance schedule. Leave in open position. Inspect drain system to ensure proper drainage and protection from freezing weather.

Customer Meters	
Two to Ten Years	Time and measure volume of meter-delivered flow; dismantle, clean, and inspect all parts, replace worn or defective parts; retest meter for accuracy. Frequency varies based on meter size.

Air Valve Assemblies	
One to Two Years	Flush and inspect.

Blowoff Assemblies	
One to Two Years	Flush and inspect.

Telemetry and Control System	
Monthly	Visually inspect cabinets and panels for damage, dust, and debris.
Twice per Year	Inspect inside of cabinets and panels for damage, dust, and debris.
Twice per Year	Vacuum clean all modules.
Twice per Year	Test alarm indicator units.
Twice per Year	Clean and flush all pressure sensitive devices.
Twice per Year	Visually inspect all meters to coordinate remote stations.
Twice per Year	Check data backup system.
Annually	Check master and RTU's for proper operation; repair as necessary.

Rolling Stock	
Weekly	Check all fluid levels and brakes.
As Needed	Replace fluids and filters in accordance with manufacturer's recommendations (or more frequently depending on type of use).

Tools	
As Needed	Clean after each use; lubricate and maintain as necessary.

Engine Generator Sets	
Weekly	Operate to achieve normal operating temperatures; observe output.
As Needed	Replace fluids and filters in accordance with manufacturer's recommendations (or more frequently depending on amount of use).
As Needed	Perform tune-up; replace parts as necessary.

The following is a list of general preventive maintenance goals and policies.

- Facility and equipment breakdown is given the highest maintenance priority. Emergency repairs will be made even if overtime labor is involved.
- Equipment will be scheduled for replacement when it becomes obsolete, and as funding is available.
- Worn parts will be repaired, replaced, or rebuilt before they represent a high failure probability.
- Spare parts will be stocked for all equipment items whose failure will impact the ability to meet other policy standards.
- Equipment that is out of service will be returned to service as soon as possible.
- Tools will be obtained and maintained to repair all items whose failure will impact the ability to meet other policy standards.
- Dry, heated shop space will be available for maintenance personnel to maintain facilities.
- All maintenance personnel will be trained to efficiently perform their jobs.
- Maintenance will be performed by water maintenance staff and supervised by the department supervisor.
- Written records and reports showing O&M history will be maintained on each facility and item of equipment.

STAFFING

The preventive maintenance procedures, as well as the normal and emergency operations of the utility, are described in the previous sections. The hours of labor and supervisory activity required to effectively carry out the work of these ongoing O&M schedules form the basis for determining adequate staffing levels.

The current City staff includes supervisory personnel, technicians, maintenance workers, and office personnel engaged in operating and maintaining the water system. There are currently three field crew personnel and one supervisory personnel in the O&M organization that supports the City's water system. Since the Water and Wastewater Department supervisor and the Water and Wastewater Department crew also support other City utilities, only a portion of their time is available for the water utility.

SAFETY PROCEDURES AND EQUIPMENT

Safety is the concern and responsibility of all water O&M staff. To maintain the highest level of safety, the City has taken steps toward educating its staff and providing resources to ensure a safe working environment. The City will strive to improve its safety program on an on-going basis. The AWWA publishes a manual entitled, *Safety Practices for Water Utilities* (M3), which describes safety programs and provides guidelines for safe work practices and techniques for a variety of water utility work situations. This manual is available to all department personnel. Safety training classes in first aid, CPR, traffic flagging, chlorine handling, and confined space entry are required of all water department staff. Additionally, the City requires staff members to review its chlorine safety video, confined space safety video, trenching and excavation safety video, annual AWWA Safety Talks video, and MSDS sheets that are all available in the City's laboratory.

HAZARDOUS MATERIALS AND AREAS

The following identifies procedures to be followed for O&M tasks that involve the most common potential workplace hazards in the water system.

Use of Chlorine or Chlorine Products

Standard Procedure – Handle with care, provide adequate ventilation, wear safety glasses, rubber gloves, and a self-contained breathing apparatus (SCBA).

Working in Confined Spaces

Standard Procedure – Follow state requirements for confined space entry.

Working around Heavy Equipment

Standard Procedure - Obtain proper training and follow all safety procedures.

Working in Traffic Areas

Standard Procedure – Wear proper clothing and provide adequate signage and flagging for work area.

Working on or Around Water Reservoirs

Standard Procedure – Follow proper safety harness procedures for working on tall structures.

Working in or Around Pump Stations

Standard Procedure – Obtain proper training and follow all safety procedures for working on pumps and electrical equipment.

Working on Asbestos Cement (AC) Water Main

Standard Procedure – Obtain proper training and follow all safety procedures for working with asbestos materials.

SAFETY EQUIPMENT

The following includes a list of safety and first aid equipment available to water department staff to carry out safety procedures for O&M tasks.

- First aid kits in each department vehicle, workshop, and lab.
- Eye wash stations in each facility.
- SCBA equipment for chlorinator maintenance and confined spaces.
- Retrieval equipment for work in confined spaces (e.g., man lift, tool winch, etc.).
- Chlorine Institute emergency repair kit.
- Gas monitoring equipment.
- Personal protection equipment.
- Ventilation equipment for work in confined spaces.
- Traffic safety equipment.
- Wet suits for use in cleaning the WTP intake screens.
- Trench shoring equipment.
- Radios and cell phones.

REGULATIONS

The Public Works Department follows all appropriate Occupational Safety and Health Administration and Washington Industrial Safety and Health Act regulations in its day-to-day operations and complies with the following state requirements.

- WAC 296-809 – Confined Spaces.
- WAC 296-155-650 to 66411 – Excavation, Trenching and Shoring.
- WAC 296-155-429 – Lockout and Tagging of Circuits.
- WAC 296-155-245 through 24525 – Fall restraint for access to the top of the City's water reservoirs.
- *Manual on Uniform Traffic Control Devices* – Traffic control for work in the public right-of-way.

EMERGENCY RESPONSE

EMERGENCY RESPONSE PROGRAM

An Emergency Response Plan (ERP) has been prepared as part of this WSP and is included in **Appendix F**. City Code Section 13.12 describes the City's authority. The ERP contains a vulnerability assessment of the City's water system facilities, a contingency operation plan for responding to emergency events, a list of personnel responsible for making decisions in emergency situations, and other elements.

On October 23, 2018, America's Water Infrastructure Act (AWIA) was signed into law. The law requires water systems serving more than 3,300 people to develop or update risk assessments and ERPs. The law specifies the components that the risk assessments and ERPs must address and establishes deadlines by which water systems must certify to EPA completion of the risk assessment and ERP. For systems serving between 3,300 and 50,000 people, the risk assessment must be done by June 30, 2021, and the ERP by December 30, 2021. The City's population as of 2018 is estimated at 3,095 people. Current projections show the City may reach 3,300 people sometime between 2025 and 2032, therefore the City is not required to comply with the AWIA for the current planning period. Compliance with be re-evaluated in a future water system plan.

PUBLIC NOTIFICATION

The federal Safe Drinking Water Act (SDWA) and WAC 246-290-495 require purveyors to notify their customers if any of the following conditions occur:

- Failure to comply with a primary MCL as described under WAC 246-290-310.
- Failure to comply with a surface water treatment technique.
- Failure to comply with monitoring requirements under WAC 246-290.
- Failure to comply with testing requirements.
- Failure to comply with a DOH order.
- Failure to comply with a variance or exemption schedule from DOH.
- If the system is identified as a source of waterborne disease outbreak.
- If DOH issues the system a category red operating permit.
- If DOH issues an order.
- If the system is operating under a variance or exemption.

Specific notice content, distribution channels, and time limit requirements as specified in WAC 246-290-480 must be in compliance when notification is required.

CAPABILITIES

The City is well equipped to accommodate short-term system failures and abnormalities. Its capabilities are as follows.

Multiple Supply Capability

The two parallel treatment columns that comprise the WTP can function independently and produce up to 1,200 gallons per minute (gpm) each. Thus, in an emergency, the City could lose the operation of its groundwater wells as well as the operation of one of the WTP's treatment columns without adversely impacting its ability to meet normal customer demands.

Multiple Reservoirs

Water storage is provided by two active reservoirs that are located at different sites and in different pressure zones. Loss of either tank would cause a significant disruption to service since there is no secondary tank in either zone. The addition of pressure relief valves at Well No. 4 and the WTP in 2019 improved the ability to supply water if the Sherman Reservoir is out of service. The pressure relief valve (PRV) in the Sherman booster station provides similar functionality.

If the Sherman Reservoir is out of service, the following steps should be taken:

- Activate Well No. 4 and WTP PRVs.
- Activate Well No. 10.
- Request customers reduce water use.
- If the outage is in the summer, Well No. 10 will not be able to meet customer demands and a temporary pump will be needed to replace the inactive Sherman pump station.

If the Kennedy Reservoir is out of service, the following steps should be taken:

- Verify the Sherman booster pump station PRV is functional. Adjust to maintain approximately 100 pounds per square inch (psi).
- Install a backup 2-inch temporary pressure reducing valve on a fire hydrant at a location where a continuous 100 gpm discharge will not cause damage.
- If the outage is in a low demand period, activate Well No. 10. If it is in the summer, activate the small Sherman pump. Leave the large Sherman pump off if possible.
- Request customers reduce water use.

Distribution System

The City has attempted to loop water mains wherever possible to improve water circulation (i.e., water quality) and minimize impacts to the system if a portion of the distribution system must be taken out of service for maintenance or repairs.

Emergency Equipment

The City is equipped with the tools necessary to deal with common emergencies. If a more serious emergency should develop, the City will hire a local contractor who has a stock of spare parts necessary to make repairs to alleviate the emergency condition.

Emergency Telephone

Key or on-call personnel can be reached by the Police Department and all emergency situations are resolved by calling 911. In addition, all after hours calls to City Hall are forwarded to a dispatcher (answering service) who can contact on-call personnel via pager.

On-call Personnel

The on-call person is equipped with a service vehicle and can generally respond to a call within 15 minutes. A list of emergency telephone numbers is provided to each on-call employee. New employees are not placed on-call until they are familiar with the water system and maintenance procedures.

Material Readiness

Some critical repair parts, tools, and equipment are kept on hand in fully operational condition. As repair parts are used, they are re-ordered. Inventories are kept current and are adequate for most common emergencies that can reasonably be anticipated. The City has ready access to an inventory of repair parts, including parts required for repair of each type and size of pipe within the service area.

CROSS CONNECTION CONTROL

The City adopted a Cross-Connection Control Program to comply with WAC 246-290-490 pertaining to contamination of potable water due to cross-connections. The Cross-Connection Control Plan has been updated with this WSP and is included in **Appendix E**. Backflow prevention assemblies are required at service connections where a potential for contamination exists, as outlined in the City's Municipal Code. Cashmere Municipal Code 13.10.110 describes adoption of the Pacific Northwest Seismic Network (PNS) AWWA Cross-connection Control Manual. Mr. Bruce Germain is a certified Cross-Connection Control Specialist, as shown in **Table 7.1**. The City performed the initial assessment in 2012, which resulted in installation of 12 double check valve assemblies (DCVA) and 42 reduced pressure principal DCVAs (RPBA). As new customers request service, the City evaluates each for cross-connection risk. As of 2018, there are 210 DCVAs, and 84 RPBAs. All were tested in 2018. The City uses Tokay tracking software.

DEVELOPER EXTENSION REVIEW

If a party ("developer") requests service that, in the City's opinion, requires construction of a watermain extension, the following procedure shall be followed.

1. Developer obtains a determination from the Fire Department of fire flow requirements.
2. Developer and City meet to discuss the requirements for constructing improvements to the water system.
3. Developer contracts with a professional engineer to develop plans. Optionally, developer may request if the City's engineer may prepare the plans.
4. City's engineer reviews the developer's plans and provides comments.
5. After all review comments have been addressed, developer submits plans for City signature.
6. Developer constructs improvements.
7. City inspector observes and approves the installation methods, pressure testing, and purity testing.
8. City accepts the extension as complete. Developer transfers ownership to the City.
9. Engineer of record prepares a DOH Construction Completion Report.

8 | SYSTEM IMPROVEMENTS

INTRODUCTION

This chapter presents proposed improvements to the City of Cashmere's (City) water system to resolve existing system deficiencies, and to accommodate the projected growth of water customers. The water system improvements were identified from an evaluation of the results of the water system analyses presented in **Chapter 6**. The water system improvements were sized to meet both the existing and future demand conditions.

A Capital Improvement Program number, herein referred to as a CIP number, has been assigned to each improvement. The improvements are organized and presented in this chapter according to their purpose. The remainder of this chapter presents a description of each group of improvements, the criteria for prioritization of improvements, the basis for the cost estimates, and the proposed implementation schedule.

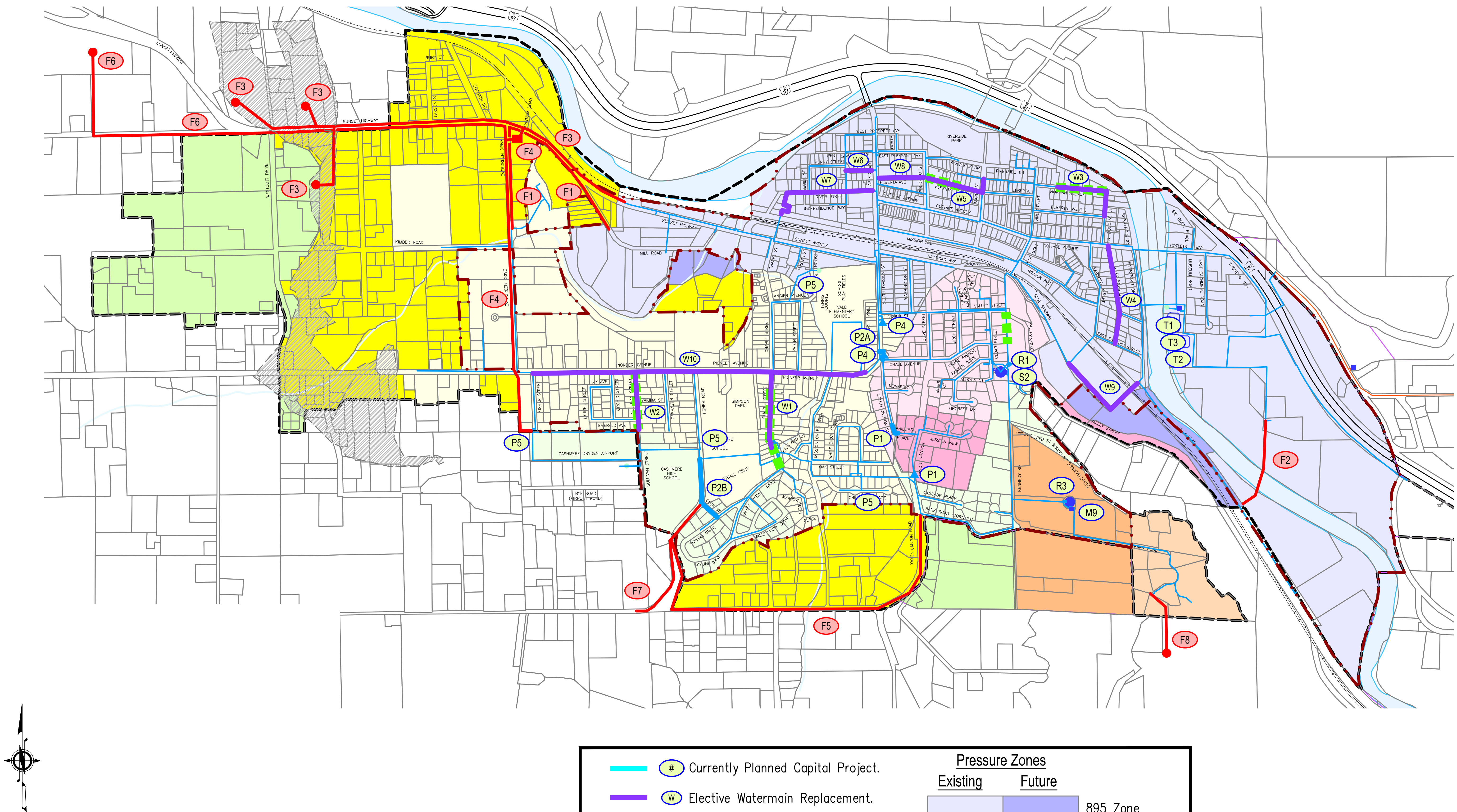
SYSTEM IMPROVEMENTS

This section provides a general description of each group of improvements and an overview of the deficiencies that they will resolve. Most of the improvements are necessary to resolve existing system deficiencies; however, improvements have also been identified for some of the undeveloped areas of the Urban Growth Area (UGA) to illustrate the major facilities that will be required when development occurs in this area. The locations of improvements in the undeveloped areas are shown schematically in **Figure 8.1** and may be altered depending on how development progresses.

SYSTEM IMPROVEMENTS SINCE THE LAST WATER SYSTEM PLAN

The water system has undergone some changes since the City last updated its Water System Plan (WSP). The following list includes most of the recent projects.

- 2012: Installed 3,400 feet each of 12-inch fire main and 2-inch domestic service main in Riverfront Drive from East Parkhill Street to the Wastewater Treatment Plant (WWTP).
- 2012 (Developer): Installed 1,800 feet of 12-inch water main along SR2/97 from the old TreeTop plant to Old Monitor Road for the Bluestar facility.
- 2013: Installed 400 feet of 8-inch water main on the old mill site property, replacing a badly leaking main.
- 2014: Installed 1,000 feet of 12-inch water main in Mission Avenue from Vine Street to Parkhill Street.
- 2014 (Developer): Installed 1,200 feet of 8-inch water main from Evergreen Drive to the Washington Grower's League housing project.
- 2015: Installed 1,000 feet of 12-inch water main in Aplets Way from Cottage Avenue to north of Prospect Street.
- 2015: Installed supervisory control and data acquisition (SCADA) equipment at reservoirs, wells, water treatment plant (WTP), and Sherman booster pump station (BPS).
- 2016 (Developer): Installed 200 feet of 8-inch water main in Mt. Cashmere Place for a new residential development.



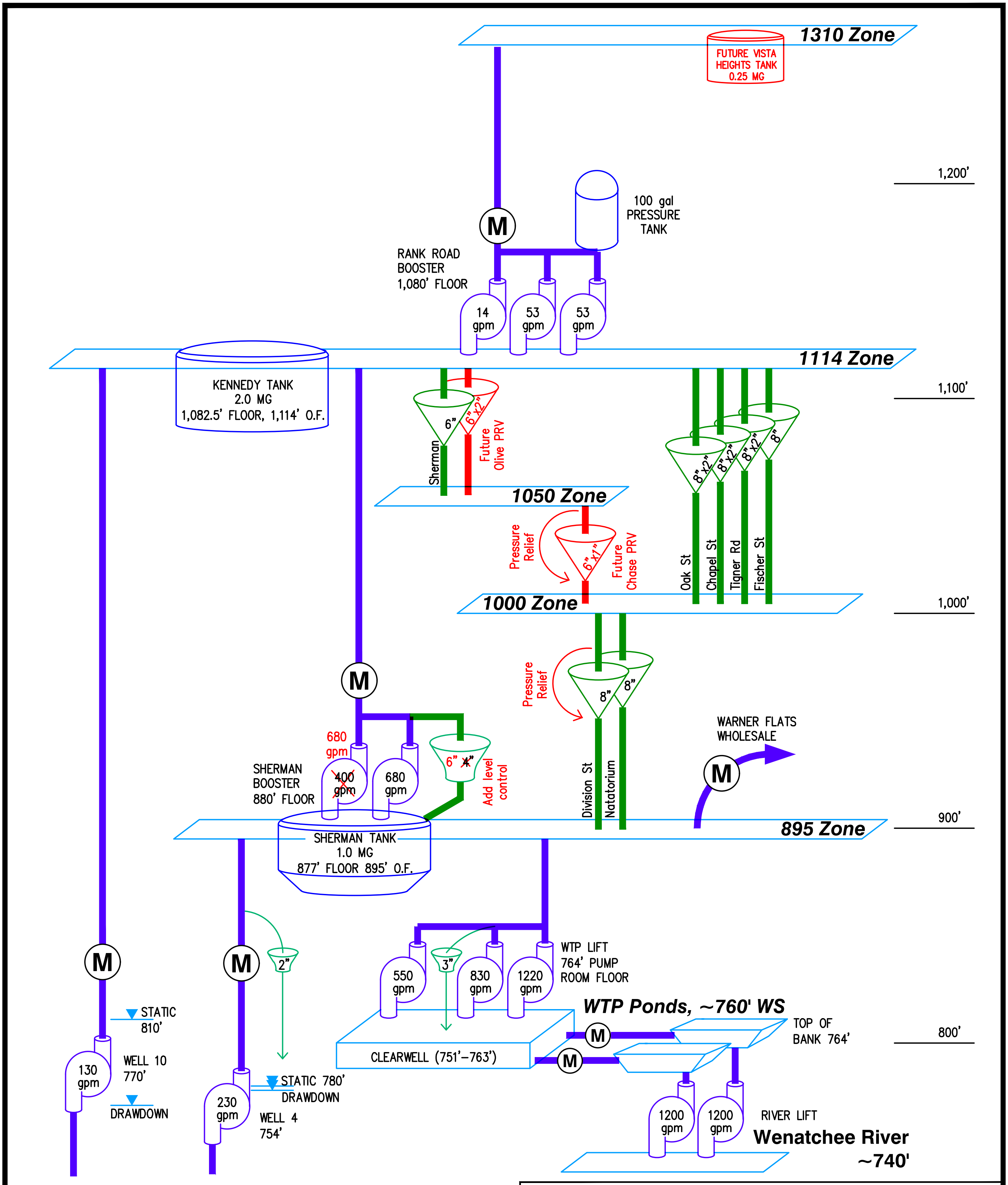
	Pressure Zones	
Currently Planned Capital Project.	Existing	Future
Elective Watermain Replacement.		895 Zone
Future Project Dependant on Growth.		1000 Zone
Currently Planned Sewer Project per 2009 Sewer Plan		1050 Zone
Compatible Elevation Range for Future 895 Reservoir.		1114 Zone
		1310 Zone

Figure 8.1: Capital Improvement Projects

CITY OF CASHMERE
2019 COMPREHENSIVE WATER SYSTEM PLAN

SCALE: 1 in = 1,000 ft
DRAWING IS FULL SCALE WHEN BAR MEASURES 1"

PLOT DATE: 12/23/2019 JOB: CA 217.102
FILE NAME: CAWSP19-F-CIP.DWG



PRESSURE REDUCING STATION

PRESSURE RELIEF VALVE

PUMP

(M) FLOW METER

PROPOSED PROJECTS SHOWN IN RED

Figure 8.2: 10 Year CIP Hydraulic Profile

CITY OF CASHMERE
2019 COMPREHENSIVE WATER SYSTEM PLAN

SCALE: Not to Scale
0" 1/2" 1"
DRAWING IS FULL SCALE WHEN BAR MEASURES 1"

PLOT DATE: 10/5/2019 JOB: CA 217.102
FILE NAME: CAWSP19-F-HPRO.DWG

RH2 ENGINEERING 40 YEARS SINCE 1978

- 2016 (Developer): Installed 250 feet of 8-inch water main in Newberry Street for a new residential development.
- 2017 (Developer): Installed 400 feet of 8-inch water main in Vine Street from Elberta Avenue north to a new residential development.
- 2017 (Developer): Installed 300 feet of 8-inch water main in Hassan Street for a new residential development.
- Year unknown (Developer): Installed 450 feet of 8-inch water main in Tangier Lane for a new residential development.
- 2018: Replaced one River Intake pump and motor due to excessive wear. Replaced failed motor on second River Intake pump.
- 2018: Replaced motor on 30 horse power (hp) Sherman booster pump.
- 2019: Installed 850 feet of 8-inch water main along Chapel Street from Pioneer Avenue to the Chapel Street pressure reducing valve (PRV), replacing leaking and undersized mains.

DISTRIBUTION IMPROVEMENTS

Water main improvements were identified from the results of the system analyses discussed in **Chapter 6**. Many of the water main improvements are replacements of existing water mains and are grouped in the elective water main replacement program (CIP W1). The other water main improvements are mostly larger diameter water mains that function as a backbone for future expansion and are identified as individual projects. **Figure 8.1** shows how the future pressure zones are expected to expand.

CIP W1: Elective Water Main Replacement Program

Issue: Most of the water main improvements shown in **Figure 8.1** will improve fire flow with the objective of approaching or meeting land use fire protection goals. The mains have been selected to provide a basic arterial system that can be expanded in the future. Some areas also contain water mains that have had reported occurrences of leaks or breaks. Other projects are intended to coincide with road or sewer improvement projects to reduce the cost of surface restoration and indirect costs.

Improvement: Replace existing water main with new ductile iron (DI) water main in accordance with the City’s construction standards. The individual water main improvements grouped under this project are numbered W1, W2, W3, etc., as shown in **Figure 8.1**. The selection of specific projects will be accomplished annually during the City’s budget development process and will be guided by the prioritization presented later in this chapter. This provides the City with the flexibility to coordinate these projects with other projects that may occur within the same area. An allowance of up to $300,000 per year has been proposed for the annual replacement of water mains.

There is approximately 54,000 feet of cast iron pipe in the system, the majority of which is more than 40 years old, although the specific ages are unknown. An estimate of the cost to replace all cast iron pipe is $14,000,000, or approximately $250 per foot for 8-inch pipe, and $300 per foot for 12-inch pipe. These prices include survey, design, construction, trench patching, and administration. Long term program cost options to replace all cast iron pipe are shown in **Table 8.1**.

Table 8.1
Estimates to Replace All Cast Iron Pipe

Years	Feet per Year	Cost per Year
20	2,700	$ 700,000
30	1,800	$ 466,667
40	1,350	$ 350,000
50	1,080	$ 280,000

Three water mains were identified in the last WSP to be replaced when the roads were rebuilt. These were Tigner Road, Pioneer Avenue, and Railroad Avenue. The City elected not to replace the water mains when those road projects were built. Tigner Road and Railroad Avenue have therefore been removed from the CIP list, but Pioneer Avenue was retained due to the importance of this main, as it is the backbone of the 1000 Zone.

SUPPLY IMPROVEMENTS

CIP S1: Backup Generator

Issue: The City does not have any backup power equipment.

Improvement: Provide a portable, trailer mounted engine generator set for backup power supply in the event of a power outage. Size to accommodate the largest single load, being the WTP pump 1 (30 hp), pump 2 (60 hp), treatment pumps (two at 10 hp each), and ancillary equipment such as lights and heat. Sizing was performed by RH2 Engineering, Inc., (RH2) in 2017 resulting in a 150 kilowatt (kW) generator. See **Appendix R**.

Although the addition of transfer switches and generator receptacles at each facility would simplify connection of the generator, it is possible for an electrician to directly wire a generator to the power supply. The cost estimate includes installation of a generator connection and manual transfer switch at the WTP, Sherman BPS, and Museum Sewer Lift Station.

The CIP budget assumes that full cost of the project will be paid by the City. However, the City is pursuing a Federal Emergency Management Agency (FEMA) Hazard Mitigation Program grant, which may cover part of the cost. If this grant is available, other projects may be accelerated.

CIP S2: Sherman Booster Pump No. 1 Replacement

Issue: If the larger Sherman pump is out of service, the smaller pump and Well No. 10 may not keep up with demands during peak periods.

Improvements: Replace the smaller pump with a pump of at least 650 gallons per minute (gpm) capacity. The electrical equipment will also need upgrading.

TREATMENT PLANT IMPROVEMENTS

CIP T1: Treatment Remote Monitoring and Operations

Issue: The City's telemetry and supervisory control equipment is functional, but only reads and logs minimal alarms, reservoir levels, and pump status (on/off). Water quality monitoring equipment exists at the WTP, but data is only logged locally, requiring frequent personnel visits.

Improvement: Upgrade the SCADA system to receive and log data and provide alarms. The following items assume continued use of Mission Communications SCADA (MCS) equipment. The cost estimate is planning level only and will require a detailed evaluation prior to implementation.

- WTP: Add lower pipe gallery flood switch. Add filter bed head differential sensors. Add MCS expansion module. Add conduit, wiring, and programming to connect existing equipment and monitor pH, turbidity, residual chlorine, sand bed differential head, clearwell level, and dry-pit flood.
- WTP River Intake: Add MCS modules. Add turbidity analyzer. Add water level sensor.
- City Hall: Install an automatic chlorine residual analyzer to monitor distribution system residual.
- Well No. 4: Upgrade MCS equipment.
- Well No. 10: Upgrade MCS equipment.
- Kennedy Tank, Vista BPS: MCS upgrade and expansion module.
- Add a second chlorine gas cylinder to Well No. 4 and Well No. 10 plus automatic changeover equipment to provide continuous chlorination for extended periods.

Costs are estimated at $10,000 for a detailed evaluation of equipment required, and $90,000 for implementation.

The MCS equipment does not currently include functionality to automatically shut off pumps under an alarm condition (other than reservoir level). The system can be configured to send an alarm to the operators, who can then shut of pumps manually through a remote device, although this method requires the MCS alarm call-out system to function reliably.

CIP T2: Water Treatment Plant Settling Pond

Issue: Poor Wenatchee River water quality can lead to a rapid buildup of undesirable materials in the filter ponds, reducing supply capacity, and increasing maintenance.

Improvements: Construct a setting pond between the river intake pumps and the filter ponds. The City owns about 0.7 acres where a pond could be installed. The cost of this project has not yet been estimated, as a predesign evaluation should first be performed.

CIP T3: Water Treatment Plant - Other

Issues: A number of issues affect the efficient operation of the plant, these include the following.

- Rocks and sand occasionally obstruct the WTP’s intake screen area which reduces the supply capacity of the facility.
- The pump building and river intake facilities have limited means of removing existing pumps.
- The plant only has flow meters from the filter ponds to the clearwell. There are no flow meters at the river intake or at the plant discharge. Without metering, the pump condition is difficult to assess, and real time customer demands are difficult to estimate.

Improvements: The following projects would address the issues noted but are not considered high priority at this time. The projects may be reevaluated later as operations and budgets allow.

- Roof hatches and cranes would simplify pump removal.

- Modification of the intake screens could reduce the occurrences of plugging, though the City's current procedures have been reasonably effective to date in dealing with the issue.
- River intake pump and WTP discharge metering would improve record keeping and pump condition monitoring. Meters may have to be installed in vaults outside of the existing structures.

STORAGE IMPROVEMENTS

CIP R1: Sherman Reservoir Roof Replacement

Issue: The center portion (about 15-percent) of the Sherman Reservoir roof trusses collapsed in early 2019.

Improvement: The mechanism of failure cannot be determined until the Sherman Reservoir is drained and the roof is removed, so it is not known if the remaining trusses may also be pending failure. Rather than attempt a partial repair, which has a high risk of being unsuccessful, full replacement of the roof is planned.

CIP R2: Sherman Reservoir Fill Valve

Issue: Unable to reliably provide fire flow water from the Kennedy Reservoir to the Sherman Reservoir.

Improvement: Replace the existing 4-inch relief valve in the Sherman BPS with a 6-inch Cla-Val Model 50-03 pressure relief valve with solenoid override (a solenoid powered to open valve) and anti-cavitation trim. Activate the solenoid to open the valve via floats or level transmitter when the Sherman Reservoir is low. This will allow the Kennedy Reservoir to supply water to the 895 low zone during an emergency without relying on local pressure suppression at the Natatorium or Division PRV stations. In addition, the Sherman pumps must be shut down to prevent robbing water from the Sherman Reservoir until it recovers sufficiently.

Left unconstrained, the proposed bypass could run at 40 feet per second (fps), which exceeds the recommended 20 fps maximum continuous velocity in a control valve. To prevent valve damage, the bypass line should be throttled, or the control valve should be provided with a maximum pressure differential pilot to not exceed approximately 20 pounds per square inch (psi), or as recommended by the valve manufacturer. Set to 20 fps maximum, the existing 4-inch valve should allow the reservoir to retain approximately 6 feet of water. Optionally, replacing the 4-inch valve with a 6-inch valve should allow inflow to nearly match the outflow and maintain a steady reservoir level. The cost estimate assumes installation of a new 6-inch valve. The City has already purchased the control valve, but the installation is still pending.

CIP R3: Reservoir Inspection

Issue: The interiors of the reservoirs have not been inspected for some time. If paint is damaged, the underlying steel can deteriorate rapidly. Cracks in concrete can widen over time.

Improvement: The reservoir interiors should be inspected every five years. A diving company can perform this inspection with the reservoir in service.

CIP R4: Kennedy Reservoir Repainting

Issue: The Kennedy Reservoir was last painted in 2003. Steel reservoir paint systems typically have a life of 20 to 40 years depending on the quality of the original job, and the attention to maintenance.

Improvement: Unless an internal inspection (see CIP R2) notes otherwise, the reservoir is not expected to need repainting in the near future, but should be reevaluated every few years.

PRESSURE ZONE AND PRV STATION IMPROVEMENTS

CIP P1: 1050 Zone Improvements

Issue: The existing 1050 Zone is supplied only by a single 6-inch PRV. The large valve is not well-suited for low flows, and there is no backup should it fail. Pressure in the adjacent Mission View Place is over 90 psi. South Division Street and Mission View Place are both dead end mains.

Improvements: Install a 6-inch main in Phillips Place connecting the two dead end mains. Install a 2-inch by 6-inch PRV Station along Olive Street just north of Cascade Place.

CIP P2A: 1000 Zone Reliability Supply Phase 1

Issue: A single 40-year old 10-inch DI main conveys all water to the 1114 and 1000 Zones. Loss of a portion of this main would greatly restrict or terminate service to a portion of each zone.

Improvement: Install a 1050 to 1000 Zone pressure reducing station and approximately 100 feet of 8-inch main to connect the 6-inch main at South Division and Chase Avenue to the 12-inch main at South Division and Pioneer Street. The PRV should be a 6-inch valve. Include a smaller 1-inch bypass PRV for circulation. A larger bypass is not required because there are already three 2-inch bypass PRVs feeding the 1000 Zone.

CIP P2B: 1000 Zone Reliability Supply Phase 2

Improvement: Install approximately 800 feet of 8-inch main along Tigner Road and Glen Street from Skyline Drive to the existing 10-inch main in Tigner Road adjacent to the high school parking lot. This would provide a backup main to the existing main along the school track, and provide a loop to the Valley View and Skyline Drive dead end system.

CIP P4: 1000 and 1050 Zone Pressure Relief Valves

Issue: The 1000 and 1050 Zones do not have any means of relieving high pressure should a PRV station fail in the open position.

Improvement: The pressure reducing station described in CIP P2A should also contain a relief feature, which will be sized during the design of the improvements to relieve pressures from the 1050 Zone to the 1000 Zone in the event of a failure of one of the PRVs. The existing PRV at Division Street can be modified to include a pressure relief feature, or a bypass relief valve can be installed. The cost presented assumes the existing valve can be modified and a separate dedicated station is not required.

CIP P5: Fisher Street, Tigner Road, Oak Street, and Natatorium (1114 to 1000 Zone) PRV Improvements

Issue: The existing pressure reducing stations are flooded because of high groundwater. This slows maintenance, accelerates corrosion, and poses a risk of cross-connection.

Improvement: Provide a sump pump for removal of standing water in the vault, provide waterproofing of the vault structure, or reconstruct the stations above grade. Advantages of above-grade stations are the elimination of confined spaces and ease of maintenance. There is room at most sites for a small above-grade station, though each has its challenges. Power would need to be added to each site for heating the structure.

- Fisher Street: This would be the easiest site to improve as there is sufficient land adjacent to the airport.
- Tigner Road: Improvements would include removal of hedges and trees, and a possible need for an easement from the School District. With proximity to the school parking lot, potential vandalism should be considered.
- Oak Street: The existing station is on an easement within a small residential lot. The City would need to enforce its rights to the easement, which has been encroached in the past. A legal opinion may be needed to decide if the City can construct an above-grade structure, or is the easement limited to below-grade only. There do not appear to be alternate sites nearby because the area is built out. The station could possibly be relocated to the east end of Oak Street and fed from Olive Street, though this would require another private easement.
- Natatorium: The site is owned by the City for the pool, but extensive hardscape restoration may be required.

A detailed cost estimate to construct above-grade stations has not been performed. A rough estimate is as follows: $10,000 for a heated enclosure (“hot box”), $30,000 for pipe revisions (assuming existing PRVs are retained), $5,000 for power service, and $20,000 for other costs (design, tax, administration, etc.) for a total of $65,000 per site.

OPERATIONS AND PLANNING IMPROVEMENTS

CIP M1: System Mapping

Issue: The City’s water system computer aided drafting (CAD) and geographic information system (GIS) maps are schematic and have not been field checked in many years. Lack of a good valve map can increase the time needed for construction or emergency shutdowns. Overgrown or buried meter boxes can be hard to find.

Improvement: Obtain global positioning system (GPS) locating of visible facilities (valve boxes, hydrants, air valves, meter boxes, etc.). Review City records to verify pipe sizes and locations. Update the CAD and GIS maps. GIS mapping gives a base for adding additional information such as sizes, depths, and service dates.

CIP M2: Hydraulic Model Calibration

Issue: The City’s hydraulic model has not been calibrated. Pipe sizes were obtained from old maps and friction factors were applied based on common industry standards.

Improvement: Perform calibration of the hydraulic model by performing fire hydrant flow tests in the field and comparing the results to model predictions. Preferred timing would be after a flow meter is installed at the WTP (CIP T3) and a pump operational condition assessment is complete (CIP M7).

CIP M3: Comprehensive Water System Plan Update

Washington Administrative Code (WAC) 246-290-100 requires that the City's WSP be updated every six to ten years and submitted to the Washington State Department of Health (DOH) for review and approval.

Project: The City will update and submit its WSP to comply with State requirements.

CIP M4: Water Rights Planning Activities

Issue: The City may not have sufficient water rights to meet the demands of long-range future customers, especially if industrial users request large quantities of water. Two water rights are in dispute between the City and Washington State Department of Ecology (Ecology).

Improvement: The process of acquiring additional water rights was begun with adoption of the Water Resources Inventory Area (WRIA) 45 *Watershed Management Plan* in 2006 which established potential additional available water resources. In 2015, a coordinated effort to formally establish allocation of new water rights was begun. Completion of the process is hoped to occur in 2019. Some additional costs may yet be necessary for legal counsel and engineering support.

CIP M5: Customer Meter Replacement

Issue: All customer meters will eventually require recalibration or replacement.

Improvement: All customer meters were replaced about 8 to 10 years ago and are not expected to need service immediately. However, a rotating schedule for replacement is proposed to keep meters accurate. Often, it is more economical to replace a meter rather than to recalibrate, though the City may elect to attempt recalibration. Replacement can be budgeted either as an annual allocation, or as a single project. Recently, it has been more practical to replace all meters within a one- to three-year period so that the electronic read heads all use the same technology. The budget in the CIP has spread the cost to reflect a 15-year replacement cycle, assuming that the City will create a meter replacement fund and contribute to it annually. Once sufficient reserves are acquired, the replacement program can be implemented. The fund would then be replenished over time for the next replacement cycle.

CIP M6: Wellhead Protection Area Reevaluation

Issue: The City's current *Wellhead Protection Plan* includes basic travel time areas of influence using the Calculated Fixed Radius method. From the DOH *Wellhead Protection Program Guidance* document, DOH recommends a more detailed method be used for systems with more than 1,000 connections within five years following the initial delineation, especially if the well sites are classified as high risk, which applies to Well Nos. 4 and 10.

Improvement: Perform a more accurate delineation of the wellhead protection area boundaries utilizing analytical models, hydrogeologic mapping, and computer flow models. The City will also continue its existing water quality monitoring and public education programs. One possible outcome of the effort would be that the travel time boundaries are narrowed, reducing the amount of land the City needs to review for possible contaminant sources. The effort is not included in the current CIP, as the cost to perform the work ($25,000 estimate) exceeds the cost the City may incur to perform risk evaluations on, what is likely, a larger area than necessary. The City may reprioritize this item in the future.

CIP M7: Pump Condition Evaluation

Issue: Well Nos. 4 and 10 operate with manual throttling, which places them outside of the optimal range. WTP Pumps 1, 2, and 3 do not appear to be operating near their nameplate ratings, which may be a result of wear, restrictions, mislabeling, or inaccurate testing. Very little is known about the Sherman pumps other than horsepower and normal flow rate.

Improvement: Perform pump condition assessments consisting of flow, pressure, vibration, and electrical draw. Such testing at the WTP would be best achieved after a discharge flow meter is installed, otherwise manual calculations using the clearwell drawdown rate will be required, similar to that done for the 2016 tracer study. Estimated cost is $8,000.

CIP M8: Pump Station Flow and Pressure Monitoring

Issue: The City's new telemetry and supervisory control equipment is functional, but only reads and logs minimal alarms, reservoir levels, and pump status (on/off). The existing Vista Heights booster station flow meter does not work. Well water levels and system pressure are not automatically monitored.

Improvement: Modify or replace the flow meters at each pump station for compatibility with the SCADA system and integrate flow meters with SCADA. Discharge pressure transmitters and well level transducers can also be added but are not included in the CIP estimate. The estimate assumes the existing flow meters can be modified with new readout heads.

CIP M9: Well No. 4 and Well No. 10 Upgrades

Issue: Well Nos. 4 and 10 operate with manual throttling, which increases the cost of electricity. It may also increase wear on the impellers and bearings due to operation outside of the recommended range. Throttling is necessary to prevent excessive drawdown in the wells. Both wells are turned on and off manually. Well No. 4 lacks a pump control valve and the Well No. 10 pump control valve is not functioning. Neither well has the automation that would allow standard automatic control based on reservoir levels. This adds a risk of reservoir overflow if a high-water alarm is not addressed soon enough.

Well No. 10 has lost roughly half of its capacity since the last redevelopment.

Improvement: The pumps could be replaced with pumps more suited for the available well capacity, or the drives replaced with variable frequency drives (VFD). These improvements should be reviewed in advance of any future pump replacement or electrical upgrades to either facility. Pump control valves are required for starting and stopping the pumps automatically if VFDs are not installed. New pump control panels may be required to incorporate automation. The pump motors may need to be replaced if the existing are not compatible with VFD. This effort is not currently scheduled in the CIP because the City has indicated they are comfortable operating the system as-is, and the electrical cost savings alone would not pay for the improvements. Costs for upgrades may range from $30,000 to $80,000 per well depending on options selected.

Redeveloping Well No. 10 may cost $15,000. Alternately, a new well could be drilled adjacent to the existing building at an estimated cost of $70,000. Equipping a new well with a new pump and VFD may cost $100,000.

FUTURE OR DEVELOPER FUNDED PROJECTS

The following projects are not expected to be necessary in this 6-year cycle based on current growth projections. They have been included to give a long-range view of how the system may be configured as it expands into the UGA, or if the City reevaluates their reliability criteria. A more thorough evaluation of the scope and configuration of these projects will be necessary as the need for them approaches a future budgeting cycle. The projects are not listed in any particular order.

CIP F1: West Cashmere Transmission 12-inch Water Main on Evergreen Drive and Sunset Highway

Issue: Development that occurs in the westerly part of the UGA will require transmission mains to convey supply and storage throughout the area.

Improvement: Install new 12-inch DI water main along Evergreen Drive from Kimber Road to Sunset Highway, then along Sunset Highway east to the pressure zone boundary. The costs associated with water system facility improvements in this undeveloped area will be shared by the City and by developers in the improvement area, as the majority of the improvement does not provide benefit to existing water customers.

CIP F2: Third River Crossing

Issue: The City currently has two river crossings, although a third would improve reliability and potentially eliminate two dead end mains.

Improvement: Install a new main between the City's industrial WWTP on the east bank and the WWTP on the west bank. The project is not necessary in this planning period, but may be revisited depending on the City's evaluation of risk, and future development in the east UGA. A rough budget estimate is provided, though this must be reevaluated should the project be deemed feasible in the future.

CIP F3: New 895 Zone 1.0 Million Gallons (MG) Reservoir and Transmission Main

Issue: The storage evaluation in **Chapter 6** indicates that the storage requirements of the 895 Zone are met by the existing storage for the 20-year planning period, but only if fire flow storage for the entire City is held in the Kennedy Reservoir. However, should growth (especially industrial which is difficult to forecast) exceed current predictions additional storage may be required sooner. Also, should the City reevaluate its standards for reliability, new storage may be necessary.

Improvement: Locate and construct a new 895 Zone reservoir. Site the reservoir so that the base of the structure is at or above an elevation of 879 feet to eliminate dead storage compatible with the Sherman Reservoir. The proposed reservoir is currently assumed to provide approximately 1.0 MG of usable storage and will have an overflow elevation of 895 feet. Install approximately 5,000 feet of 16-inch transmission main from the proposed 895 Zone reservoir to the existing 16-inch main in Sunset Highway. Possible locations of the reservoir and water main are shown schematically in **Figure 8.1** and may be altered based on future development and property availability in the UGA. A water age analysis should be performed during the predesign phase to reduce the chance of poor water quality. The City may wish to begin discussions with property owners to secure a site while the land is still available.

CIP F4: New 1114 Zone Booster Pump Station and Transmission Main

Issue: The City does not have sufficient backup supply to ensure non-interrupted service in the 1114 Zone if the Sherman BPS is out of service. Future development in the west UGA may require additional capacity if land use designations change to allow higher density development.

Improvement: Following the completion of a future 895 Zone reservoir (CIP F3) construct a new 895 to 1114 Zone BPS that will function as the primary supply facility for the 1114 Zone, which includes providing supply to the Kennedy Reservoir. Construct approximately 3,500 feet of 12-inch main along Evergreen Drive to the airport. The BPS may have a capacity of approximately 1,000 gpm to satisfy the peak water demand of the zone. One possible pump arrangement is two pumps each sized for approximately 600 gpm, with space for a future third pump. The actual pump capacities and configuration will be determined during the preliminary design phase of the project when more information is available about the area to be served. An engine generator set receptacle for emergency power supply should be included. The location of the BPS is shown schematically in **Figure 8.1** and may be altered based on the final location of a new 895 Zone reservoir (CIP F3), future development, and property availability in the area.

CIP F5: 1114 Zone Reliability

Issue: Much of the existing 8-inch and 10-inch, including some 12-inch water main from the Kennedy Reservoir to the western edge of the 1114 Zone is currently undersized to meet the desired fire flow goals in the 1114 and 1000 Zones. There are no backup or parallel mains to provide redundancy. CIP P2A provides a reasonable interim solution.

Improvement: The effort to replace or parallel the existing main is currently cost prohibitive. One option is to replace the existing mains with approximately 7,000 feet of new 16-inch water main from the Kennedy Reservoir to the Fisher Street PRV. Alternately, the City could develop a new route for a parallel 12-inch main, such as along Yaksum Canyon Road and Binder Road, those these are currently outside of the City limits. These projects are not currently financially viable but should be reevaluated in the next WSP. Construction of CIP F1, F3, and F4 would improve reliability without the need for these additional mains.

CIP F6: New 1114 Zone Reservoir and Transmission Main

Issue: The storage evaluation in **Chapter 6** indicates that the storage requirements of the 1114 Zone is sufficient for the foreseeable future, but the long distance between the existing reservoir and future developments in the UGA to the west may be insufficient for transmission.

Improvement: Locate and construct a new upper zone reservoir in the westerly part of the UGA. The lack of elevation gain would locate the tank outside of the current UGA. The tank could be sited to serve either the 1114 Zone or the 1000 Zone. A transmission main will also be needed to serve the reservoir. Until more development occurs in the western portion of the UGA, the size and elevation of the reservoir cannot be accurately determined. One possible location of a 1114 Zone reservoir and water main is shown schematically in **Figure 8.1** and may be altered based on future development and property availability in the area. A water age analysis should be performed during the predesign phase to reduce the chance of poor water quality. The City may wish to begin discussions with property owners to secure a site while the land is still available.

CIP F7: New School Field Main

Issue: The Cashmere School District (School District) owns property just south of the City limits along Tigner Road. The closest City water main is approximately 2,000 feet to the north. If the School District builds structures, fire flow may be required.

Improvement: Construct 2,000 feet of water main. Initial hydraulic modeling indicates an 8-inch main may provide 1,300 gpm, or a 12-inch main may provide up to 2,000 gpm. It is assumed that the School District would fund this project. This would be a long dead end main, so ideally it would be combined with project CIP F5 for looping.

CIP F8: Vista Heights (1310 Zone) Reservoir

Issue: The 2007 WSP amendment stated the Vista Heights pump station was intended only to serve the 14 lots of the development Phase 1. By 2018, 10 lots were occupied. There is no fire flow storage or fire flow pumping capacity to Phase 1, but the water mains were sized to convey fire flow in the future. The 2007 WSP amendment stated that Phase 2 would include construction of a reservoir.

Improvement: Construct a reservoir to provide fire flow of 1,500 gpm for two hours and customer storage needs. Reservoir size may be 0.25 MG or larger depending on the number of new customers proposed. Construct approximately 1,000 feet of 12-inch water main. A cost estimate is included in the CIP table, though this project is expected to be funded by the developer. The cost estimate does not include purchase of property or easements. An alternate approach may be to upgrade the existing pump station if a reservoir site cannot be procured. The City has included a line in their development application forms to acknowledge if a proposed project will be in the 1310 Zone.

CIP F9: Additional Supply

Issue: The conservative demand forecasts indicate the City's supply sources may be at capacity in approximately 20 years.

Improvement: Evaluate consumption and supply annually to determine if current demand projections are occurring. Begin studying options for increasing supply no later than the next WSP. Options may include drilling a new well adjacent to Well No. 10 or upgrading the WTP.

COST ESTIMATES

Cost estimates presented are an opinion of probable cost based on the project as described in this WSP and compared to the costs of similar projects where available. The actual costs may vary due to numerous factors such as change of scope, inflation rates, availability of labor and materials, and other market conditions.

Costs are presented in 2018 dollars. The estimates include the estimated cost of construction and indirect costs estimated at 31-percent of the construction cost for water mains and 53-percent for pump stations and reservoirs. The indirect costs include survey, design, construction administration services, permitting, legal, and general administrative services. The construction cost estimates also include a 5- to 20-percent contingency depending on the location, and sales tax of 8.2 percent.

The unit costs for each water main size are based on estimates of all construction related improvements, such as materials and labor for the water main installation, water services, fire hydrants, fittings, valves, connections to the existing system, trench restoration, asphalt surface restoration, and other work for a complete installation. Additional costs were added to some water main improvements to cover anticipated, increased costs related to the project location and degree of difficulty. Total project costs range from $200 per foot of pipe for relatively simple mains, up to $370 per foot for more challenging areas.

All cost estimates shown in the following tables are presented in 2018 dollars and adjusted for an assumed inflation rate of 3-percent per year. Therefore, it is recommended that future costs be adjusted to account for changing construction market conditions at the actual time of project implementation. Future costs can also be adjusted using the Engineering News Record (ENR) Construction Cost Index.

RANKING

The water main improvements were ranked to identify projects with the most deficiencies and greatest benefit.

Table 8.2 lists criteria that were established for ranking the water main improvements. The criteria are based on the underlying deficiencies of the existing water main and the size of the area benefitted by the replacement. The criteria are arranged in three different categories with a weighted factor assigned to each category. The leakage, fire flow, and road or sewer improvement categories were given the most weight. Road or sewer improvement indicates replacement of the water main when a road is rebuilt or resurfaced, or a sewer project is scheduled for the same road, to reduce the cost of surface restoration.

The existing fire flow capability category ranks the water main improvements based on the ability of the existing water mains to provide the target fire flow, as determined from the results of the hydraulic analyses addressed in **Chapter 6**. The history of leakage category ranks the water main improvements based on the frequency of reported leaks or breaks that the City has on record. The benefit area category ranks the water main improvements based on the size of the area that will benefit from the water main replacement.

Table 8.2
Water Main Ranking Criteria

Points	Description
5	Available fire flow less than 50% of goal
3	Available fire flow at 51%-75% of goal
1	Available fire flow at 76%-100% of goal
5	History of leakage
4	Road or sewer improvement
2	Large benefit area
1	Small benefit area

The water main ranking criteria was applied to the elective water main replacement projects, which are grouped under CIP W and numbered 1 through 10. A higher score indicates a project may provide more benefit than lower scored projects, but does not necessarily represent a scheduling priority. The elective water main replacement projects are presented in **Table 8.3** with their ranking, and are also shown in **Figure 8.1**. Other water main projects may be substituted for those listed here if conditions change, such as if funding for road projects becomes available, or a main begins to leak.

Table 8.3
Elective Water Main Replacement Ranking

Existing Main	Along	From	To	Diameter (inch)	Length (feet)	Ranking Score	Construction Cost
6" CI	Chapel St (2019)	PRV station	Pioneer Ave	8	800	12	$183,790
2" Galv, 4" CI	S. Douglas St (2024)	Cottage Ave	Parkhill St	8	1,100	10	$247,189
6" CI, 2" Galv	Pioneer Ave	S. Division St	Evergreen Dr	12	3,700	10	$1,071,163
4" CI	Norman & Douglas St	Vine St	Elberta Ave	8	850	10	$175,177
4" & 6" CI	Elberta and Maple	Woodring St	Alley	8	800	8	$197,772
4" CI	Sullivan St (2022)	Pioneer Ave	Dead end	8	700	7	$141,870
2" Galv	Perry St	Aplets Way	Alley	8	400	6	$146,543
6" CI	River St	Aplets Way	Railroad	12	1,200	5	$346,407
2" Galv	Elberta Ave	Aplets Way	Woodring St	8	550	5	$114,142
6" CI	Blue Star Rd	12" Main	Riverfront Dr	12	1,100	5	$335,569

The pressure zone, pressure reducing station, and facility improvements were prioritized based on existing deficiencies, safety concerns, maintenance requirements, and capacity requirements. The remaining improvements were prioritized based on regulatory requirements and an assessment of the water system needs. The priority order of these improvements is reflected in the schedule of improvements presented in the next section.

SCHEDULE

The results of prioritizing the improvements were used to assist in establishing an implementation schedule that can be used by the City for preparing its 6- to 10-year CIP and yearly water budget. The implementation schedule for the proposed improvements is shown in **Table 8.4**. The City will identify and schedule replacement of elective water mains during the annual budget process. This provides the City with the flexibility to coordinate this work with road improvement projects or other projects within the same area. For many projects, the costs are allocated for design in the year prior to construction.

One very important item listed, but not fully integrated into in this CIP, is the replacement of the Sherman Reservoir roof, which suffered significant damage in early 2019. Because this event occurred after this WSP was mostly complete, the budgeting has not been revised. Depending on the cost of the project, it should be expected that other projects will be deferred accordingly.

Table 8.4
Capital Improvement Program

									Inflation Multiplier	100%	103%	106%	109%	113%	116%	119%	123%	127%	130%	127%
No.		**Description**			**Size**	**Length**	**Design (1)**	**Construction**	**Total Cost**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**no date**
Watermain Projects																				
W#		Elective Watermain Replacement Projects								$ 222,500	$ 20,500	$ 161,200	$ 26,900	$ 250,200	$ 338,900	$ 252,800	$ 252,700	$ 489,900	$ 159,500	$ 2,056,500
	No.	**Along**	**From**	**To**																
	1	Chapel St	PRV station	Pioneer Ave	8 in	800 ft	$ 25,800	$ 196,700	$ 222,500	$ 222,500										
	2	Sullivan St	Pioneer Ave	Dead end	8 in	700 ft	$ 19,900	$ 151,900	$ 171,800		$ 20,500	$ 161,200								
	3	Norman & Douglas St	Vine St	Elberta Ave	8 in	850 ft	$ 24,600	$ 187,500	$ 212,100				$ 26,900	$ 211,100						
	4	S. Douglas St	Cottage Ave	Parkhill St	8 in	1,100 ft	$ 34,700	$ 264,500	$ 299,200					$ 39,100	$ 306,700					
	5	Elberta and Maple	Woodring St	Alley	8 in	800 ft	$ 27,700	$ 211,700	$ 239,400						$ 32,200	$ 252,800				
	6	Perry St	Aplets Way	Alley	8 in	400 ft	$ 20,600	$ 156,900	$ 177,500								$ 193,000			
	7	River St	Aplets Way	Railroad	12 in	1,200 ft	$ 48,500	$ 370,700	$ 419,200								$ 59,700	$ 469,600		
	8	Elberta Ave	Aplets Way	Woodring St	8 in	550 ft	$ 16,000	$ 122,200	$ 138,200									$ 20,300	$ 159,500	
	9	Blue Star Rd	12" Main	Riverfront Dr	12 in	1,100 ft	$ 47,000	$ 359,100	$ 406,100											$ 514,500
	10	Pioneer Ave	S. Division St	Evergreen Dr	12 in	3,700 ft	$ 150,000	$ 1,146,200	$ 1,296,200											$ 1,642,000
Supply Projects																				
S1		Backup Generator (Assumes City Funded)			150 kW		$ 24,600	$ 187,600	$ 212,200		$ 218,600									
S2		Sherman Booster Pump No. 1 Replacement (650 gpm)			60 hp		$ 10,400	$ 78,800	$ 89,200					$ 100,400						
Treatment Projects																				
T1		Treatment and Water Quality Remote Monitoring					$ 10,000	$ 90,000	$ 100,000	$ 10,000	$ 90,000									
T2		Water Treatment Plant Settling Pond							TBD											
T3		Water Treatment Plant - Other							TBD											
Storage Projects																				
R1		Sherman Reservoir Roof Replacement							$ 1,000,000	$ 1,000,000										
R2		Sherman Reservoir Fill Valve					$ 1,700	$ 12,600	$ 14,300	$ 14,300										
R3		Reservoir Interior Inspection						$ 5,000	$ 5,000		$ 5,200					$ 6,000				
R4		Kennedy Reservoir Repainting					$ 50,600	$ 386,400	$ 437,000											$ 553,600
Pressure Zone Projects																				
P1		1050 Zone (PRV & S. Division St Connection)			8 in	150 ft	$ 12,000	$ 91,100	$ 103,100	$ 12,000	$ 93,900									
P2A		1000 Zone Phase 1 (PRV & Division St Connection)			8 in	100 ft	$ 12,800	$ 97,200	$ 110,000		$ 13,200	$ 103,200								
P2B		1000 Zone Phase 2 (Tigner Road Watermain)			8 in	800 ft	$ 20,900	$ 159,700	$ 180,600							$ 25,000	$ 196,500			
P4		1000 and 1050 Zone Pressure Relief Modifications					$ 1,200	$ 8,500	$ 9,700			$ 10,300								
P5		PRV Station Flooding Improvements			4 Ea		$ 7,600	$ 58,000	$ 262,400			$ 32,400	$ 253,600							
Operations and Planning Projects								**Estimate**	**Total**											
M1		System Mapping						$ 27,000	$ 27,000		$ 27,900									
M2		Hydraulic Model Calibration						$ 27,000	$ 27,000				$ 29,600							
M3		Water System Plan						$ 75,000	$ 75,000	$ 25,000						$ 89,600				
M4		Water Rights Planning						$ 11,000	$ 11,000	$ 11,000										
M5		Customer Meter Replacement						$ 35,000	$ 35,000	$ 35,000	$ 36,100	$ 37,200	$ 38,300	$ 39,400	$ 40,600	$ 41,800	$ 43,100	$ 44,400	$ 45,700	
M6		Wellhead Protection Area Reevaluation						$ 27,000	$ 27,000											$ 27,000
M7		Pump Condition Evaluation						$ 8,000	$ 8,000				$ 8,800							
M8		Pump Station Flow and Pressure Monitoring						$ 29,000	$ 29,000				$ 31,700							
Future or Developer Funded Projects																				
F1		West Cashmere Transmission			12 in	2,700 ft	$ 80,600	$ 616,000	$ 696,600											$ 882,500
F2		Third River Crossing			12 in	1,000 ft	$ 65,500	$ 500,600	$ 566,100											$ 717,200
F3		895 Zone 1 MG Reservoir and Water Main			12 in	5,000 ft	$ 709,400	$ 3,783,400	$ 4,492,800											$ 5,691,400
F4		New 1114 Zone Booster Station and Water Main			12 in	3,500 ft	$ 434,400	$ 2,316,700	$ 2,751,100											$ 3,485,100
F5		1114 Zone Reliability			12 in	5,000 ft	$ 150,000	$ 1,145,900	$ 1,295,900											$ 1,641,700
F6		1114 Zone Reservoir and Water Main					TBD		TBD											TBD
F7		New School Field Main			12 in	2,000 ft	$ 64,900	$ 495,900	$ 560,800											$ 710,500
F8		Vista Heights 0.25 MG Reservoir and Water Main			12 in	1,000 ft	$ 245,200	$ 1,307,300	$ 1,552,500											$ 1,966,700
F9		Source Capacity Improvements Exploration					TBD		TBD											TBD
Total Estimated Costs per Year										**$ 1,329,800**	**$ 505,400**	**$ 344,300**	**$ 388,900**	**$ 390,000**	**$ 379,500**	**$ 415,200**	**$ 492,300**	**$ 534,300**	**$ 205,200**	**$ 17,832,200**

(1) "Design" includes efforts prior to construction such as planning, survey, design, and permitting.

9 FINANCIAL ANALYSIS

INTRODUCTION

The financial analysis assesses the ability of the City's water utility to remain financially viable during the planning period, considering its recent historical performance as well as anticipated future needs. It also evaluates the affordability of the City's water rates, both at existing levels and with any rate increases needed to support its operations and planned capital program.

FINANCIAL HISTORY

Table 9.1 summarizes the financial performance of the City's water utility from 2010 – 2018.

Table 9.1
Historical Financial Performance ($000s)

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Water Sales	$ 601	$ 621	$ 698	$ 716	$ 768	$ 818	$ 867	$ 877	$ 907
Other Operating Revenue	30	19	11	18	31	23	25	37	32
Total Operating Revenue	$ 631	$ 640	$ 709	$ 734	$ 800	$ 841	$ 892	$ 914	$ 939
Operating Expenses	$ 411	$ 430	$ 455	$ 526	$ 540	$ 504	$ 523	$ 553	$ 616
Net Operating Income	**$ 220**	**$ 210**	**$ 254**	**$ 208**	**$ 259**	**$ 337**	**$ 370**	**$ 361**	**$ 323**
O&M Coverage Ratio	**153%**	**149%**	**156%**	**139%**	**148%**	**167%**	**171%**	**165%**	**152%**
Unrestricted Ending Balance	**$ 666**	**$ 512**	**$ 884**	**$ 973**	**$1,029**	**$ 764**	**$1,042**	**$1,380**	**$1,693**
Days of Cash on Hand	**591**	**434**	**709**	**675**	**695**	**554**	**728**	**911**	**1,003**

Important take-aways from this analysis include:

- Annual water sales revenue increased by 51.1% over the 2010 – 2018 period. The number of water service connections served by the City increased by an estimated 16.3% during this period; the remainder of the observed revenue growth is attributable to water rate increases implemented by the City.
- Total annual operating expenses increased by approximately 49.8%. Labor costs (salaries and benefits) increasing by 131.4% during this period, likely due to the addition of staff over time as well as rising benefits costs.
- The operating ratio provides a means of evaluating the utility's self-sufficiency as an enterprise, measuring the ability of annual operating revenues to cover annual operating costs. The water utility maintained an operating ratio of 139 – 171% during the 2010 – 2018 period, suggesting that operating revenues have been adequate to cover operating expenses.
- Net operating income remained positive over the period, providing some capacity to fund capital investment needs.
- Days of cash on hand is a measure of financial security, quantifying how long the City's water utility would be able to fund daily operating and maintenance costs if it received no additional revenue. It is calculated by dividing unrestricted cash by the average daily cost of operations. While there is no firm minimum standard for this metric, bond rating agencies have recently expressed a preference for a minimum of 180 days of cash on hand for utilities

seeking the highest bond ratings. The water utility has maintained an unrestricted cash balance between 434 and 1,003 days of operating expenses since 2010.

- The water utility has not had any debt outstanding since 2010.

CAPITAL FUNDING RESOURCES

In addition to cash financing, the City may use multiple sources to fund the water capital improvement program described in detail below:

GOVERNMENT PROGRAMS

Federal and state grant programs were historically available to local utilities for capital funding assistance. However, these assistance programs have been mostly eliminated, significantly reduced in scope and amount, or replaced by low-interest loan programs. Remaining grant programs are usually lightly funded and heavily subscribed. Nonetheless, even the benefit of low-interest loans makes the effort of applying worthwhile. Funding programs for which the City might be eligible include:

Public Works Trust Fund (PWTF) Loan Program

Cities, counties, special purpose districts, public utility districts, and quasi-municipal governments are eligible to receive loans from the PWTF. Eligible projects include repair, replacement, and construction of infrastructure for domestic water, sanitary wastewater, stormwater, solid waste, road, and bridge projects that improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance. Information regarding the application process, status of the funding process, as well as rates and terms are posted on the PWTF website. Further detail is available at http://www.commerce.wa.gov/building-infrastructure/pwb-home-page.

Drinking Water State Revolving Fund (DWSRF) Loan Program

DWSRF funding has historically targeted protection of public health and compliance with drinking water regulations. Loan repayments can range from 20 to 30 years and in some cases, provide partial loan forgiveness. Applicants need an approved water system plan (or plan amendment) containing the DWSRF project prior to submitting an application. All public water systems that receive a DWSRF loan must undergo an environmental review, a cultural review, and an Investment-Grade Efficiency Audit (IGEA). The IGEA is an effort to apply energy efficiency to water systems and may be financed as part of the DWSRF loan. The DWSRF loan program is typically appropriated \$20 million per year, with annual application cycles beginning on October 1st and running through November 30th. More information regarding the DWSRF Loan Program can be found at https://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/WaterSystemAssistance/DrinkingWaterStateRevolvingFundDWSRF.

Community Economic Revitalization Board (CERB) Grant and Loan Program

A division of the Washington State Department of Commerce, CERB was formed in 1982 to respond to local economic development issues in Washington communities. It provides funding to local governments and federally recognized tribes for public infrastructure (including water, stormwater, wastewater, public buildings, telecommunications, and port facilities) that supports private business growth. It prioritizes projects that create or retain jobs for low and moderate-income residents. CERB generally provides funding through three programs:

- Committed Private Partner Program: This program provides loans and grants to public agencies that have a commitment from the private sector to help fund the construction of infrastructure necessary for private business expansion. Applicants must submit evidence that private development is contingent on CERB funding and demonstrate that no other timely source of funding is available at terms comparable to what CERB offers.
- Planning Grant Program: This program provides limited funding for studies to evaluate high-priority economic development projects that target job growth and long-term economic prosperity.
- Prospective Development Program: This program offers rural communities loans and grants for public infrastructure that facilitates future business development. It requires an economic feasibility study demonstrating that the project will lead to a significant level of job creation and private capital investment. Applicants must also show a need for CERB assistance and evidence that no other timely source of funding is available at terms comparable to what CERB offers.

CERB offers a maximum of $2 million per project, per policy with interest rates ranging from 1% to 3%. The Board meets every two months to consider projects and make funding decisions. Even if funding were available, CERB is intended to be a "last-resort" measure relative to other funding sources, and therefore the City might not qualify for assistance under this program.

More information can be found at http://www.commerce.wa.gov/building-infrastructure/community-economic-revitalization-board.

Infrastructure Assistance Coordination Council

The Infrastructure Assistance Coordinating Council is comprised of state and local agencies whose function is to provide funding for infrastructure repair and development. Its purpose is not to directly provide funding, but to assist local governments in coordinating funding efforts for infrastructure improvements. As a result, they are a valuable resource to provide awareness of any new funding opportunities. An example of this is their annual conference where they offer sessions dedicated to teaching attendees about available resources.

More information can be found at http://www.infrafunding.wa.gov/.

BOND FINANCING

Revenue Bonds

Commonly used to fund capital improvements that exceed a utility's financial resources, revenue bonds are secured by revenues of the issuing utility. With this limited commitment, revenue bonds typically bear higher interest rates than other types of debt and often require additional security measures to protect bondholders from default risk. Such measures may include the maintenance of dedicated reserves and minimum financial performance standards (e.g. bond debt service coverage).

Washington State law does not require a public vote for issuing revenue bonds. While there is no explicit statutory bonding limit, the conditions that come with revenue bonds often impose practical limits on a utility's level of indebtedness. Excessive levels of debt may reduce flexibility to phase in rate increases as well as increase the overall cost of capital investment given the related interest payments. It is important to note that bond rating agencies also consider debt service coverage when assigning a debt rating – higher levels of indebtedness make it more difficult for a utility to meet the coverage ratios that the rating agencies require for the highest rating. In recent years, the coverage ratios required for higher ratings have often exceeded the minimum legal standards outlined in the applicable bond covenants. Ratings are financially important because higher ratings generally provide access to lower interest rates.

OTHER FUNDING SOURCES

System Development Charges (SDCs)

Under the authority of RCW 35.92.025, the City imposes an SDC on development as a condition of connecting to its utility systems. This charge recovers an equitable share of the cost of utility infrastructure from growth, promoting equity between new and existing customers. SDC revenues provide a source of cash funding for utility capital needs and related debt service payments.

FINANCIAL PLAN

The main goal of the financial plan is to develop a multi-year rate strategy that generates enough revenue to cover the utility's operating and capital costs. This study focuses on defining the amount of revenues needed to meet the system's financial obligations including:

- Operation and maintenance costs
- Administrative and overhead costs
- Policy-based needs (e.g. reserve funding)
- Capital costs
- Existing and new debt service obligations

The City's water utility operates as an enterprise, relying on revenue from user rates rather than taxes or other external resources to cover the costs it incurs to provide service. The financial plan examines the utility's ability to fund these expenses while maintaining affordable water rates. It is a comprehensive analysis that includes both operating and capital elements:

- The capital funding plan develops a funding strategy for the capital improvement program (CIP) that considers rate revenues, existing reserves, SDCs, debt financing, and other anticipated resources (e.g. grants, developer contributions). It can impact the overall financial plan through the use of debt financing (resulting in annual debt service) and capital funding embedded in rates.
- The revenue requirement analysis determines the amount of revenue necessary to fund the ongoing operation, maintenance, and administration of the utility on an annual basis. This analysis focuses specifically on the needs funded from operating revenues. It includes a framework of fiscal policies intended to promote long-term financial stability and viability.

FINANCIAL POLICIES

The ensuing discussion summarizes the key financial policies used in this analysis.

Utility Reserves

Reserves are a key component of any utility financial strategy, as they provide the ability to manage variations in costs and revenues that could otherwise have an adverse impact on ratepayers. For the purpose of this analysis, resources are separated into the following funds:

- Operating Fund: This fund provides an unrestricted fund balance to accommodate short-term cycles of cash flow, intending to address variations in revenues and expenses whether anticipated (e.g. billing/receipt cycles, payroll cycles) or unanticipated (e.g. weather, economic conditions). This analysis assumes the City maintains a minimum balance equal to 60 days of operating expenses in this fund. Based on the water utility's 2019 Budget, this target is about $107,000.
- Capital Fund: This fund provides a source of cash for unanticipated capital expenditures such as an emergency asset replacement or capital project overruns. In the context of the financial analysis, it also enforces an appropriate segregation of resources restricted (or otherwise designated) for capital purposes. This analysis assumes a minimum balance equal to 1% of the cost of system assets, which based on the estimated cost of system assets as of the end of 2018 is approximately $60,000.
- Bond Reserve: Bond covenants often establish reserve requirements as a means of protecting bondholders against the risk of nonpayment. The City's water utility does not currently have any outstanding debt requiring such a reserve. For any projected debt issuance, this analysis assumes a reserve requirement equal to one year's debt service payment.

The financial forecast presented in **Table 9.4** reflects rate increases that were set to maintain these minimum balances while meeting the water utility's operating and capital needs.

System Reinvestment

System reinvestment funding promotes system integrity by ensuring adequate capital to fund the replacement of aging system facilities. Related funding policies intend to generate a reasonable level of cash funding for capital investment, rather than guarantee full cash funding at any particular point in time. When choosing a benchmark or a target amount for system reinvestment funding, it is worth noting that a higher target will have a greater upfront impact on existing ratepayers but will reduce future debt issuance and result in lower costs in the long-term. City policy establishes a target of $400,000 per year for annual capital funding through water rates.

Financial Performance Standards

The revenue requirement analysis uses a pair of sufficiency tests to establish the amount of revenue in any given year to meet the utility's financial obligations on an annual basis.

- Cash Flow Test: This test defines "sufficient revenue" as the amount needed to fund all known cash requirements including O&M expenses, debt service payments, system reinvestment funding (and other rate-funded capital outlays), and reserve funding.
- Coverage Test: Intended to ensure compliance with the City's bond covenants, satisfying this test requires that "net revenue" (generally defined as system revenue net of operating expenses) is greater than or equal to a specified multiple of annual parity debt service.

The annual revenue requirement can be defined as the amount needed to satisfy both of these tests. Cash flow deficits may occur as part of a strategy to phase in rate increases, but the utility must always meet any applicable coverage standards. Because the City's water utility does not have any outstanding debt, cash-flow needs define its annual revenue requirement.

Capital Funding Plan

The 2019 – 2028 CIP identifies $4.5 million in project costs (in 2018 dollars); adjusting for inflation at an assumed rate of 3.0% per year, the total projected ten-year CIP is $5.1 million. **Table 9.2** summarizes the capital cost forecast. **Table 9.3** summarizes the projected capital funding strategy.

Table 9.2
2019 – 2028 Capital Improvement Program ($000s)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Watermain Projects										
Chapel Street	$ 223	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sullivan Street	-	20	152	-	-	-	-	-	-	-
Norman & Douglas Street	-	-	-	25	188	-	-	-	-	-
South Douglas Street	-	-	-	-	35	265	-	-	-	-
Elberta and Maple	-	-	-	-	-	28	212	-	-	-
Perry Street	-	-	-	-	-	-	21	157	-	-
River Street	-	-	-	-	-	-	-	49	371	-
Elberta Avenue	-	-	-	-	-	-	-	-	16	122
Supply Projects										
Backup Generator	-	212	-	-	-	-	-	-	-	-
Sherman Booster Pump No. 1 Replacement	-	-	-	-	89	-	-	-	-	-
Treatment Projects										
Treatment and Water Quality Remote Monitoring	10	90	-	-	-	-	-	-	-	-
Storage Proiects										
Sherman Reservoir Roof Replacement	1,000	-	-	-	-	-	-	-	-	-
Sherman Reservoir Fill Valve	14	-	-	-	-	-	-	-	-	-
Pressure Zone Projects										
1050 Zone (PRV & S. Division Street Connection)	12	91	-	-	-	-	-	-	-	-
1000 Zone Phase 1 (PRV & Division St. Connection)	-	13	97	-	-	-	-	-	-	-
1000 Zone Phase 2 (Tigner Road Watermain)	-	-	-	-	-	-	21	160	-	-
1000 and 1050 Zone Pressure Relief Modifications	-	-	10	-	-	-	-	-	-	-
PRV Station Flooding Improvements	-	-	30	232	-	-	-	-	-	-
Operations and Planning Projects										
System Mapping	-	27	-	-	-	-	-	-	-	-
Hydraulic Model Calibration	-	-	-	27	-	-	-	-	-	-
Water System Plan	25	-	-	-	-	-	75	-	-	-
Water Rights Planning	11	-	-	-	-	-	-	-	-	-
Pump Condition Evaluation	-	-	-	8	-	-	-	-	-	-
Total Cost (2018 Dollars)	**$1,330**	**$ 493**	**$ 324**	**$ 356**	**$ 346**	**$ 327**	**$ 368**	**$ 400**	**$ 422**	**$ 157**
Plus: Adjustment for Inflation @ 3% per Year	**10**	**30**	**30**	**45**	**55**	**63**	**85**	**107**	**129**	**54**
Total Projected Expenditures	**$1,340**	**$ 523**	**$ 354**	**$ 400**	**$ 402**	**$ 391**	**$ 453**	**$ 507**	**$ 550**	**$ 211**

Table 9.3
Summary of Projected Capital Funding Strategy ($000s)

Capital Fund Forecast	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Beginning Balance	$1,349	$ 421	$ 210	$ 193	$ 154	$ 165	$ 186	$ 160	$ 124	$ 98
Plus: Rate-Funded System Reinvestment	400	300	325	350	400	400	400	400	400	400
Plus: Transfer from Operating Fund	-	-	-	-	-	-	15	59	112	93
Plus: System Development Charges	12	12	12	12	12	12	12	12	12	12
Less: Capital Expenditures	(1,340)	(523)	(354)	(400)	(402)	(391)	(453)	(507)	(550)	(211)
Ending Balance	$ 421	$ 210	$ 193	$ 154	$ 165	$ 186	$ 160	$ 124	$ 98	$ 391
Minimum Balance (1% of Plant in Service)	*$ 60*	*$ 65*	*$ 69*	*$ 73*	*$ 77*	*$ 81*	*$ 85*	*$ 90*	*$ 96*	*$ 98*

Table 9.3 reflects the City's preference to fund capital needs on a "pay-as-you-go" basis, relying on annual rate-funded transfers to generate the majority (about 74%) of the funding required to complete the planned projects. SDC revenues and additional transfers from the Operating Fund are expected to provide the rest of the funding needed to complete the CIP and maintain a Capital Fund balance at or above the minimum level.

REVENUE REQUIREMENT

The revenue requirement analysis evaluates the water utility's ability to cover its projected costs under its currently adopted water rates. In the event of any projected deficiencies, this analysis will serve as the basis for a strategy of recommended rate adjustments.

Projected Financial Performance

The financial forecast was developed from the City's 2019 Budget, along with various assumptions:

- The rate revenue forecast is initially based on the projection in the 2019 Budget and adjusted for anticipated customer growth. The City's estimate of 8 new equivalent residential units (ERUs) per year corresponds to an annual growth rate of approximately 0.4%.
- Customer-related fees are based on the 2019 Budget values and adjusted for growth at 0.4% per year. Interest earnings are computed based on projected fund balances, assuming an interest rate of 0.7% per year based on a five-year average of earnings in the Washington State Local Government Investment Pool.
- The forecast of operating expenses is based on the 2019 Budget, with future projections reflecting adjustments for inflation.
    - o Most expenses are adjusted for general inflation (based on the Consumer Price Index) at a rate of 2.0% per year.
    - o Taxes are calculated based on the projected revenues and prevailing rates.
- As shown in **Table 9.3**, system reinvestment is generally held at the City's targeted level of $400,000 per year. To mitigate near-term rate impacts, this analysis assumes a temporary relaxing of this policy and funds $300,000 – $350,000 per year from 2020 – 2022.

Table 9.4 summarizes the City's projected financial performance and rate revenue requirements based on the above assumptions.

Table 9.4
Summary of Revenue Requirement Forecast ($000s)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Revenue										
Rate Revenue at Adopted Rates	$ 903	$ 907	$ 911	$ 915	$ 918	$ 922	$ 926	$ 929	$ 933	$ 936
Other Operating Revenue	21	13	11	11	11	11	11	11	11	11
Total Operating Revenue	$ 924	$ 920	$ 922	$ 926	$ 929	$ 933	$ 937	$ 940	$ 944	$ 947
Expenses										
Operating Expenses	$ 648	$ 659	$ 670	$ 681	$ 692	$ 704	$ 716	$ 728	$ 740	$ 753
Rate-Funded System Reinvestment	400	300	325	350	400	400	400	400	400	400
Total Expenses	$1,048	$ 959	$ 995	$1,031	$1,092	$1,104	$1,116	$1,128	$1,140	$1,153
Net Cash Flow	$ (124)	$ (39)	$ (73)	$ (105)	$ (163)	$ (171)	$ (179)	$ (188)	$ (196)	$ (205)
Annual Rate Increases		**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**4.0%**	**2.5%**
Summary After Rate Increases										
Rate Revenue	$ 903	$ 939	$ 977	$1,016	$1,057	$1,099	$1,143	$1,189	$1,236	$1,267
Net Cash Flow	$ (124)	$ (8)	$ (9)	$ (8)	$ (31)	$ (2)	$ 29	$ 62	$ 96	$ 115
Ending Operating Fund Balance	$ 220	$ 212	$ 202	$ 194	$ 163	$ 162	$ 177	$ 179	$ 163	$ 186
Equivalent Days of O&M	*124*	*118*	*110*	*104*	*86*	*84*	*90*	*90*	*81*	*90*
Minimum Balance (60 Days of O&M)	*$ 107*	*$ 108*	*$ 110*	*$ 112*	*$ 114*	*$ 116*	*$ 118*	*$ 120*	*$ 122*	*$ 124*

Table 9.4 shows that consistent with the water utility's recent historical financial performance documented in **Table 9.1**, revenues at existing rates are adequate to cover projected operating expenditures but fall short of generating an additional $400,000 per year for system reinvestment. The water utility's projected 2019 performance suggests that the City would need to increase annual sales revenue by approximately $124,000 (14%) to reach the desired level of capital funding. The recommended rate strategy of 4.0% annual increases reflects a policy decision to phase this increase in, temporarily reducing system reinvestment to $300,000 – $350,000 per year from 2020 – 2022.

Funding system reinvestment is an important part of the capital funding strategy, representing approximately 74% of the funding needed during the 2019 – 2028 period (as shown in **Table 9.3**). The City could opt to fund system reinvestment at a lower level in the near-term to reduce the projected rate increases, but it would have to issue debt or defer capital projects to make up the difference.

It is important to note that these financial projections are based upon current assumptions and the current capital program. Circumstances might change over time, causing actual rate adjustments to be higher or lower once actual costs are known. It would be prudent for the City to monitor the financial status of its water utility regularly, revisiting the analysis periodically or in the event of significant changes to the assumptions outlined above.

RATE AFFORDABILITY

The Washington State Department of Health and the Public Works Board use an affordability index to prioritize low-cost loan awards. They typically look how a system's rates compare to the median household income (MHI) for the demographic area – a community's rates are considered to be "affordable" if they result in bills that are below 2% of the MHI.

U.S. Census Bureau data indicates that the 2013 – 2017 average MHI for residents of the City of Cashmere was $47,917. **Table 9.5** summarizes the affordability evaluation of the City's water rates assuming that the rate increases shown in **Table 9.4** are applied uniformly to the City's existing water rate structure.

Table 9.5
Affordability Evaluation

Single-Family Bill Forecast	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Monthly Bill @ 5,000 Gallons	$36.02	$37.46	$38.94	$40.50	$42.10	$43.79	$45.52	$47.34	$49.25	$50.47
Bill as % of Monthly MHI	0.90%	0.94%	0.98%	1.01%	1.05%	1.10%	1.14%	1.19%	1.23%	1.26%

Table 9.5 suggests that the City's water rates are, and will remain, within the affordability threshold of 2% of MHI during the 2019 – 2028 time period.

SDC UPDATE

SDCs are a form of connection charge authorized by RCW 35.92.025, promoting equity between existing customers and future customers by recovering an equitable share of the cost of utility infrastructure from growth. While the RCW does not explicitly define a methodology for calculating SDCs, the most common approaches involve dividing an allocable "cost of the system" by an applicable number of "capacity units" to arrive at a cost per unit of capacity.

EXISTING COST BASIS

The SDC cost basis includes costs associated with existing assets to recognize that those assets were oversized to accommodate growth and will benefit future customers. In addition, RCW 35.92.025 allows the City to recover up to ten years of interest accrued on assets. Conceptually, this interest provision attempts to account for opportunity costs that the City's customers incurred by supporting investments in infrastructure rather than having the money available for investment or other uses. In addition, the cost basis is adjusted to exclude costs associated with meters and service lines, as these facilities are of localized rather than general system benefit. This adjustment also recognizes that developers will generally have to purchase their own meters and service lines.

FUTURE COST BASIS

The SDC can also include costs associated with future capital projects. Though not explicitly required for cities, the conservative practice is to include only costs associated with projects that are part of an adopted comprehensive plan. The capital costs included in the future cost basis are generally based on the (uninflated) cost of projects shown in **Table 9.2**, with a couple of adjustments:

- Grants/Developer Contributions: Future water capital projects that the City intends to fund with grants or developer contributions (and would not otherwise complete without that funding) are excluded from the cost basis on the premise that the SDC should only recover costs actually incurred by the City's water utility.
- Renewal and Replacement Projects: Given that some of the projects in the CIP involve replacing existing assets, including both the full CIP and the complete inventory of existing assets in the SDC would charge customers for an asset and its replacement concurrently. To avoid this, the calculation methodology can either exclude costs associated with renewal and replacement projects from the cost basis or include them and adjust the existing cost basis to remove the cost of the assets being replaced. For consistency with the methodology underlying the City's wastewater SDCs, this analysis excludes renewal and replacement projects from the future cost basis.

CUSTOMER BASE

Since the City's water customers can impose different demands on the water system, the calculation converts each account into meter equivalents (MEs) and equivalent residential units (ERUs). The ERU represents the water demand of a typical single-family home, while the ME represents the demand of a standard service connection (generally a 1inch meter per City policy). The ME and ERU are roughly equivalent for a single-family connection, but that relationship does not necessarily hold true for larger meter sizes and other types of users. While system capacity is typically expressed in terms of ERUs, it is important to define a relationship between ERUs and MEs in recognition of how the City actually imposes SDCs on customers. The customer base is separable into two parts:

- Existing Customers: Based on the City's maximum-day demand and the estimated maximum-day demand per ERU (806 gpd per **Table 3.8**), the City currently serves 1,638 ERUs. Single-family accounts are assigned 1 ERU and 1 ME per account, regardless of meter size. Other customers are assigned MEs based on an inventory of meters by meter size, with larger meters being converted to MEs based on industry-standard meter capacity ratios. With these assumptions, the existing customer base consists of 1,638 ERUs and 1,254 MEs.
- Growth/Future Customers: The estimate of incremental capacity remaining to serve growth is based on the difference between total capacity and the capacity currently being utilized by existing customers. The City's engineer provided ERU capacity estimates for different system components including source (2,863 ERUs), storage (4,970 ERUs), and transmission (5,446 ERUs). For other asset types, the ERU capacity (4,768 ERUs) is estimated by converting the projected maximum-day demand at buildout (3.84 MGD **Table 3.16**) to ERUs using the planning assumption of 806 gpd per ERU. The future count of MEs that the system will serve is based on the existing ME count stated above (1,254 MEs), scaled up proportionately to reflect the potential growth in ERUs based on the ERU capacity by system component. The estimates of total ME capacity based on this methodology are 2,193 MEs for the source component, 3,616 MEs for the storage component, 4,171 MEs for the transmission component, and 3,652 MEs for the rest of the system.

CALCULATION OF THE SDC

Table 9.6 shows the updated water SDC calculation:

Table 9.6
Water System Development Charge Calculation

	Source	Storage	Transmission	Other	Total
Existing Cost Basis ($000s)					
Plant in Service as of 12/31/18	$1,511	$ 611	$2,110	$46	$4,649
Plus: Interest on Utility-Funded Assets	1,055	464	860	20	2,399
Net Existing Cost Basis	$2,566	$1,075	$2,970	$66	$,6677
Future Cost Basis ($000s)					
20-Year CIP (Uninflated)	$439	$3,014	$14,648	$154	$18,606
Less: Renewal & Replacement Projects	(89)	(14)	(2,325)	-	(2,779)
Less: Developer-Funded Projects	-	(1,553)	(9,797)	-	(11,350)
Less: Non-Capitalizable Projects	-	-	-	(100)	(100)
Net Future Cost Basis	$350	$1,447	$2,526	$ 54	$ 4,377
Total Cost Basis ($000s)	$2,916	$2,522	$5,496	$120	$11,054
System Capacity in Meter Equivalents (MEs)	2,193	3,616	4,171	3,652	
Total SDC per ME	**$1,330**	**$697**	**$1,318**	**$33**	**$3,378**
Existing SDC per ME					***$1,530***

Table 9.6 shows a substantial increase in the SDC per ME, primarily due to the CIP and the addition of assets and accrual of related interest since the SDC was last calculated. This represents the maximum justifiable charge based on the established methodology. The City has the flexibility to phase the increase in over time, or adopt a lower charge – to be conservative, the financial plan does not assume the implementation of the updated SDC.

CONCLUSION

Table 9.3 indicates that the City will be able to cash-fund the $5.1 million in water capital projects planned to occur within the next ten years with funding from water rates. As shown in **Table 9.4**, the City will need to increase its water rates to generate the necessary funds for system reinvestment. The recommended rate strategy calls for annual rate increases of 4.0% – even with these rate increases, the median residential bill is expected to remain below the affordability threshold of 2% of median household income for the ten-year planning period.

Based on the water utility's current asset inventory and planned projects, the City can justify increasing its water SDC from $1,530 to $3,378 per ME. As this represents the maximum allowable charge allowed by RCW 35.92.025, the City may choose to implement a lower charge – however, doing so would reduce the amount of cash available from these fees for capital improvements.

It would be prudent for the City to regularly review the financial position of its water utility, revisiting the key underlying assumptions that make up this analysis and verifying that revenues remain adequate to meet the utility's financial obligations.