City of Yakima
2017 Water System Plan
System Number 991509

Yakima County, Washington

July 2017

Prepared by: HDR, Inc.

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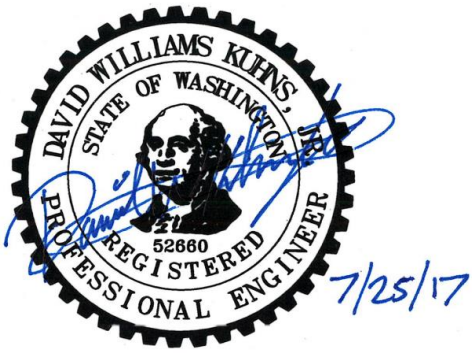
CERTIFICATION

This 2017 Water System Plan for the City of Yakima was prepared by HDR Engineering, Inc., and City of Yakima staff, under the direction of the following Registered Professional Engineers:



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David Kuhns, PE

HDR Engineering, Inc.

APPROVAL

Approved by the City of Yakima by Resolution No. R-2017-081 dated July 11, 2017.

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Contents

List of Tables

List of Figures

Appendices

1 Description of Water System

1.1 Ownership and Management

The name of this water system, as officially listed in the Washington State Department of Health (DOH) records, is the City of Yakima Water Division. The DOH System Identification number is 991509. The City of Yakima (City), which owns the system, is a municipal corporation. Yakima is a first class city as defined in Chapter 35.01.010 RCW.

The City has a Council-Manager type of municipal government as defined under Chapter 35.18 RCW. An organizational chart of the Water Division is shown in Figure 1-1. The Water/Irrigation Division Manager is directly responsible to the Public Works Director.

A copy of the current Water Facilities Inventory (WFI) form is included in Appendix D of this water system plan.

1.2 System History

The original City of Yakima water system was developed by the Pacific Power and Light Company (PP&L) in the early 1900s. The City purchased the system on July 1, 1926. At that time, the supply consisted of a diversion from the PP&L power canal.

In an effort to expand the water supply, the City purchased 343 acres of land at Oak Flats to develop a source on the Naches River. A 14-mile, 24-inch wood stave transmission main was constructed to transport the supply to twin concrete reservoirs with a combined 24-million gallon (MG) capacity.

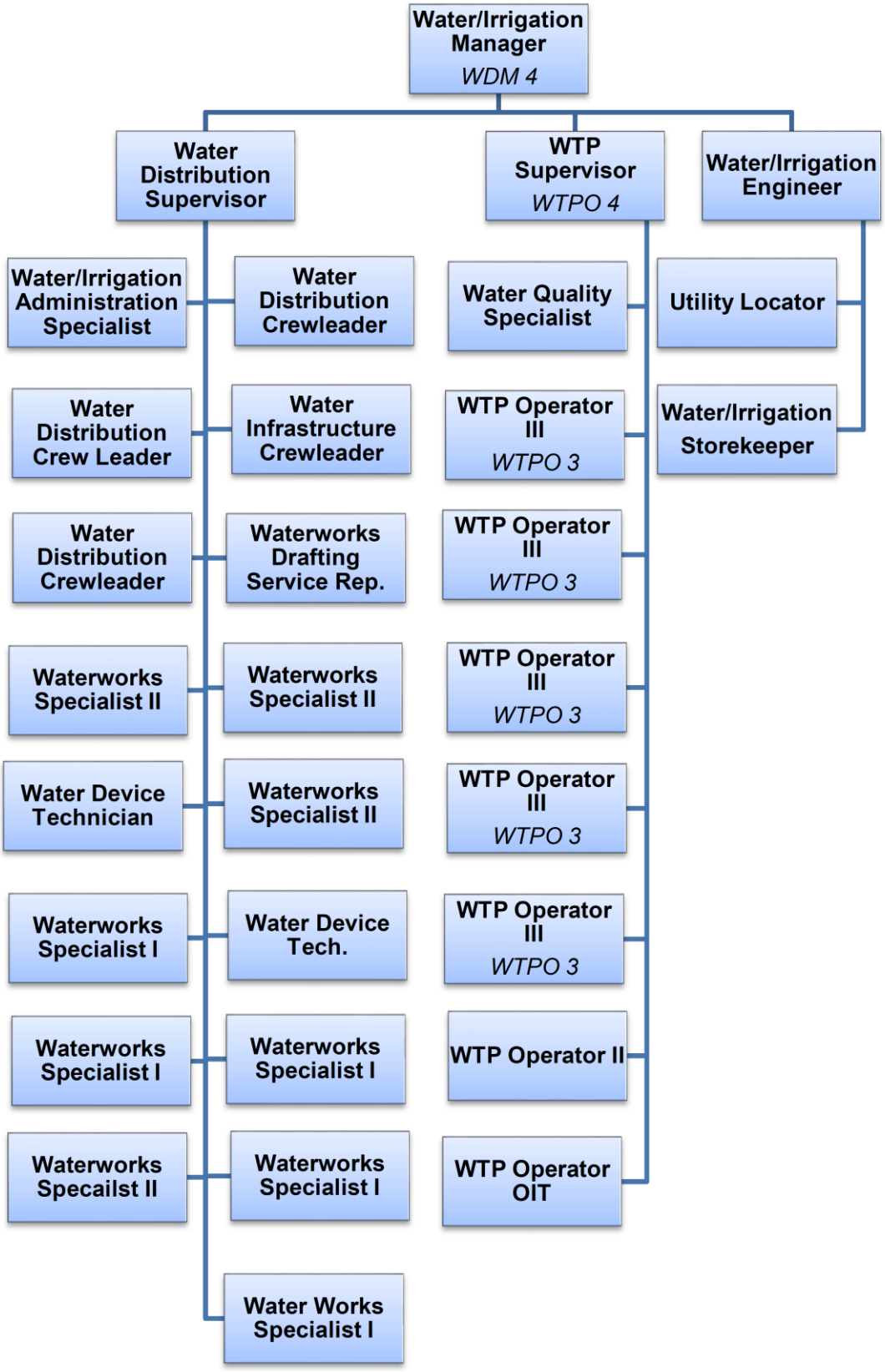
Three shallow wells, including a Ranney collector were later developed in 1948 and 1950 to supplement the Oak Flats supply. The first well developed was the Wright Avenue Well. (The water right for the Wright Avenue Well was later transferred to the Kissel Park Well.) The second well developed was located near 16th Avenue and what is now Highway 12. This well and the water right was abandoned in 1969 when this section of Highway 12 was expanded to four lanes. It was not being used at the time it was abandoned because of high coliform levels.

Two deep wells were developed in 1962 and 1965 to further supplement the Oak Flats supply. The first of these was the Kiwanis Park Well (1962) and the second was the Airport Well (1965). Both of these wells are in service today as seasonal/emergency sources of supply.

A water treatment plant (WTP) near Rowe Hill on the Naches River and a 48-inch transmission pipeline to the City were constructed during the period from 1969 to 1971 to replace the Oak Flats supply. The WTP is discussed in detail in Chapter 3 of this plan.

In 1993, the Kissel Park Well was added to the City's system with a new water right. Since then, the city has relinquished the Kissel Park Well water right. The City has transferred 900 gallons per minute (gpm) from the Wight Ave Well (discontinued) and 2,000 gpm of the 5,000 gpm Ranney collector well water right to the Kissel Park Well. In 2015, the City replaced the Kissel Park Well pump and motor after the equipment had been damaged in a lightning storm. This well is also used for seasonal/ emergency purposes and to help meet peak demands.

Figure 1-1. City of Yakima Water/Irrigation Division - Water Organizational Structure



In January 2012, the City completed constructed the Gardner Park Well. The remaining portion of the Ranney collector well water right (3,000 gpm) was transferred to the Gardner Park Well. In 2015, the City began conducting an Aquifer Storage and Recovery (ASR) pilot test at the Gardner Park Well under a preliminary permit issued by the Washington Department of Ecology (Ecology). In January 2017, Ecology issued a final Reservoir Permit authorizing the City to conduct ASR activities. A discussion of the City's ASR program is presented in Section 1.3.1 and Chapter 4.

In recent years, the City has not found it necessary to make any major expansions to the water system facilities, in part because of the high level of service that the system is already capable of providing, and also because expansion of the City's water service area is limited by the surrounding water association and municipal water purveyors. Potential for expansion is also limited by the "place of use" conditions of the surface water rights in accordance with the 2002 water rights settlement agreement. (City of Yakima Water Rights Settlement Agreement with the United States and the State of Washington Department of Ecology regarding the City's Naches River Water Rights in connection with the Yakima River Basin (Acquavella Adjudication).

1.3 Inventory of Existing Facilities

This section describes the major components of the City's water system including: supply and treatment, the distribution system, and storage. The physical facilities as well as the operation of each of these components are summarized here.

More detailed evaluations and analyses of the water system components are discussed in subsequent chapters:

- Water Supply - Chapters 3 and 4
- Storage - Chapter 3, Section 3.6
- Distribution System - Chapter 3, Section 3.7
- Water System Operation - Chapter 6

A map of the water system is presented in Figure 1-2. The ordinance for the City's water system is City Code Chapter 7.68, which is contained in Appendix E.

1.3.1 Supply Facilities

The supply system consists of a Water Treatment Plant (WTP) on the Naches River and four active groundwater wells. These facilities are shown in Figure 1-2 and described in the following subsections.

Naches River Water Treatment Plant

The capacity of the Naches River WTP is 20 million gallons per day (MGD). However, the plant is laid out to allow space for expansion to 60 MGD capacity if demand warrants increased supply capacity and subject to the availability of the necessary water right. Treated water from the plant flows over a weir into a 48-inch transmission main and to the City by gravity.

In 2011, a flood event damaged existing air/vacuum release valves on the 48-inch transmission main at the Naches River crossing. In response to this event, the City installed new valves on the transmission main on each side of the river crossing to allow for an emergency bypass in the event of future damage to the transmission main.

In 2014, the City upgraded the backwash settling basin and electrical service at the WTP. This involved constructing multiple concrete lined basins and a recycle pump station to

replace the original unlined basins and residuals handling process. The City also upgraded the electrical service at the WTP to be large enough to provide reserve capacity. Along with the new electrical service, the City also installed a new larger emergency backup generator system. The city also upgraded the Supervisory Control and Data Acquisition (SCADA) system and associated equipment.

In 2015, Yakima County completed the Eschbach Park Levee Setback and Restoration project. Eschbach Park is located across the Naches River from the WTP. Prior to this project, the levee adjacent to the WTP did not meet requirements to be designated as a 100-year flood levee. By modifying the levee at Eschbach Park, the levee adjacent to the WTP now qualifies as a 100-year flood levee, thereby reducing the risk of flooding at the WTP.

Groundwater Wells

The City of Yakima water system currently has four wells. The wells are located at the Airport, at Kiwanis Park, at Kissel Park, and Gardner Park. Table 1-1 shows the capacity, zone served, and other pertinent information about the City's wells. A discussion of the hydrogeology of the aquifers from which these wells withdraw water is presented in Chapter 4.

Aquifer Storage and Recovery Program

The City has developed an Aquifer Storage and Recovery (ASR) program to provide additional water supply and improve water system reliability. The ASR program involves diverting water from the Naches River during low demand periods (e.g., the winter), treating the water to drinking water standards at the Naches River WTP, delivering water through the City's distribution system to groundwater wells, and injecting (recharging) water through the wells into the aquifer (reservoir). The City could then withdrawal groundwater at a later time for municipal use.

The City has conducted extensive hydrogeologic studies and been in close coordination with Ecology for over 15 years in the course of developing the ASR program. After conducting initial pilot testing in 2000-2001, the City submitted Reservoir Permit Application R4-3552 to Ecology on April 12, 2002. The proposed storage reservoir is the Upper Ellensburg aquifer in the Ahtanum-Moxee subbasin.

More recently, Ecology issued a preliminary permit to the City in May 2014, allowing the City to conduct additional recharge and recovery testing at the Gardner Park Well. This was followed by Ecology's issuance of a temporary permit to the City on February 24, 2015, allowing recharge activities to occur at the Gardner Park and Kissel Park Wells. The City began recharge operations on March 10, 2015, under the conditions of the 2015 temporary permit. Approximately 41 million gallons of water were recharged at the Gardner Park Well in the spring of 2015.

In January 2017, Ecology issued a final Reservoir Permit (R4-34552P) authorizing the City to recharge up to 14,400 acre-feet per year using the Gardner Park, Kissel Park, and proposed Southeast Area wells. The Reservoir Permit also authorizes the City to use all of its wells for recovery of stored water. Recent development and permitting activities have been coordinated with the Yakima River Basin Integrated Water Resources Management Plan (Integrated Plan), as described in Section 1.4.9.

The City's ASR program is discussed further in Chapter 4.

Naches River Water Treatment Plant

Gleed Pump Station

3rd Level Pump Station

40th Avenue Pump Station

2nd Level Reservoirs

3rd Level Reservoirs

1st Level Reservoir

Stone Church Pump Station

Kiwanis Park Well

Kissel Park Well

Airport Well

Gardner Park Well

12

82

LEGEND

City Limits Boundary

Waterlines

Diameter (in Inches)

- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 48
- 54

Place of Use, Existing, Retail and Future Service Area

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

CITY OF YAKIMA WATER SYSTEM MAP

FIGURE 1-2

YAKIMA WATER SYSTEM PLAN

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MILES

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Table 1-1. Groundwater Supply Facilities

Designation	Kiwanis Park	Airport	Kissel Park	Gardner Park
Capacity (MGD/gpm)	3.0 / 2,100	2.8 / 1,950	3.6 / 2,500	4.3 / 3,000
Pump Depth (feet)	330	310	300	400
Well Depth (feet)	850	1,100	1,171	900
Casing Diameter (inches)	20	16	20 (first 472 feet) and 16	24 & 16
Ground Surface Elevation (ft)	1,037	1,056	1,112	1,038
Pump Type and Manufacturer	Vertical turbine U.S. Pump	Vertical turbine Peabody Floway	Submersible American-Marsh	Vertical turbine FlowServe
Pump HP	300	300	300	700
Remarks	Located in lower Ellensburg aquifer	Located in lower Ellensburg aquifer	Located in lower Ellensburg aquifer. Used for ASR.	Located in lower Ellensburg aquifer. Used for ASR.

1.3.2 Pressure Zones

The City of Yakima water system has three major pressure zones, designated as the 1st, 2nd, and 3rd Level zones, plus a separate pressure zone for the unincorporated community of Gleed. A water system hydraulic profile is shown in Figure 1-3. The relationship between the pressure zones is discussed in this section.

First Level Pressure Zone

The gravity supply from the 48-inch-diameter transmission main flows to the 6-MG 1st Level Reservoir located at North 40th Avenue and Englewood Avenue. This reservoir supplies water to the 1st Level zone. Flows from the WTP are manually adjusted to maintain a nominal hydraulic elevation of 1,264 feet, resulting in a static pressure range in the 1st Level zone of approximately 54 to 110 psi.

During emergencies, the 1st Level zone can also be served from the four wells. In extreme emergencies, such as fire-flow conditions, the 1st Level zone can also be served by the nine pressure-reducing valves (PRVs) which allow water to flow from the 2nd Level zone. The 1st Level zone can also be served by opening the valve that controls the intertie from the Nob Hill Water Association.

Second Level Pressure Zone

The 2nd Level pressure zone is served by the 40th Avenue Pump Station and the Stone Church Pump Station. The 40th Avenue Pump Station draws from the 48-inch supply transmission main and pump operation is controlled by the WTP operators based on the water level in the two 12-MG 2nd Level Reservoirs. The nominal hydraulic elevation is 1,380

feet, which results in a static pressure range of 43 to 105 psi. The Stone Church Pump Station was installed in 2000 to improve reliability and the ability to satisfy emergency demands. This pump station provides another alternative to supply the 2nd Level zone. The Stone Church Pump Station is equipped with a 250 kilowatt (KW) emergency generator to allow for operation during electrical power outages.

During emergencies, the 2nd Level zone can be supplied by three PRVs from the 3rd Level zone. During extreme emergencies, the 3rd Level zone can supply some of the 2nd Level zone's needs for approximately one day of average water use.

Third Level Pressure Zone

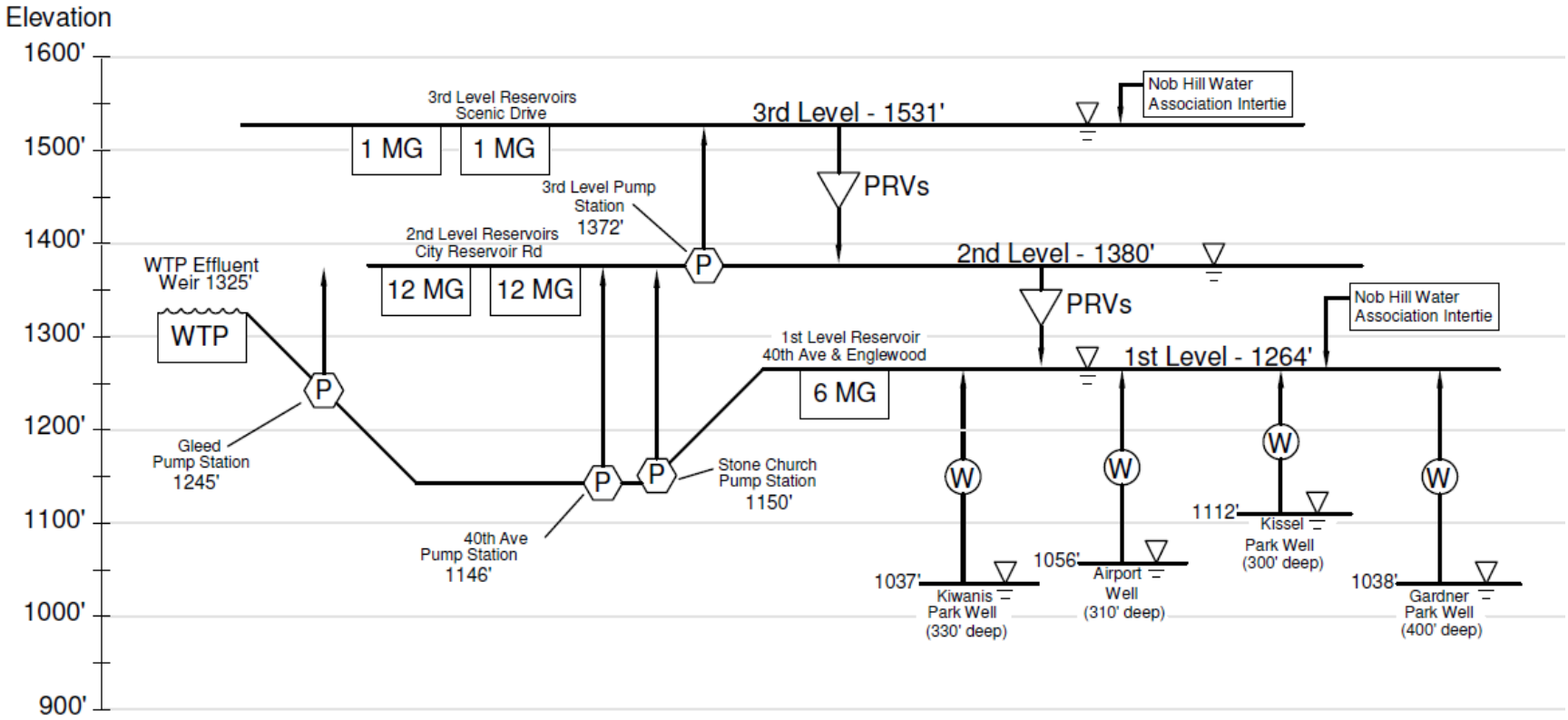
The 3rd Level pressure zone is served from the 2nd Level zone by the 3rd Level Pump Station, located at the site of the two 12-MG 2nd Level Reservoirs. In 2014, the City replaced the 3rd Level Pump Station motor control center and emergency power transfer switch. In addition, the 3rd Level Pump Station includes a 250- kW generator to provide emergency power. The 3rd Level Pump Station operation is controlled based on operating levels in the two 1-MG 3rd Level Reservoirs. The nominal hydraulic elevation is 1,531 feet, resulting in a static pressure range of 70 to 115 psi.

During emergencies, the 3rd Level zone can be supplemented by opening the valve that controls the intertie from the Nob Hill Water Association. During fire demand periods, water can be supplied to the 3rd Level pressure zone from the 2nd Level pressure zone through the three 2-way PRVs which connect the two zones.

Gleed Pressure Zone

The Gleed community, with a service capacity of 100 residential units, is served from the 48-inch transmission main through the Gleed Pump Station. Two 80- gpm pumps provide the average and maximum day demands, with a 2,000-gpm pump reserved for fire flow. A hydropneumatic tank is used to regulate pressure in this area. No storage facilities are located in the Gleed community.

Figure 1-3. City of Yakima Water System Hydraulic Profile



1.3.3 Distribution System

The pipelines in the distribution system range from 4 to 24 inches in diameter. The distribution system piping (6 inches and greater in diameter) are shown in Figure 1-4. The distribution system pipe materials are mainly cast iron, with ductile iron being used since the early 1970s.

The City's water system has been fully metered for many years. However, in 2011, the City began a program to replace or upgrade essentially all of the existing water meters with advanced metering infrastructure (AMI). The City completed this program in 2015. The new AMI system allows for real time monitoring and geographical analysis of consumption data and will contribute information useful in future water system planning. Chapter 4 of this Water System Plan provides additional information about the City's AMI program.

In 2017, the City plans to initiate the steel main replacement program. This program will involve the replacement of steel, galvanized iron, and unlined cast-iron pipelines that are 4 inches in diameter or less. The pipelines identified for replacement are located mainly in the business district and in portions of the older residential districts. The City plans to replace these pipelines with 6-inch (minimum) ductile iron pipe. The City aims to replace 500 to 2,000 linear feet of pipeline each year.

Booster Pump Stations

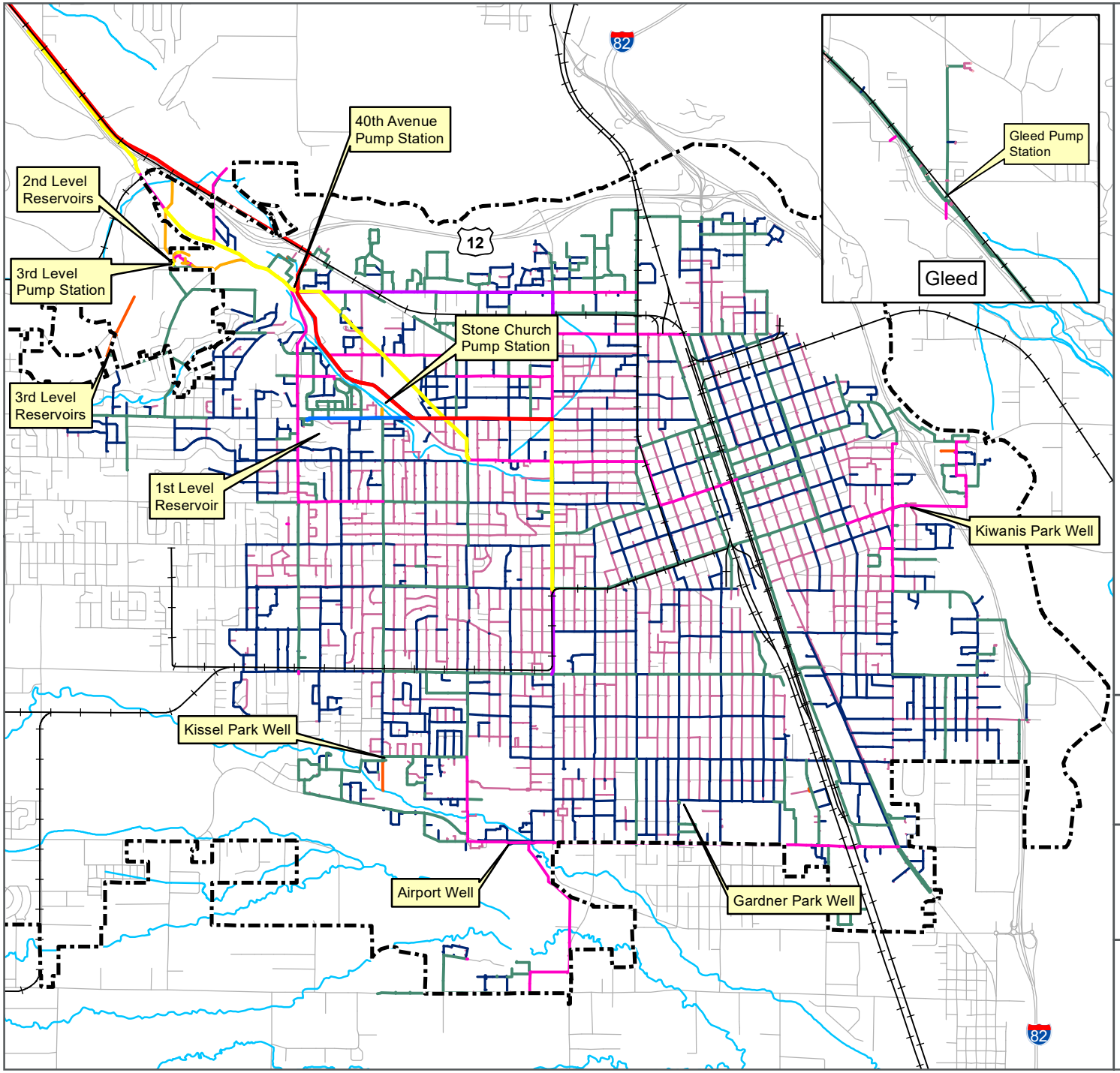
The booster pump stations provide water to the 2nd Level and 3rd Level zones and to the Gleed community, as shown in the hydraulic profile in Figure 1-3. The pump station location, the supply location, the zone that is served, the number of pumps in each station, pump capacity, and other characteristics are listed in Table 1-2.

Pressure-Reducing Valves

Emergency supply from the 3rd Level to the 2nd Level zone and from the 2nd Level to the 1st Level zone is provided by 12 PRVs located throughout the water system, as shown schematically in the hydraulic profile in Figure 1-3. There is one additional PRV that serves the intertie connection between Nob Hill Water Association and the 1st Level zone. The PRVs are set to open and close at various hydraulic elevations. Table 1-3 shows the location, size, inlet and outlet pressures, and other characteristics of each PRV.

The purpose of the PRVs is to provide additional flow for emergency purposes. The reduction of pressure in a zone under emergency conditions because of a fire flow or other large water need causes the hydraulic elevation to decrease. Reduction in hydraulic elevation will cause the normally closed, hydraulically activated valves to open and provide additional flow into the zone. In addition to the 12 PRVs, there are three additional connections between the 3rd Level and 2nd Level zones:

- Check valve at Lincoln Avenue and North 40th Avenue to allow water to flow from the Middle zone to the 3rd Level zone under emergency conditions (i.e., very low 3rd Level zone pressure).
- Closed valve with a 2-inch-diameter bypass for winter operation at Westpark Alley and North 40th Avenue.
- Closed valve at Summitview Avenue and North 44th Avenue.



LEGEND

City Limits Boundary

Waterlines

Diameter (in Inches)

- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 48
- 54

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

DISTRIBUTION SYSTEM PIPING

FIGURE 1-4

YAKIMA WATER SYSTEM PLAN

N

0 0.5 1 1.5 2

MILES

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Table 1-2. Pump Stations

Station Name	Location	Zone Supply	Zone Service	Pump No.	Pump HP	TDH (ft.) Operating	TDH (ft.) Shut Off	Pumping Rate (gpm)	Local Elev. (ft.)	Pump Manufacturer
Third Level[1,2]	Reservoir Road	2nd Level	3rd Level	1 2 3	125 125 30	203.5 203.5 203.5	315 315 270	1,700 1,700 400	1372	Byron-Jackson Byron-Jackson Simons
North 40th Avenue[2]	River Road & Powerhouse Road	1st Level	2nd Level	2 3 4	40 60 100	126 125 130	182 176 240	1,000 1,500 2,500	1,146	Peerless Peerless Peabody Floway
Gleed[3]	Gleed	1st Level	Gleed	1 2 3 4	5 5[4] 125	135 135 --- 300	198 198 --- 330	80 80 --- 2,000	1,245	Aurora Aurora --- Aurora
Stone Church	Englewood Ave. & 32nd Ave.	1st Level	2nd Level	1 2 3	125 100 50	172 172 172	202 195 235	2,500 1,500 700	1,150	PACO PACO PACO

1. Only one large pump at a time, in conjunction with the 40- horse power (hp) pump, is operated in the 3rd Level zone under the present power source. The 3rd Level Pump Station includes a 250 kW standby generator.
2. Controlled from reservoir level transmitters for pump start and stop.
3. Controlled by pressure activated controls.
4. Not installed at the present time.

Table 1-3. Pressure Reducing Valves

WA #	Size (inch)	Location	Approx. Ground Elevation (feet)	Service Levels	High Side PSI[1]	Low Side PSI	Downstream PSI Setting
WA5065	4	N.41st Ave. & Snowmountain Rd.	1266	3rd to 2nd	118	45	20
	2						40
WA5021	6	N.40th Ave & Richey Rd.	1254	3rd to 2nd / 2nd to 3rd	120	55	20
	2						50
WA5017	6	40th Ave. Pump Station	1144	2nd to 1st	130	55	50
							-
WA5009	6	S. 32nd Ave. & W. Viola Ave.	1122	2nd to 1st	110	48	20
	2						43
WA5010	6	S. 19th Ave. & W. Chestnut Ave.	1160	2nd to 1st	92	41	20
	2						36
WA5011	4	S. 31st Ave & Clinton Way	1124	2nd to 1st	110	59	20
	2						54
WA5012	8	S. 30th Ave. & W. Nob Hill Blvd.	1132	2nd to 1st	104	51	20
	2						46
WA5013	6	S. 20th Ave. N. of Bonnie Doone	1140	2nd to 1st	105	50	20
	2						45
WA5016	6	Park Ave. & Summitview Ave.	1135	2nd to 1st	95	45	20
	2						40
WA5018	4	S. 27th Ave. & Fraser Way.	1144	2nd to 1st	102	52	20
	2						47
WA5019	10	N. 20th Ave. & W. Lincoln Ave.	1112	2nd to 1st	Visual Only		-
							-
WA5014	12	S 32nd Ave. & Ahtanum	1088	Nob Hill Intertie	Visual Only		50
							-
WA5020	8	506 N. 40th Ave. (between Richey and Englewood)	1264	3rd to 2nd	115	50	20-25
							-

1. psi= pounds per square inch.
2. The values in this table are based on the PRV settings used in September 2015.

1.3.4 Distribution Storage Reservoirs

Each pressure zone has an established hydraulic elevation. This elevation is maintained by the distribution reservoir located in each of the pressure zones. The reservoirs shown in the hydraulic profile in Figure 1-3 are listed in Table 1-4.

Table 1-4. Distribution Storage Reservoirs

Zone Designation	Location	Volume MG	Max. Elevation (feet)	Min. Elevation (feet)	Zone Served	Construction Material
1st Level	40th Ave. & Englewood	6	1,264	1,234	1st Level	Reinforced Concrete
2nd Level	Reservoir Road	24 (two at 12 MG ea.)	1,380	1,356	2nd Level	Reinforced Concrete
3rd Level	Scenic Drive	2 (two at 1 MG ea.)	1,531	1,511	3rd Level	concrete (1) steel

1.3.5 Supervisory Control and Data Acquisition System

The SCADA system is a personal computer based system served by programmable logic controllers (PLCs) that performs the following functions:

- Monitors WTP operations
- Continually records water quality
- Records storage reservoir levels continually
- Records pump station flow rates continually
- Actuates booster pumps from reservoir levels through local PLCs
- Sequences Pump operation through local PLCs

The main control panel for the SCADA system is located at the Naches River WTP. Radio communications are used to transmit data between the main control panel and the remote sites (reservoirs, pump stations, and supply wells). In 2014, the City upgraded the computers and PLCs at the WTP and all remote sites.

1.3.6 Interties with Adjacent Water Systems

As discussed previously, the City has common boundaries with, or is approximately adjacent to, four other water purveyors:

- Nob Hill Water Association
- City of Union Gap
- Terrace Heights area (Yakima County)
- City of Selah

Other smaller Group A water systems adjacent or near the City's water system include:

- Noel Canning (#07143)
- The Ice Rink (#99114)
- Regal Mobile Estates (#71725)
- Whispering Pines (#42948)
- Laura Lee Mobile Home Park (#46219)
- American Legion (#01985)
- Gleed Mobile Estates (#27828)
- Apple King LLC (#62020)

- Bertsch Subdivision Water Association (#05885)
- Sun-Tides RV Park (#85138)
- Suntides Mobile Park (#86280)
- Raybung Community Well (#70630)

The City has two interties with the Nob Hill Water Association. A summary of the interties, including location, size, hydraulic grade line (HGL), adjacent purveyor, and other data, are included in Table 1-5. The 32nd Avenue and Ahtanum intertie is automatically activated during certain types of fire flow events. The other intertie is activated manually. The City of Yakima HGL elevations shown in the table are based on the HGL at the storage reservoir when full and under static conditions.

No previous communications have taken place between the City and nearby purveyors for regionalization of water systems. The City does not currently have any plans for regionalization to occur. If such discussions were to take place, Yakima County, as a Satellite Management Agency (SMA) would lead such efforts.

Table 1-5. Interties

Pressure Zone	Location	Adjacent Purveyor	HGL (ft.) City of Yakima	HGL (ft.) Adjacent Purveyor	Main Size City of Yakima	Main Size Adjacent Purveyor	Intertie Metered	Intertie Agreement
1st Level	32nd Ave. & Ahtanum	Nob Hill Water	1,199	1,415	12	12	No	Yes
3rd Level	56th Ave. & Lincoln Ave.	Nob Hill Water	1,531	1,521	12	12	No	Yes

1.4 Related Plans

1.4.1 Yakima Urban Area Comprehensive Plan

The Yakima Urban Area Comprehensive Plan was adopted in April 1997 and amended in 1998, 2000, 2001, 2002, 2006, and 2010 in compliance with the Washington State Growth Management Act (GMA) (Chapter 36.70A RCW). The City is currently updating the Yakima Urban Area Comprehensive Plan. The City aims to complete the plan update by 2017. Compliance with the GMA is also dependent on the adoption of the implementation regulations as defined in Chapter 36.70A.040 RCW including:

1. Zoning map amendments
2. Zoning ordinance amendments
3. Development standards
4. Critical area ordinance
5. New subdivision ordinance
6. Transportation capacity management ordinance
7. Regulatory reform procedure
8. Future land use map
9. Comprehensive plan text changes
10. Revised transportation plan

1.4.2 Yakima Urban Area Zoning Ordinance

The Yakima Urban Area Zoning Ordinance (Yakima Municipal Code Title 15) was revised December 28, 1998, to comply with the requirements of the GMA as discussed above. The Yakima Urban Area Zoning Ordinance was most recently updated in 2010.

1.4.3 Yakima County Comprehensive Plan

Yakima County's currently adopted Comprehensive Plan - Plan 2015 - is a policy document that guides county decisions related to growth and development in unincorporated Yakima County. The County is currently preparing an update to Plan 2015, titled "Horizon 2040," which should be available by June 2017. The County's Comprehensive Plan was developed to provide the policy framework for how the County would develop in the future. It contains land use maps as well as the other planning elements required by the GMA.

Another integral part of the long range plan for Yakima County, are the plans of the individual cities. Although not technically part of the County's Comprehensive Plan, each city in the county has adopted a comprehensive plan that defines their vision of the future. Yakima County is a partner with the City of Yakima in the adoption of the Yakima Urban Area Comprehensive Plan, which includes separately adopted neighborhood plans.

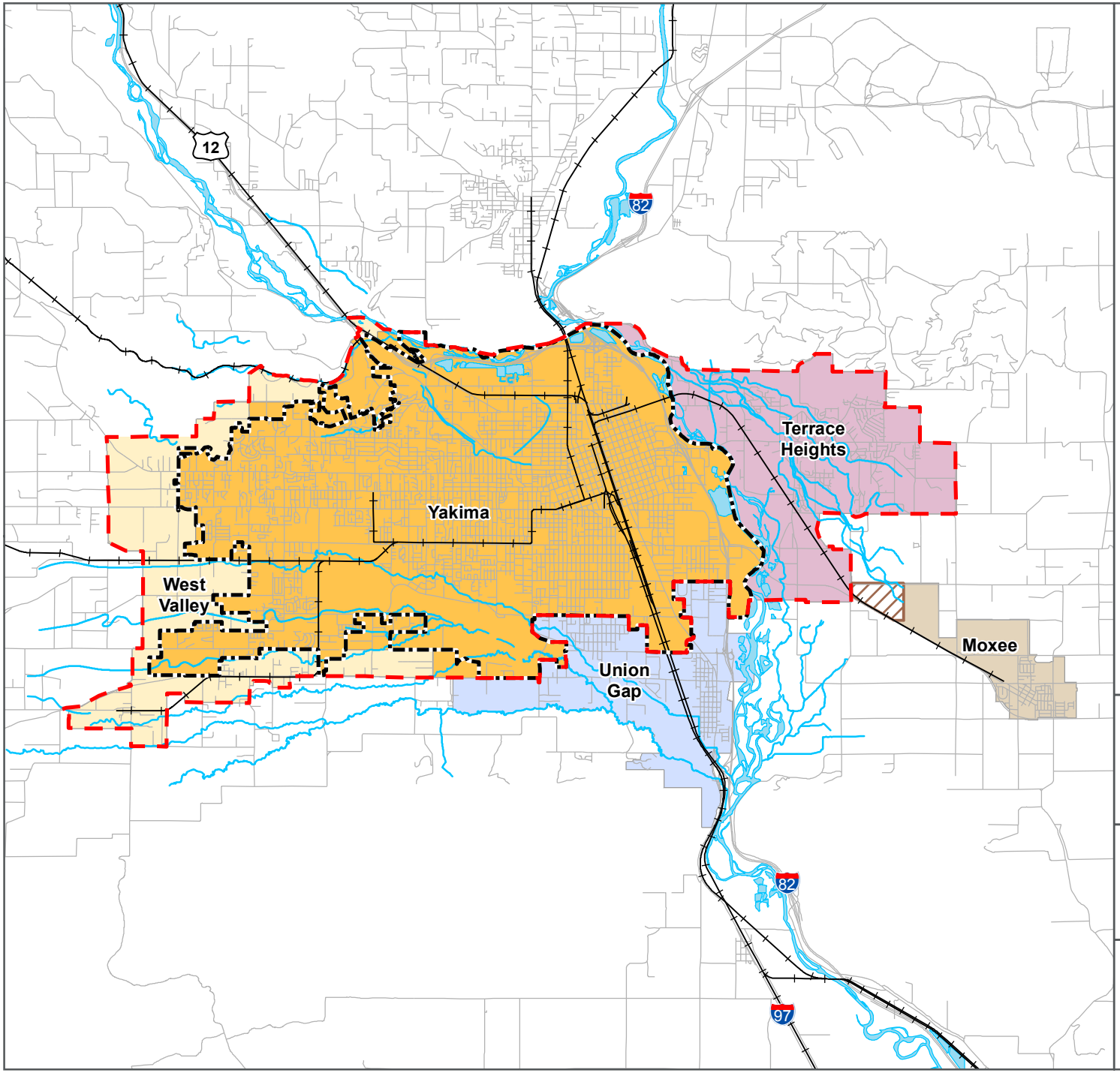
1.4.4 West Valley Neighborhood Plan

The West Valley Neighborhood Plan and Area-Wide Rezone were adopted on February 15, 2011. They became effective on February 28, 2011, in the unincorporated area, and on March 20, 2011, inside the Yakima City limits. The West Valley Neighborhood lies outside of the Yakima Water System Service Area and is served by the Nob Hill Water Association.

1.4.5 City of Yakima Wastewater Collection System Master Plan

The City adopted the Wastewater Collection System Master Plan in October 2013. The Yakima Regional Wastewater Treatment Plant (WWTP) is owned and operated by the City and provides treatment services for the City of Yakima, the City of Union Gap, the City of Moxee, unincorporated lands to the east of the City of Yakima, referred to as Terrace Heights, and several other unincorporated areas under the jurisdiction of Yakima County including the area to the west of the City of Yakima known as West Valley. The City provides sewer service to these areas based upon an inter-local agreement known as the "Four Party Agreement" which was agreed upon and entered into on February 23, 1976, by the City of Yakima, Yakima County, the City of Union Gap, and the Terrace Heights Sewer District to allocate capacities and service areas.

The regional sewer service boundaries are shown in Figure 1-5. Since the regional wastewater treatment facilities are intended to serve the entire urban area, the service area boundaries and the associated population projections are considerably larger than those of the City's water system. As such, the service area and population projection considerations presented in this Water System Plan are not directly comparable to the wastewater system. The urban areas not served by the City's water system are served by the adjacent water purveyors which include the City of Union Gap, the Nob Hill Water Association, and Yakima County (Terrace Heights water system).



LEGEND

- City Limits Boundary
- Urban Growth Area

Waste Water Service Area

- Yakima Service Area
- West Valley
- Terrace Heights
- Union Gap City Limits
- Moxee Planning Area
- Moxee (To Be Annexed)

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

WASTE WATER SERVICE

FIGURE 1-5

YAKIMA WATER SYSTEM PLAN

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1.4.6 Wellhead Protection Programs

The Upper Yakima Valley Regional Wellhead Protection Plan (WHPP) was completed in October 2000. The purpose of this plan is to identify potential sources of contamination near the member purveyors' groundwater supplies, implement management strategies to prevent contamination of those supplies, and develop a contingency plan for contamination mitigation in the event that groundwater does become contaminated. In this Regional WHPP, each member community in the Upper Yakima Valley plays a role in protecting the groundwater supplies of the entire area by pooling resources and management efforts to target an audience beyond that which could be reached at a local level. The member purveyors participating in this wellhead protection plan include:

- Yakima County
- City of Yakima
- Town of Naches
- City of Moxee
- Town of Tieton
- City of Union Gap
- City of Selah
- Nob Hill Water Association

Regional management efforts adopted by the eight purveyors forming the Regional Wellhead Protection Committee include:

- Development of a Geographical Information System (GIS) database of the wellhead protection areas, potential contamination sources, and water quality data in order to monitor and track sources and receptors.
- Development of a planning trigger to distribute wellhead protection notification letters for development changes (i.e., building permits, zoning changes, SEPA, etc.) within wellhead protection areas.
- Coordination with Ecology to prioritize their Hazmat Technical Assistance Sweep within wellhead protection areas.
- Coordination with the State Health Department's Sanitary Surveys to ensure up-to-date information is maintained in the regional GIS potential contamination source inventory.
- Coordination with County Health District to identify septic tanks and private wells with Global Positioning System (GPS) units.
- Coordination with the Washington Association of Realtors to adopt a Property Disclosure Addendum that will help identify private and abandoned well locations during property transfers.
- Designation of the 6-month wellhead protection area as a critical "Red Zone" by County Emergency Management (LEPC) in order to prioritize wellhead protection during emergencies (i.e., hazardous material spills). Outreach to educate the public, including the distribution of literature.
- Coordination with Education Services District (ESD) which provides continuing education to area teachers in order to better integrate wellhead protection and water issues into school curriculum.

- Development of a regional website to increase public awareness on the need to protect groundwater.
- Development of a logo for wellhead protection area signs.
- Development of an interlocal agreement among the eight purveyors to make sure that wellhead protection is given a high priority in the Upper Yakima Valley.

1.4.7 County Water and Sewer General Plans

The *Yakima County Rural Water & Sewerage General Plan* was adopted by Yakima County in May 1988. This plan was subsequently amended by the *Yakima County Water System Satellite Management Plan* which was completed in December 1996. This satellite management plan, prepared in accordance with the requirements of WAC 246-295, was approved by DOH thereby authorizing the county to become a satellite management agency (SMA). A SMA is an individual, purveyor, or entity approved by DOH to own or operate more than one public water system on a regional or county-wide basis.

The County's SMA includes all of Yakima County except the incorporated area, the Yakima Training Center, and certain areas of the Yakama Indian Nation. Under its satellite management plan, the County will acknowledge the service area boundary of any existing water system that has a DOH approved water system plan. Developments located within a defined service area boundary will be referred to that water purveyor for service, thus allowing the existing water purveyor the first right for providing water service.

Yakima County currently operates 28 satellite water systems. Six of these systems are within the City of Yakima Urban Growth Area. These are the Terrace Heights, Bittner, Oliver, Horizon View, Norman, and Star Crest Water Systems. The County does not currently operate any water systems which it does not own.

1.4.8 Groundwater Management Plans

In 1999, United States Bureau of Reclamation (USBR), Ecology, and the Yakama Nation signed a Memorandum of Agreement (MOA) to fund and oversee a study of the groundwater resources of the Yakima River Basin. In 2011, the U.S. Geological Survey (USGS) completed a study of the availability of groundwater resources and of the interaction or "continuity" between groundwater and surface water in the Yakima River Basin. Through computer modeling of groundwater flows, the USGS found that generally the surface and groundwater resources in the Yakima River Basin are interconnected such that increased groundwater pumping results in decreased surface water flows. The USGS model can be used as a tool by water-management agencies and other stakeholders to quantitatively evaluate proposed alternative management strategies that consider the interrelation between groundwater availability and surface-water resources.

1.4.9 Yakima River Basin Integrated Water Resource Management Plan

In June 2009, Ecology and Reclamation brought representatives from the Yakama Nation, irrigation districts, environmental organizations, and federal, state, county, and city governments, including the City of Yakima, together to form the Yakima River Basin Water Enhancement Project (YRBWEP) Workgroup to help develop a consensus-based solution to the basin's water problems. In 2011, the YRBWEP Workgroup developed the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan). The Integrated Plan encompasses seven elements: (1) habitat and watershed protection

and enhancement, (2) reservoir fish passage, (3) surface storage, (4) enhanced water conservation, (5) structural and operational changes, (6) groundwater storage, and (7) the use of market-based forces to reallocate water and habitat among willing buyers and sellers. The goals of the Integrated Plan are to protect, mitigate, and enhance fish and wildlife habitat; provide increased operational flexibility to manage instream flows to meet ecological objectives; and improve the reliability of the water supply for irrigation, municipal supply and domestic uses. The seven plan elements each include recommended projects to meet the goals of the Integrated Plan. As an example, the groundwater storage element of the Integrated Plan includes the development of an ASR program in the City of Yakima.

1.4.10 Basin Plans

In 1998, the Washington State Legislature passed the Watershed Management Act (RCW 90.82, [ESHB 2514]) (WMA). The WMA identifies the "initiating governments" that select a lead agency, apply for grant funding, determine the scope of planning, and convene a "Planning Unit." In the Yakima Basin, the Tri-County Water Resource Agency (TCWRA) represents the initiating governments under WMA. Representation on the TCWRA includes Benton, Kittitas, and Yakima Counties; the Cities of Yakima and Ellensburg; Sunnyside Valley Irrigation District, Roza Irrigation District, and Yakima-Tieton Irrigation District.

The Yakima Basin Water Resources Agency (YBWRA) was formed to replace the TCWRA when the members in Kittitas County dropped out of the program. In 2003, the *Watershed Management Plan, Yakima River Basin* was adopted by Yakima and Benton Counties. The Detailed Implementation Plan (DIP) was developed and adopted in 2007. The DIP was being administered though the YBWRA until Ecology stopped funding local Watershed Agencies in 2010. As such, there is not an operating Lead Agency for the purposes of adopted watershed plan implementation needs. Instead, the water quality related (instream flow management, surface and groundwater diversion or withdrawals, storage and water banking) watershed plan implementation needs and objectives are being addressed under the Integrated Plan implementation effort.

In addition to regional watershed planning efforts, the City works with agencies and organizations operating in the Naches River Watershed to protect the City's surface water source. The City's Watershed Control Program is documented in Chapter 5 of this Water System Plan.

1.4.11 Water System Plans for Adjacent Purveyors

City of Union Gap

The City of Union Gap's most recent water system plan update was completed in June 2011. The area presently served by the Union Gap water system is shown in Figure 1-6.

Nob Hill Water Association

Nob Hill Water Association Water System Plan Update was completed in 2015. The area presently served by the Nob Hill Water Association water system is shown in Figure 1-6.

Yakima County

Yakima County's Water System Plan was completed in 2009. The County is currently updating the Yakima County Water System Plan. The County aims to complete the Water System Plan update by early 2017. The area served by Yakima County water system is shown in Figure 1-6.

City of Selah

The City of Selah's most recent Water System Plan update was completed in 2014. The area presently served by the Selah water system is shown in Figure 1-6.

1.5 Existing Service Area Characteristics

The City's water system is within the Yakima Urban Area, as defined in the *Yakima Urban Area Comprehensive Plan,* which was adopted in April 1997 and amended in 1998, 2000, 2001, 2002, 2006, and 2010. The City of Yakima is currently updating the Yakima Urban Area Comprehensive Plan. The City aims to complete the plan update by 2017. The Urban Growth Area and city limits are shown in Figure 1-6. The Washington State GMA, passed in 1990, requires municipalities to establish boundaries within which "urban services", such as water supply, will be provided.

The City's existing water service area shown in Figure 1-6 is delineated by the boundary of plats currently served by mains and service connections. The existing service area extends beyond other boundaries such as city limits, urban boundary, and future service boundary. For example, City service is provided to county areas, such as the Gleed community. If the existing service area extends into an adjacent purveyor's future service area, it is by mutual verbal or written agreement until the adjacent purveyor's system is extended. The City does not have plans to pursue regionalization at this time. For the purpose of this plan, the existing and future water service areas are essentially the same.

1.5.1 Adjacent Purveyors

Four water purveyors supply water to areas adjacent to or within the City of Yakima: Nob Hill Water Association, the City of Union Gap, Yakima County in the Terrace Heights area, and the City of Selah. The existing service areas of these purveyors are shown in Figure 1-6.

Nob Hill Water Association

The Nob Hill Water Association serves the West Valley area west of Yakima. A significant portion of the system is located within the City's corporate limits and the remainder is located in unincorporated Yakima County. The system is operated as an association with a board of directors. In 2013, the Association had approximately 9,750 connections, serving a population of 29,460. Nob Hill Association's 2015 Water System Plan Update projects an average growth rate of 2.6 percent through the year 2035. The systems' five active wells have a capacity of 8,050 gpm. The distribution storage consists of six reservoirs with a total capacity of 4.23 MG.

The City has two interties with the Nob Hill Water Association. The two interties are located at West Lincoln Avenue and North 56th Avenue, and South 32nd Avenue and Ahtanum. These interties are for emergency purposes only and are covered in a Memorandum of Understanding between the City and the Association dated September 6, 2000, a copy of which is included in Appendix F. These interties are not designed for normal operation of either system and are not considered as a source of supply in the storage and supply analyses presented in Chapter 3 of this plan. In the past, whenever an intertie has been activated, it has been a joint effort. Crews from Nob Hill and the City have been present to open the two valves (each with a locking cap) and to check system pressure. The interties are not metered. Instead, the City has estimated supply by comparing the current pump records to the previous year's pump records during the same time period, or by estimating supply using the systems hydraulic models.

City of Union Gap

The City of Union Gap is located in the southeast corner of the urban area. Union Gap's water system supplies approximately 2,760 connections. The source of supply is five wells with a combined capacity of approximately 4,855 gpm and a reservoir capacity of 1.6 MG.

The City does not have any interties with Union Gap. However some water could be delivered to Union Gap in an emergency through a connection between fire hydrants near Washington Avenue.

Terrace Heights Area (Yakima County)

Until recently, the Terrace Heights area consisted of four water systems with greater than 100 services and approximately 20 water systems that served between 10 and 99 customers. The major systems were the Country Club District, Terrace Estates, Sun Country Mobile Estates, and Skyline Mobile Estates. There were also a number of systems that served mainly commercial establishments or had fewer than 10 connections. Yakima County has developed a well in the Terrace Heights area, purchased two of the water systems, and intends to serve the area within the urban boundary east of the Yakima River.

The County's future service area for Terrace Heights extends westward to the City's service area boundary. Overlaps and islands of service do not exist and are not anticipated. The county utility is expected to grow into a major purveyor within the urban boundary.

City of Selah

Selah is located east of the Gleed community and North of the City of Yakima (see Figure 1-6). In 2012, the City of Selah had approximately 2,450 services, serving a population of 7,290. Because Selah is located across the Naches River and is outside the current water service area and urban area, it is not expected that the City will provide water service to this area.

Yakima County

Selah

Nob Hill

Yakima

Union Gap

12

82

82

LEGEND

City Limits Boundary

Urban Growth Area

Water Service Area

Yakima

Nob Hill

Selah

Union Gap

Yakima County

Moxee

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

ADJACENT PURVEYOR SERVICE AREAS

FIGURE 1-6

YAKIMA WATER SYSTEM PLAN

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1.6 Future Service Area

The areas currently designated or planned to be included in the City's future water service area are discussed in this section and are shown in Figure 1-6.

1.6.1 Potential Service Area

The future service boundary describes the specific area for which water service is planned by a public water system (WAC 246-293). The future service boundary is important to meet the requirements of the GMA, and it is critical to the efficient and cost-effective development of the water system. Annexations by the City of Yakima or its neighboring cities will not affect that water service area, because the water service boundaries are established by separate agreements.

Four other utilities provide service within or near the urban boundary. Service agreements have been or are being developed among the utilities to determine which utility will serve new areas of growth.

The criteria used to determine the City's future service boundary include:

- **Place of Use** - The “place of use” boundary (see Figure 4-1 in Chapter 4) defines the specific area within which the City is allowed to utilize its surface water supply.
- **Physical features** - Boundaries formed by physical features are usually expensive and often impractical to cross.
- **Adjacent jurisdictional boundaries** - Jurisdictional boundaries include other city limits and adjacent purveyor future service areas. It is inefficient and perhaps impossible politically to serve in areas already planned for service by adjacent purveyors.
- **Urban Growth Boundary** - The GMA requires that the water utilities establish common future service boundaries within the growth management planning area designated by the Urban Growth Boundary.
- **Policy** - The City's current policy is to provide service outside the existing service area only where it is economical and practical. Resolution No. D- 1250, adopted March 29, 1965, describes the City policy regarding service outside the existing city limits (Appendix G).

The alignment of different sections of the City's future service boundary is based on different combinations of these criteria. The main sections of the City's future service boundary in terms of these criteria are discussed below.

North Boundary

The Naches River, the urban growth boundary, the adopted urban area of the City of Selah, and the City of Yakima boundary define the north section of the future service boundary.

East Boundary

The east boundary is defined by the Yakima River and the City of Yakima boundary.

This boundary is coincident with Yakima County's future service boundary for Terrace Heights.

South Boundary

The south boundary primarily depends on adjacent jurisdictional boundaries and policy. The Water Service Agreement between the City of Yakima and the City of Union Gap dated April 21, 1987, (Appendix F) did not completely define the service areas of the Cities of Yakima and Union Gap. As a result, some disagreement arose over which purveyor would provide service to some areas. These disagreements are described in the following sections. Although Union Gap recently annexed all of the land south of Washington Avenue, water service is still provided to some areas by the City of Yakima.

On South Side or Washington Avenue, the current service area of the City of Yakima extends into the Union Gap service area as defined by the agreement (as shown in Figure 1-6). By verbal agreement, the City of Yakima serves all parcels abutting the south side of Washington Avenue east of South 16th Avenue and west of Voelker Avenue. Thus, the necessity for both cities to install a main in Washington Avenue is avoided.

Some parcels south of, but not adjacent to, Washington Avenue are served by the City of Yakima by verbal agreement between the two cities. It is understood that, when the City of Union Gap system is extended to these areas, the ownership of the mains and services will be transferred from the City of Yakima to Union Gap.

West Boundary

The Nob Hill Water Association operates and maintains a water system in the western part of the City of Yakima under a 25-year franchise agreement (City of Yakima Ordinance No.93-86, December 1, 1993, Appendix F). The association's service area also extends well beyond city limits.

Generally, as shown in Figure 1-6, the City's future service boundary is the same as the existing boundary. There are several areas that can be served by either utility. Some of these areas are "islands" completely surrounded by the other utility's service area. Other parcels abutting the future service area boundary may be served by either utility, creating an erratic boundary. In this case, the boundary might alternate from a street centerline to the back property line on either side of the same street. Nob Hill Water Association and the City have verbally agreed to maintain the status quo. Most of the parcels currently receive water service, and the distribution grid is well established. Where in- fill services are requested, the customer is given the choice of utility where both utilities have water mains in the same street.

1.7 Service Area Agreements

The City currently has written service area agreements with the Nob Hill Water Association and with the City of Union Gap. Copies of these agreements are included in Appendix F.

There are currently no comprehensive service area agreements between the City of Yakima and the other two adjacent purveyors, the City of Selah and Yakima County.

1.8 Service Area Policies

The City's service area policies are applicable to various sections of this water system plan update and may also be referenced and discussed in more detail elsewhere in this document. However, the policies are presented together here in one location in a summary form with reference made, where applicable, to other documents which the City

provides for distribution to persons interested in developing within the water service area. A brief summary of each applicable service area policy is included below.

Wholesaling Water: The City does not currently provide water to any other utilities on a wholesale basis, and does not anticipate doing so in the future.

Wheeling Water: The City currently does not allow the system's mains to be used to wheel water to another water system. A need to consider any wheeling arrangements with adjacent purveyors is not anticipated during the planning period.

Annexation: It is City policy that before utility service is provided to a contiguous, unincorporated property annexation is required. For noncontiguous properties the City would require an outside utility agreement (OUA). However, the City does not provide water service outside of the defined service area (see Figure 1-2) and, with only a few exceptions, the City's water service area is entirely within the City limits. Significant areas in the western portion of the City are actually served by the Nob Hill Water Association. The only significant area outside the City limits served by the City's water system is the unincorporated community of Gleed.

Direct Connection and Satellite/Remote Systems: Section 12.04.010 of the Yakima Municipal Code requires that:

> *All new lots and development shall be served by a public water supply line maintained by the City of Yakima, Nob Hill Water Company, or other water purveyor, and located adjacent to the lot or development site*.

Yakima Municipal Code does not prohibit satellite water systems within the City limits or water service area. The City has, however, elected not to become a satellite management agency.

Design and Performance Standards: The water system minimum design and performance standards for new development have been developed by the City of Yakima Engineering Department. The standards are available to the public in a document titled *WATER Specification and Details (1999)*. This document is available on the City's website: https://www.yakimawa.gov/services/engineering/water/

Title 12 of the Yakima Municipal Code also establishes development standards for water service extensions. Copies Title 12 – Development Standards are also available from the City Engineering Department. Chapter 12.04 covers water system development standards. Section 12.04.030 requires that all water lines shall be looped. Section 12.04.040 requires that all new water lines within the City water service area shall be constructed of Class 52 ductile iron and shall be a minimum of eight inches in diameter, and that improvements and additions to the Nob Hill Water Company system shall conform to the requirements of Nob Hill Water Company (Ord. 98-64 § 1 (part), 1998).

Surcharge for Outside Customers: The City imposes a surcharge of 1.5 × the volume rate for customers outside of the service area. There is no surcharge on the connection fee. Due to the limitations of the water rights "place of use" boundary and agreements with adjacent purveyors, the circumstances in which the City might provide service to outside customers would be very limited.

Urban Growth Area: The City's service area and water rights "place of use" boundaries are entirely within and significantly smaller than the Urban Growth Area (except for the Gleed community which was included in the interim UGA, but not in the final UGA). Because of this the growth which occurs within the City's service area will be primarily through in-fill, and the need to proactively finance extensions in anticipation of growth is not expected to be necessary.

Cross-Connection Control Program: Cross Connection control is covered in Chapter 7.68 of the Yakima Municipal Code under Article 7.68.070. The Water Division currently

has two full time Water Device Technicians who are dedicated to the inspection of cross connection control devices and enforcement of this ordinance.

Extension: Water line extensions within the City water service area are governed by Chapter 12.04.020 of the Yakima Municipal Code which states that:

> *Water lines shall be extended to the point where the adjoining property owner's responsibility for further extension begins. This typically requires extension across the street or easement frontage of the developing property. In some cases it will require dedication of an easement and a line extension across the property or extension along two or more sides of the developing property. Extensions will be consistent with and implement the city's adopted water comprehensive plan (Ordinance. 98-64 § 1 (part), 1998).*

1.9 Satellite Management Agencies

The City of Yakima Water/Irrigation Division is not now and is not currently considering becoming a Department of Health approved Satellite Management Agency (SMA). The currently approved SMAs in the area are Nob Hill Water Association and Yakima County. It is the City's intent to refer any existing or proposed satellite systems within its service area boundaries to Nob Hill Water Association or Yakima County as the approved SMA.

1.10 Conditions of Service

Municipal water suppliers have a duty to provide service to all new connections within their retail service area when the circumstances meet four threshold factors: (RCW 43.20.260 *Review of water system plan, requirements – Municipal water suppliers, retail service*)

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

For the City water system, a primary condition of service is that the customer be within the boundaries of the "place of use" area which is a condition of the City's surface water rights (see Figure 1-2).

The other conditions of service are that the customer pays all applicable connection and user costs. All water system extensions required to serve a customer must conform to the City design standards and developer standards.

1.11 Complaints

All water service related complaints are handled through the Water/Irrigation Division office which can be reached at (509) 576-6477. This number also serves as the Nights and Weekend Emergency telephone number to report problems and complaints after normal working hours.

Water quality complaints are referred to the Water Quality Specialist at the WTP. The Water Quality Specialist investigates the complaints and maintains records describing the nature of the complaint and the steps taken to resolve it. All complaints are assigned a

work order number which can then be tracked in the Cayenta Inc. management system (Cayenta). Cayenta is a City wide program which tracks information about all of the City's facilities and equipment. Additional information on Cayenta is included in Chapter 6 of this Water System Plan Update.

All low pressure and other distribution system related complaints are referred to the Distribution Supervisor who investigates and takes corrective actions as necessary. As with the water quality complaints, the distribution system related complaints are assigned a work order number and tracked in Cayenta.

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2 Basic Planning Data and Water Demand Forecasting

This chapter presents an analysis of historical water use from 2011 to 2015, existing and future zoning and land use, and population projections in order to predict future water demands for the City of Yakima's water system.

2.1 Current Population and Service Connections

2.1.1 Current Population

The Washington State Office of Financial Management (OFM) official 2010 Census population figures and 2014 population estimates for Yakima County and the City of Yakima are listed in Table 2-1.

Table 2-1. Current Population for the City of Yakima and Yakima County

Municipality	2010 Census Population	2014 OFM Estimate
Unincorporated	83,755	85,410
Incorporated	159,476	163,390
Total Yakima County	243,231	248,800
City of Yakima alone[1]	91,196	93,080

1. The City of Yakima population is included as a subset of the Yakima County Incorporated population.

As discussed in Section 1.5, Existing Service Area Characteristics, the City of Yakima water system does serve some small areas outside the current municipal boundaries (including Gleed and a small portion of Union Gap). However, it does not serve significant areas in the western portions of the City of Yakima which are within the city limits, but served by the Nob Hill Water Association. The net result is that the actual population served by the City's water system is significantly less than the OFM population figures in Table 2-1.

The current population within the City's water service area was estimated using the City's geographical information system (GIS) and the 2010 Census population data for each Census block within the city limits. By overlaying the water service area boundaries with the Census block boundaries, GIS was used to calculate the population within the service area, as well as the population within the individual pressure zones. Where the service area lines cut through a Census block the amount of population assigned to each area or zone was interpolated based on the relative areas of the resulting Census block segments. Table 2-2 presents the resulting populations for individual pressure zones and the total water service area. The 2015 population estimates were calculated by extrapolating the 2010 Census data using the OFM's estimated annual growth rate for the City of Yakima between 2010 and 2014 (0.51 percent).

Table 2-2. Current Population for the City of Yakima Water Service Area and Zones

Service Area Pressure Zone	2010 Census Population[1]	2015 Estimate[2]
Level 1	56,245	57,694
Level 2	12,392	12,711
Level 3	2,163	2,219
Total for Water Service Area	**70,800**	**72,624**

1. Assumes equal distribution of population within each census block
2. Based on OFM estimate for annual population growth within the City of Yakima between 2010 and 2014 (0.51%).

2.1.2 Total Service Connections

Table 2-3 presents the number of service connections for each customer class in 2015. These customer classes are derived from the billing codes established in the City's utility billing system for the various classes of use. Due to recent changes in the City's billing system, only service connections for the year 2015 were available.

Table 2-3. Number of Services by Billing Code

Code	Description[1]	2015
MULTI	Multi Family Residential Inside (any residence with more than one unit, duplexes, apartment building, etc.)	1,617
RES	Residential Water Inside (Single family residences)	14,794
COMM	Commercial Water Inside includes multi unit (services for commercial, not residential or industrial)	1,936
IND	Industrial Water Inside (services where manufacturing takes place, including fruit processing)	114
INTPD	All city owned accounts inside except Irrigation	49
Outside Accounts		
W10	Multi Family Residential Outside (any residence with more than one unit, duplexes, apartment building, etc.)	5
W11	Residential Water Outside (Single family residences)	68
W12	Commercial Water Outside (services for commercial, not residential or industrial)	18
W13	Industrial Water Outside (services where manufacturing takes place, including fruit processing)	2
W31	Fire Service - Inside and Outside (All fire services except city owned)	419
W35	All city owned Fire Service accounts inside	6
W52	Commercial Irrigation Only Inside (All Irrigation Only services)	202
W55	All city owned Irrigation Only accounts	103
Total Connections		**19,333**

1. Inside = Accounts Inside Yakima City Limits, Outside = Accounts Outside Yakima City Limits

2.2 Water Production, Water Use, and Equivalent Residential Units

2.2.1 Water Production Data

Table 2-4 summarizes the monthly water supply data from the flow meters at the WTP and wells (Kiwanis Park, Airport, Kissel Park, and Gardner Park). The sum of the WTP production and the output of the well pumps represent the total water supplied for a given period.

Table 2-4. Monthly Water Supply Data (WTP Flows plus Well Production)

	Monthly Water Supply (MGD)						Averages by Month (MGD)
Month	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	
Jan	7.69	7.52	7.28	7.12	6.99	7.42	7.34
Feb	7.46	7.54	7.40	7.40	7.07	7.33	7.37
Mar	7.98	7.70	7.46	8.04	7.32	8.37	7.81
Apr	9.86	9.07	8.87	9.73	9.24	11.32	9.68
May	11.25	9.92	11.66	11.80	12.45	11.98	11.51
Jun	12.07	12.83	12.27	12.72	14.22	15.30	13.24
Jul	15.17	14.47	14.28	15.79	15.59	16.39	15.28
Aug	15.64	14.67	15.01	15.18	14.80	15.46	15.13
Sep	12.09	13.10	13.19	12.69	12.69	12.87	12.77
Oct	9.53	8.79	9.43	8.98	9.70	9.78	9.37
Nov	7.52	7.45	7.47	7.00	7.55	7.06	7.34
Dec	7.52	7.25	7.64	6.98	7.68	7.23	7.38
Annual Averages	**10.32**	**10.03**	**10.16**	**10.29**	**10.44**	**10.88**	**10.35**

2.2.2 Water Use Data

Table 2-5 summarizes water consumption by customer class. This data was generated using the City's utility billing records. Figure 1-1 shows total annual metered water use for the four major user classifications. Figure 2-2 shows the average monthly water use from 2011 to 2015 for the four major user classifications. This figure illustrates seasonal water use patterns and shows that water use is generally highest from July to October.

By comparing the water consumption data in Table 2-5 to the water supply data in Table 2-4 it is possible to estimate the amount of water which is either non-revenue producing (fire, flushing mains, etc.) or unaccounted for water (leaks, under reporting meters, etc.) Table 2-6 summarizes the authorized non-revenue and unaccounted for water use ((i.e. distribution system leakage (DSL)).

Table 2-5. Summary of Metered Water Use (in MG) by Billing Code

Code	Description [1]	2011	2012	2013	2014	2015
Multi-Family	Multi-Family Residential Inside (any residence with more than one unit, duplexes, apartment building, etc.)	494	564	553	539	535
	Multi-Family Residential % of total	*16%*	*16%*	*17%*	*17%*	*17%*
Single Family	Residential Water Inside (Single family residences)	1,177	1,132	1,054	1,082	1,064
	Single-Family Residential % of total	*38%*	*33%*	*32%*	*34%*	*34%*
Commercial	Commercial Water Inside includes multi unit (services for commercial, not residential or industrial)	794	880	955	735	817
	Commercial % of total	*26%*	*26%*	*29%*	*23%*	*26%*
Industrial	Industrial Water Inside (services where manufacturing takes place, including fruit processing)	156	467	298	273	265
	Industrial % of total	*5%*	*14%*	*9%*	*9%*	*8%*
Interdepartmental	All city owned accounts inside except Irrigation	35	41	39	47	41
	Interdepartmental % of total	*1%*	*1%*	*1%*	*1%*	*1%*
Other Outside Customer Use	W10 Multi Family Residential Outside (any residence with more than one unit, duplexes, apartment building, etc.)	0.7	0.5	0.4	0.4	0.5
	W11 Residential Water Outside (Single family residences)	7.5	5.6	5.2	4.7	4.5
	W12 Commercial Water Outside (services for commercial, not residential or industrial)	3.8	3.5	2.8	3.1	3.3
	W13 Industrial Water Outside (services where manufacturing takes place, including fruit processing)	1.6	2.4	0.5	0.7	0.5
	Other Customer % of total	*0.4%*	*0.3%*	*0.3%*	*0.3%*	*0.3%*
Irrigation Only Accounts	W52 Commercial Irrigation Only Inside (All Irrigation Only services)	242	250	240	286	308
	W55 All city owned Irrigation Only accounts inside tax	172	86	104	196	132
	Irrigation Only % of total	*13%*	*10%*	*11%*	*15%*	*14%*
		3,083	**3,432**	**3,253**	**3,167**	**3,173**

1. Inside = Accounts Inside Yakima City Limits, Outside = Accounts Outside Yakima City Limits

Figure 2-1. Metered Use for the Four Major Customer Classes (Inside and Outside Yakima City Limits)

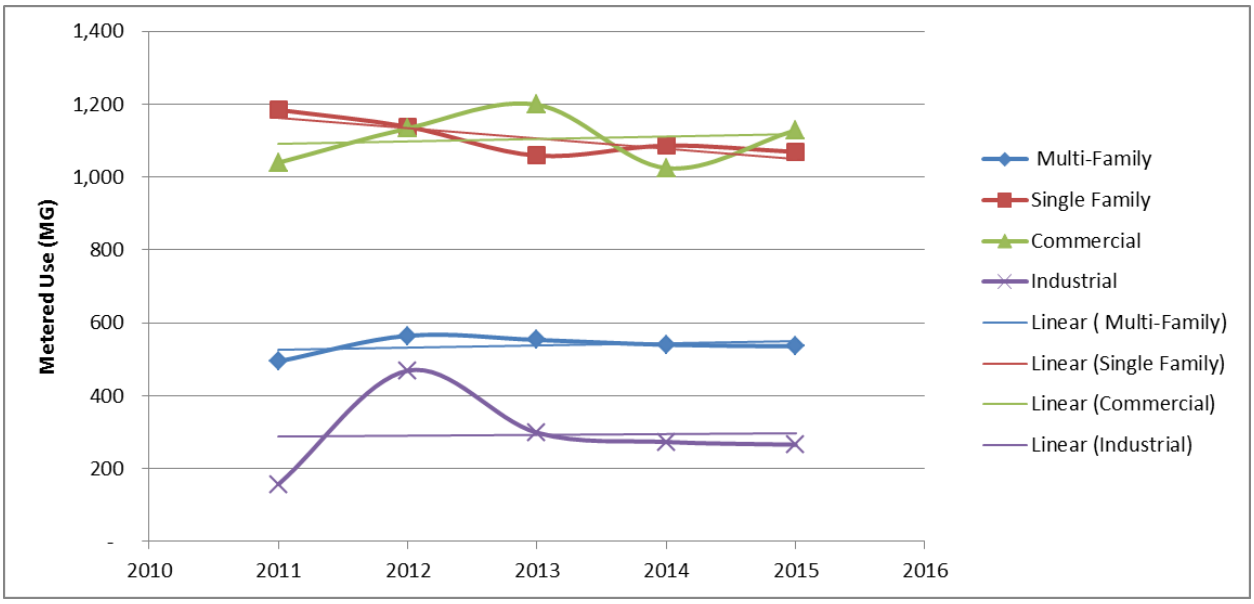


Figure 2-2. Average Monthly 2011-2015 Metered Use for the Four Major Customer Classes (Inside and Outside Yakima City Limits)

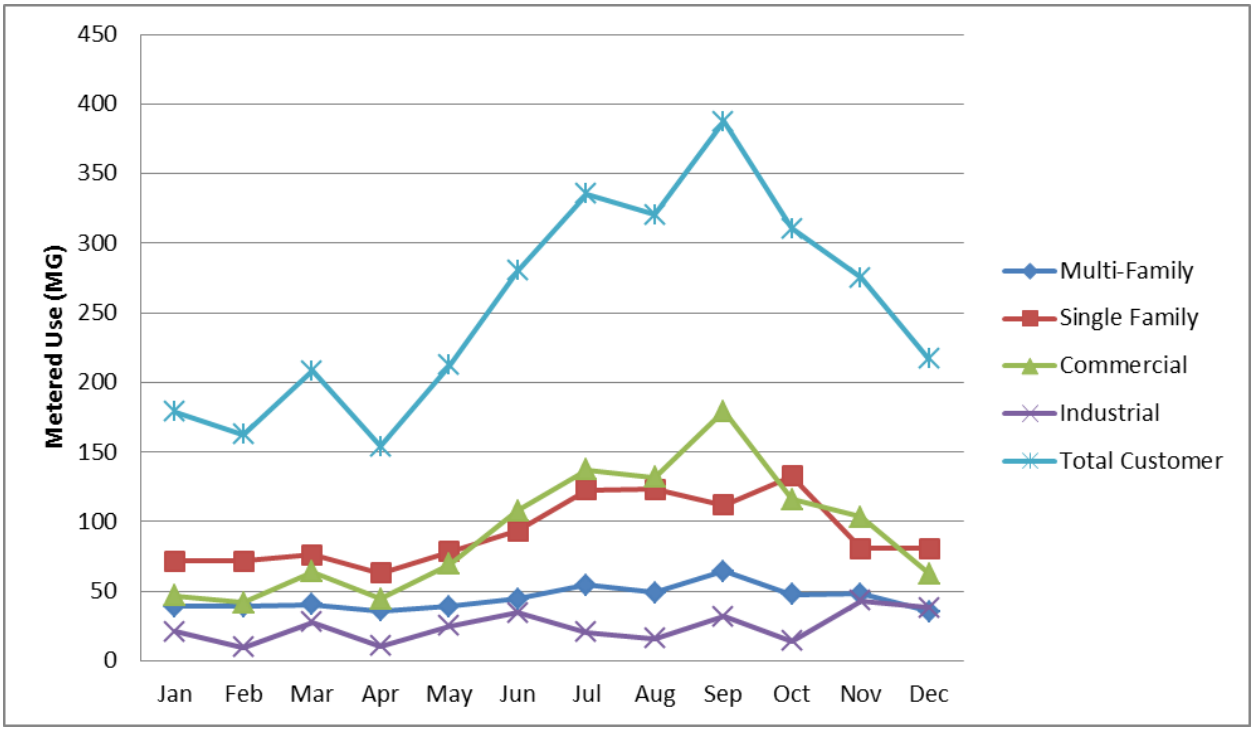


Table 2-6. Other Authorized Use and Estimated Distribution System Leakage (Gallons)

Type of Use	2011	2012	2013	2014	2015
Wastewater	890,750	1,787,200	1,809,100	1,595,621	1,075,200
Streets	183,597	190,028	127,906	105,392	94,846
Yakima Fire	363,550	1,526,300	446,690	780,750	1,137,700
Gleed Fire	13,950	12,500	25,500	43,000	20,500
Flushing	465,218	371,067	150,279	54,214	79,885
Water Sent to Nob Hill Water	0	1,807,624	1,680,000	0	3,101,000
Use at WTP	142,004,026	164,442,807	116,447,156	129,453,850	172,172,400
Aquifer Storage and Recovery (ASR) Water	0	0	0	0	40,742,000
Other System Uses	624,438	388,736	425,612	376,992	389,708
Subtotal of Other Estimated Water Uses	**144,545,529**	**170,526,262**	**121,112,243**	**132,409,819**	**218,813,239**
Total metered water use from Table 2-5	3,082,520,842	3,432,230,638	3,252,873,963	3,167,388,831	3,172,648,384
Hydrant Meters	4,065,724	6,004,196	7,243,632	6,125,416	7,304,968
Subtotal Water Sold	**3,086,586,566**	**3,438,234,834**	**3,260,117,595**	**3,173,514,247**	**3,179,953,352**
Total Authorized Consumption	**3,231,132,095**	**3,608,761,096**	**3,381,229,838**	**3,305,924,066**	**3,398,766,591**
Total Water Produced (WTP flows plus wells)	**3,664,571,600**	**3,724,475,000**	**3,762,292,000**	**3,819,049,500**	**3,977,360,000**
Distribution System Leakage	433,439,505	115,713,904	381,062,162	513,125,434	578,593,409
Unaccounted for Water (DSL) as % of Water Produced[1]	**11.8%**	**3.1%**	**10.1%**	**13.4%**	**14.5%**

1. The DSL estimates shown in this table vary somewhat from the DSL estimates documented in the City's Water Use Efficiency Reports. This discrepancy is likely due to "Other Estimated Water Uses" being underestimated in the Water Use Efficiency Reports.

In order to estimate the total usage by each customer class it is necessary to add an appropriate percentage of the unaccounted for water into the metered usage for that customer class. A proportionate fraction of the estimated unaccounted for water amounts for each year (as shown in Table 2-6) were added to the usage by each customer class to result in the adjusted use by customer class estimates presented in Table 2-7. For example, the adjusted single family residential use for 2011 includes 16 percent of the unaccounted for water estimate corresponding to that year since the single family use in that year was 16 percent of the total metered use.

Table 2-7. Water Use (in MG) by Customer Class Adjusted for DSL

Code	Description[1]	2011	2012	2013	2014	2015
Multi-Family	Multi Family Residential Inside (any residence with more than one unit, duplexes, apartment building, etc.)	563	583	618	627	633
	Multi-Family Residential % of total	*16%*	*16%*	*17%*	*17%*	*16%*
Single Family	Residential Water Inside (Single family residences)	1,342	1,171	1,177	1,257	1,259
	Single-Family Residential % of total	*37%*	*33%*	*32%*	*33%*	*33%*
Commercial	Commercial Water Inside includes multi unit (services for commercial, not residential or industrial)	906	910	1,067	855	966
	Commercial % of total	*25%*	*26%*	*29%*	*23%*	*25%*
Industrial	Industrial Water Inside (services where manufacturing takes place, including fruit processing)	178	482	333	317	314
	Industrial % of total	*5%*	*14%*	*9%*	*8%*	*8%*
Interdepartmental	All city owned accounts inside except Irrigation	40	42	44	55	49
	Interdepartmental% of total	*1%*	*1%*	*1%*	*1%*	*1%*
Other Outside Customer	W10 Multi Family Residential Outside (any residence with more than one unit, duplexes, apartment building, etc.)	3	1	1	2	2
	W11 Residential Water Outside (Single family residences)	9	6	6	6	6
	W12 Commercial Water Outside (services for commercial, not residential or industrial)	6	4	4	5	5
	W13 Industrial Water Outside (services where manufacturing takes place, including fruit processing)	3	3	2	2	2
	Other Customer % of total	*0.6%*	*0.4%*	*0.4%*	*0.4%*	*0.4%*
Irrigation Only Accounts	W52 Commercial Irrigation Only Inside (All Irrigation Only services)	300	261	281	364	389
	W55 All city owned Irrigation Only accounts inside tax	230	98	145	274	213
	Irrigation Only % of total	*15%*	*10%*	*12%*	*17%*	*16%*
Total Use (MG)		**3,580**	**3,560**	**3,677**	**3,763**	**3,837**

1. Inside = Accounts Inside Yakima City Limits, Outside = Accounts Outside Yakima City Limits.

Water Use by Pressure Zone

The current utility billing system is not capable of correlating the water usage to the location of use. It only differentiates the water use by customer class. The City has recently installed new automated meter reading system software that will allow the City to incorporate water use location into the City's billing system in the future.

To further analyze the water use patterns, the distribution of land for each zoning code classification was determined for each pressure zone using GIS to overlay the zoning code areas and pressure zones. Where the zoning areas cut through pressure zones, the amount of land area assigned to each pressure zone and/or zoning code was interpolated based on the relative areas of the resulting segments. Table 2-8 summarizes the land areas for each customer class and pressure zone.

The land use zoning code classifications in Table 2-8 are grouped to correspond to the billing code classifications: Single Family Residential, Multi Family Residential, Commercial, and Industrial. Table 2-9 summarizes the distribution of land area among pressure zones.

Table 2-8. Land Area by Customer Class and Pressure Zone

User Class	Land Use Code	Level 1 Pressure Zone		Level 2 Pressure Zone		Level 3 Pressure Zone		Totals[2]
		Acres	% Total Area[1]	Acres	% Total Area[1]	Acres	% Total Area[1]	Acres
Single Family	R-1	1,316	45%	1,152	40%	436	15%	2,905
	SR	890	96%	3	0%	37	4%	931
	Subtotal	**2,206**	**58%**	**1,155**	**30%**	**474**	**12%**	**3,835**
Multi Family	R-2	1,627	90%	167	9%	23	1%	1,818
	R-3	616	78%	160	20%	16	2%	791
	Subtotal	**2,243**	**86%**	**327**	**13%**	**39**	**1%**	**2,608**
Commercial	B-1	193	72%	69	26%	7	3%	268
	B-2	99	79%	27	21%	-	0%	126
	CBD	292	100%	-	0%	-	0%	292
	GC	1,182	100%	-	0%	-	0%	1,182
	HB	3	100%	-	0%	-	0%	3
	LCC	58	78%	-	0%	17	22%	75
	SCC	101	51%	-	46%	6	3%	198
	RD	576	100%	-	0%	-	0%	576
	Subtotal	**2,503**	**92%**	**186**	**7%**	**30**	**1%**	**2,719**

Table 2-8. Land Area by Customer Class and Pressure Zone (Cont'd.)

User Class	Land Use Code	Level 1 Pressure Zone		Level 2 Pressure Zone		Level 3 Pressure Zone		Totals[2]
		Acres	% Total Area[1]	Acres	% Total Area[1]	Acres	% Total Area[1]	Acres
Industrial	M-1	1,841	100%	9	0%	-	0%	1,850
	M-2	122	100%	-	0%	-	0%	122
	AS	675	100%	-	0%	-	0%	675
	Subtotal	**2,638**	**100%**	**9**	**0%**	**-**	**0%**	**2,647**
Totals		**9,590**	**81%**	**1,678**	**14%**	**542**	**5%**	**11,810**

1. Percent of the total area of the listed zoning code classification which lies within the respective pressure zone level.
2. This analysis of land use zoning distribution does not include the area served by the City's water system that is outside the City limits since this area is not within the City's GIS zoning coverage. The total area served by the City's water system that is outside the City limits is relatively small with respect to the total water service area (i.e. only 3% of the total water service area).

Table 2-9. Distribution of Land Use Classification Areas Among Pressure Zones

Customer Class[1]	Level 1 Pressure Zone (%)	Level 2 Pressure Zone (%)	Level 3 Pressure Zone (%)	Total (%)
Single Family	58	30	12	100
Multi Family	86	13	1	100
Commercial	92	7	1	100
Industrial	100	0	0	100

1. Percent of the total area of the listed zoning code classification which lies within the respective pressure zone level.

Table 2-10 summarizes the water use for each customer class by pressure zone. The water use for the single family, multi-family, commercial, and industrial customer classifications were estimated based on the proportion of land area for each customer class within each pressure zones. For example, the single family water use in the Level 1 pressure zone was determined by multiplying the total single family water use (Table 2-7, billing codes W11 plus W21) by the percent of land area designated as single family in the Level 1 pressure zone (Table 2-9).

Land uses (residential, commercial, industrial) differ by pressure zone. For example, the Level 1 pressure zone includes a variety of municipal land uses, while the Level 3 pressures zone includes predominately single family residential. Due to the general distribution of land use types, it is assumed that 75 percent of interdepartmental water use is in the Level 1 pressure zone, 25 percent of interdepartmental water use is in the Level 2 pressure zone, and no interdepartmental water use is in the Level 3 pressure zone. Table 2-11 summarizes the percent of the total water use within each pressure zone.

Table 2-10. Total Usage by Customer Class by Pressure Zone (MG)

Customer Class	Pressure Zone[1, 2]	2011	2012	2013	2014	2015
Single Family	Level 1	778	677	681	727	728
	Level 2	407	354	356	380	381
	Level 3	167	145	146	156	156
	Subtotal	**1,352**	**1,177**	**1,183**	**1,263**	**1,265**
Multi-Family	Level 1	486	502	532	541	546
	Level 2	71	73	78	79	80
	Level 3	8	9	9	9	9
	Subtotal	**566**	**584**	**619**	**629**	**635**
Commercial	Level 1	1,115	1,082	1,244	1,126	1,252
	Level 2	83	81	93	84	93
	Level 3	13	13	15	13	15
	Subtotal	**1,211**	**1,175**	**1,352**	**1,223**	**1,360**
Industrial	Level 1	180	483	334	318	315
	Level 2	1	2	1	1	1
	Level 3	-	-	-	-	-
	Subtotal	**181**	**485**	**335**	**319**	**316**
Interdepartmental	Level 1	203	105	141	247	196
	Level 2	68	35	47	82	65
	Level 3	-	-	-	-	-
	Subtotal	**270**	**140**	**189**	**329**	**261**
Total		**3,580**	**3,560**	**3,677**	**3,763**	**3,837**

1. Total usage for each customer class includes water use inside and outside Yakima City limits and non-revenue water consumption.
2. Assumes Single-Family, Multi-Family, Commercial, and Industrial use is proportionate to the land area for each customer class within each pressure zone. For Interdepartmental use, assumes 75% will be in Level 1, 25% will be in Level 2, and no Interdepartmental occurs in Level 3.

Table 2-11. Use by Pressure Zone

Zone	Parameter [1,2]	2011	2012	2013	2014	2015	Avg.
Level 1	Total (MG)	2,762	2,849	2,933	2,958	3,036	2,908
	Avg. Day (MGD)	7.6	7.8	8.0	8.1	8.3	8.0
	% of Total Use	77%	80%	80%	79%	79%	79%
Level 2	Total (MG)	629	545	575	626	620	599
	Avg. Day (MGD)	1.7	1.5	1.6	1.7	1.7	1.6
	% of Total Use	18%	15%	16%	17%	16%	16%
Level 3	Total (MG)	189	167	170	179	180	177
	Avg. Day (MGD)	0.5	0.5	0.5	0.5	0.5	0.5
	% of Total Use	5.3%	4.7%	4.6%	4.7%	4.7%	4.8%
Total	Total (MG)	3,580	3,560	3,677	3,763	3,837	3,683
	Avg. Day (MGD)	9.8	9.8	10.1	10.3	10.5	10.1

1. Total usage for each customer class includes water use inside and outside Yakima City limits and non-revenue water consumption.
2. Assumes Single-Family, Multi-Family, Commercial, and Industrial use is proportionate to the land area for each customer class within each pressure zone. For Interdepartmental use, assumes 75% will be in Level 1, 25% will be in Level 2, and no Interdepartmental occurs in Level 3.

It is important to consider the distribution of demand within a water system. In some cases, a few large customers can account for a significant portion of water use, such that a change in demand for those large customers can greatly impact the total demand on the water system. If this is the case, then it can be beneficial to perform additional demand analysis specific to those large customers.

Examination of the top 10 water customers in 2015 reveals that these customers only account for approximately 10 percent of total water consumption. The largest customer, Jewell Apple LTD., accounts for less than 1.5 percent of total water consumption. Overall, water demand for the largest customers is relatively small compared to total consumption. Therefore, it was determined that additional analysis specific to these large customers was not necessary.

2.2.3 Equivalent Residential Units

The demand of each customer class can be expressed in terms of equivalent residential units (ERU) for demand forecasting and planning purposes. One ERU is defined as the quantity of water used by one typical, full-time, single-family residential account. This was calculated based on the total residential volume sold (Table 2-10) divided by total residential accounts (Table 2-3).

Table 2-12 summarizes the water use per single family connection. Water system connection data was only available for 2015. As such, the ERU value was estimated based on 2015 water use and connection data.

Table 2-12. Water Use per ERU Estimate (2015)

Total Single-Family Water Use (gallons)[1]	Total Single-Family Connections	Gallons per Day (gpd) per ERU
1,264,700,000	14,862	233

1. Water use includes water use inside and outside Yakima City Limits and non-revenue water consumption.

The quantity of water used by other customer class connections can be expressed in terms of ERUs. Table 2-13 summarizes the water use expressed in ERUs for each customer class. The 2015 average day demand (ADD) was calculated based on the total usage (Table 2-10) and number of connections (i.e. accounts) (Table 2-3) for each customer class. The number of ERUs per account was then calculated by dividing the 2015 ADD by the single-family residential ERU value (233).

Table 2-13. ADD and ERUs by Customer Class

Customer Class	2015 ADD (gpad)[1,2]	Number of ERUs Per Account
Single-family Residential	233	1.0
Multifamily Residential	1072 *(164 gallons per unit per day)*[3]	4.6 *(0.7 ERUs per unit)*
Commercial	1728	7.4
Industrial	7458	32.0
Interdepartmental	1242	5.3

1. Water use includes water use inside and outside Yakima City Limits and non-revenue water consumption.
2. gpad = gallons per account per day
3. Based on 10,616 multifamily units served by 1,617 multifamily service connections.

2.3 Projected Land Use, Future Population, and Water Demand

2.3.1 Projected Land Use

Figure 2-3 shows the City's Current Zoning Map specific to the City's water service area. This map was used to estimate the distribution of customer classifications within the water service area (described in Section 2.2.2). The Current Zoning Map serves as the basis for the City's land use project permit decisions.

The City's Current Zoning Map can only be modified through the public hearing process. Changes to the Current Zoning Map will include an evaluation process with criteria

established to determine when and if rezoning of land will be necessary. The evaluation criteria includes: existing residential densities; water/sewer availability; street capacity; neighborhood characteristics; vacant land; and existing institutions (schools, hospitals, etc.).

The Future Land Use Map (Figure 2-4) shows the proposed general distribution and general location of various land uses anticipated during the next twenty year planning period. Figure 2-4 is a generalized proposal for where development is expected to occur within the water service area. Future land use designations serve as a guide for development and land use planning.

The City does not anticipate expanding water service outside the existing water service area boundaries, since adjacent purveyors already serve the areas surrounding the City's water service area (as described in Section 1.5.1). It is anticipated that residential, commercial, and industrial growth will occur within the water service area primarily through infill on vacant land and increases in population density. Within the City's water service area there are several sites that may be redeveloped with higher density uses in the next 20 years. These include the Boise Cascade Company Mill and the Yakima Speedway.

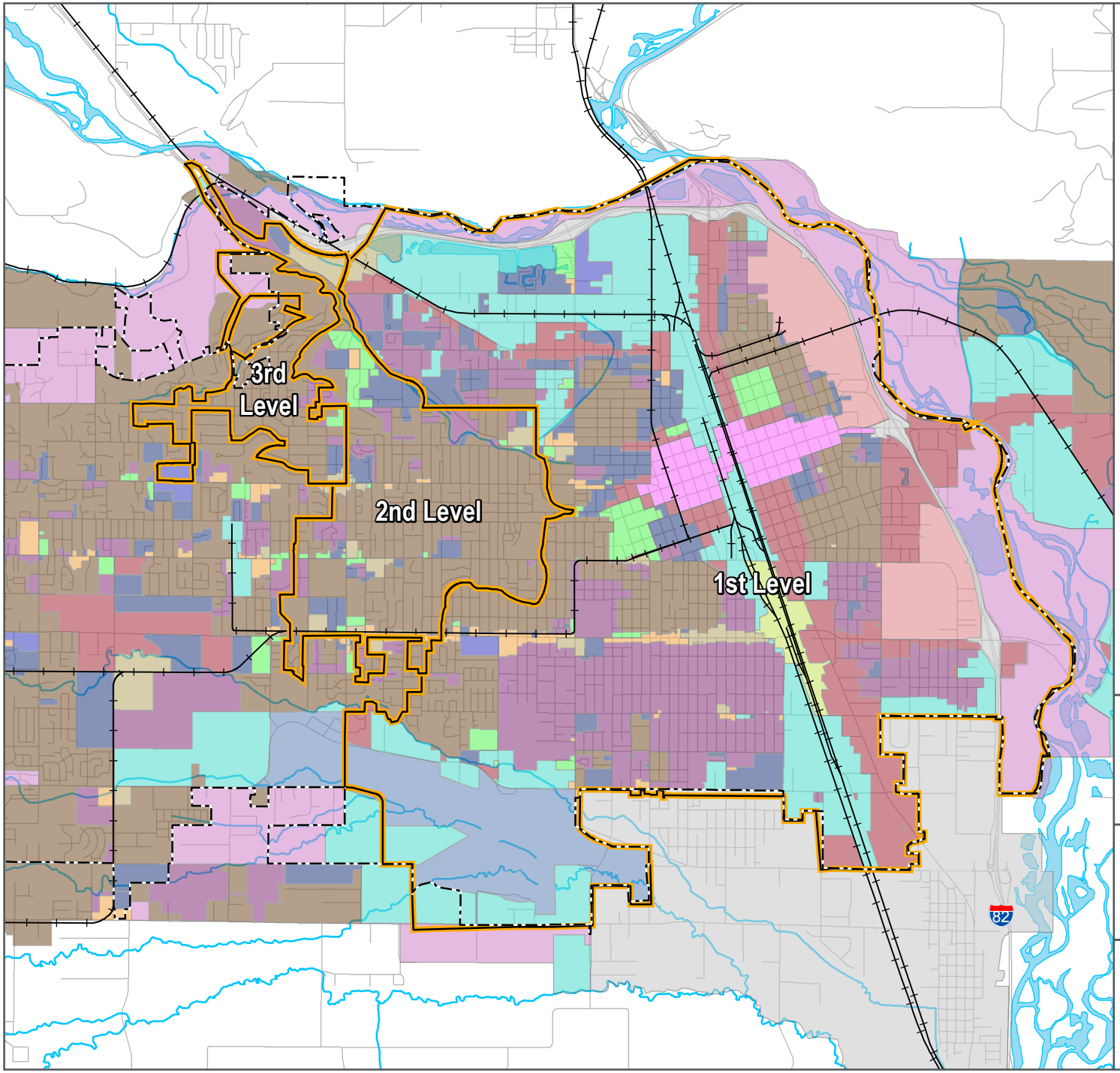
There may be more than one appropriate zoning category within any future land use designation to suit a particular proposal. If the Future Land Use Map supports a proposed development, but current zoning does not relate to the proposal, then the City may consider rezoning.

The Future Land Use Map identifies the land use preferences of the community as a result of citizen participation. Table 2-14 summarizes the inventory and composition of the future land use designations included in Figure 2-4. A community preference for low and medium density housing is evident. A variety of commercial and industrial development opportunities are also identified within the City's water service area, consistent with the past development patterns of the community and the future needs of a growing and changing community.

Table 2-14 Future Land Use Inventory (2040)

Future Land Use	Parcel (Acres)	Land Use (%)
Low Density Residential	3,668	31
Medium Density Residential	1,781	15
High Density Residential	763	6
Professional Office	404	3
Neighborhood Commercial	335	3
Regional Commercial	684	6
Large Convenience Center	39	0
Arterial Commercial	1,550	13
Central Business District	268	2
Industrial	2,128	18
Vacant/ Undeveloped	229	2
Subtotal Water Service Area	**11,849**	**100%**

Notes:
The City of Yakima Planning Division updated the Future Land Use Map in October 2016, after this section of the WSP had been prepared. Changes to the Future Land Use Map mostly involved consolidating similar land use codes. These recent changes do not have implications for the planning information presented in this WSP. Therefore, the Future Land Use codes shown in this Table have not been updated to reflect the most recent version of the City's Future Land Use Map. The City's Water Division would consult the most recent version of the Future Land Use Map if needed when planning water system modifications.



LEGEND

City Limits Boundary

Pressure Zones

Zoning

- Airport Service
- Professional Business
- Local Business
- Central Business District
- General Commercial
- Historical Business
- Large Conveneice Center
- Light Industrial
- Heavy Industrial
- Single Family
- Two Family
- Multi-Family
- Regional Development
- Small Conveneice Center
- Suburban Residential
- None

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

CURRENT ZONING

FIGURE 2-3

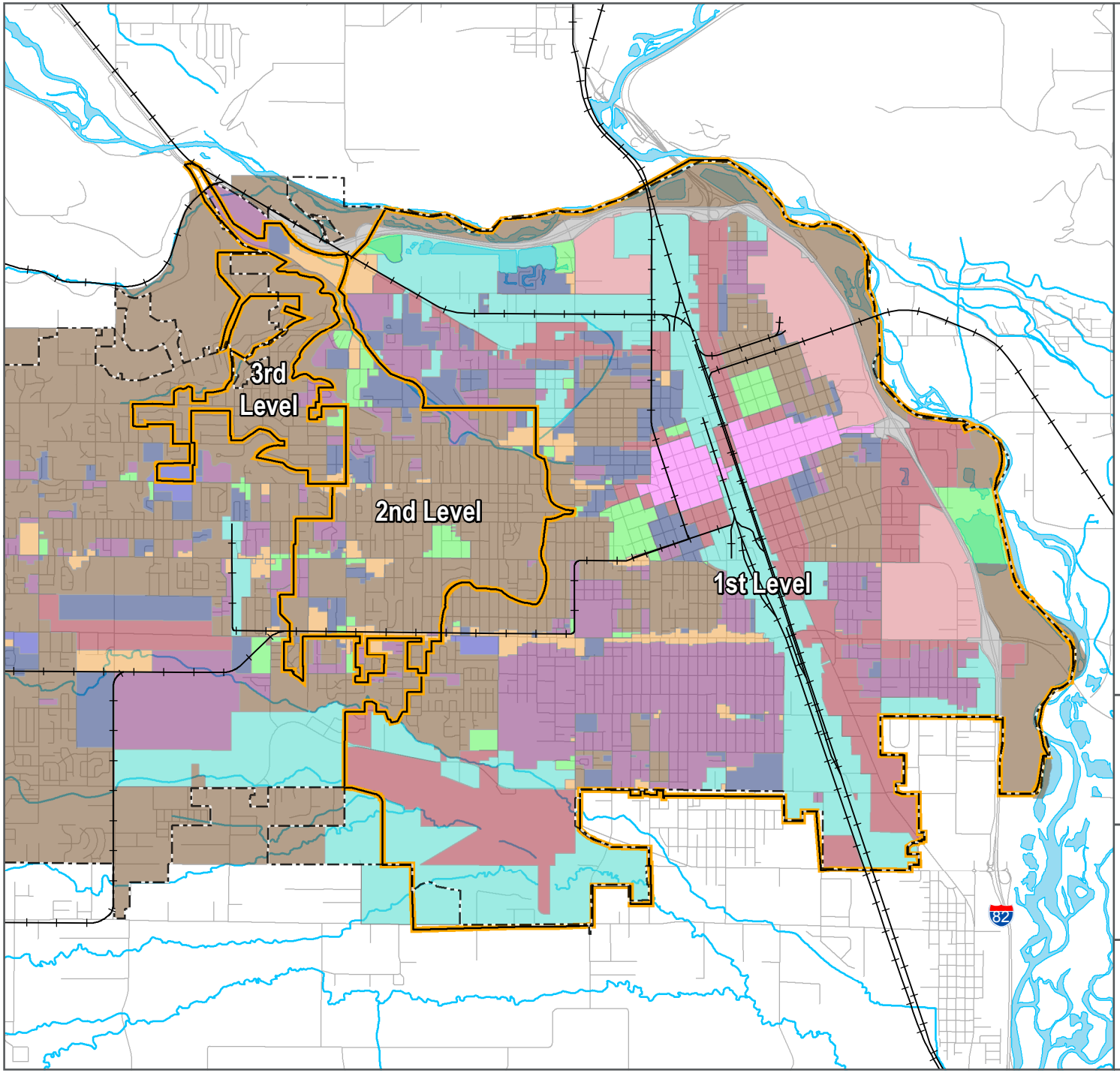
YAKIMA WATER SYSTEM PLAN

N

0 0.5 1 1.5 2

MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\LANDUSE\FIGURE2-3 ZONING.MXD - USER: DKUHNS - DATE: 5/18/2017



LEGEND

City Limits Boundary

Pressure Zones

Future Land Use

- Arterial Commercial
- Large Convenience Center
- CBD Core Commercial
- Industrial
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Neighborhood Commercial
- Professional Office
- Regional Commercial
- None

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

FUTURE LAND USE

FIGURE 2-4

YAKIMA WATER SYSTEM PLAN

N

0 0.5 1 1.5 2

MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\LANDUSE\FIGURE2-4 FUTURE LAND USE.MXD - USER: DKUHNS - DATE: 5/18/2017

Residential Land Use

The Future Land Use Map designates residential lands into three basic categories, which vary by density and permitted land uses. These include the following:

Low Density Residential - Primarily single family, detached residences. Net residential density before considering roads and right of ways is less than 7.0 dwelling units per acre, which is considered the lowest residential density to efficiently support public services.

Medium Density Residential - Characterized by a mixture of single family detached residences and duplexes, with a variety of other housing types at a residential density ranging between 7.0 and 11.0 dwelling units per acre.

High Density Residential - Apartments and densely developed planned residential developments ranging from 12 and above dwelling units per acre. A limited range of other land uses may be permitted, such as some professional offices and community services.

An adequate and affordable supply of housing for all income levels within the community is a major goal of the Yakima Urban Area Comprehensive Plan. To accomplish this goal, opportunities must be available for new development, but must also be balanced by the preservation of existing neighborhoods and the need to infill or redevelop some areas. As noted previously, infill will be a major factor with respect to growth occurring within the City's water service area.

Commercial Land Use

The Future Land Use Map includes six categories of commercial uses, which vary intensity by function and location.

Professional Office - Includes financial institutions, real estate, insurance, engineer, legal, medical offices and other similar business uses.

Neighborhood Commercial - Small scale shopping centers, with shared parking and access, usually located on arterial streets. Neighborhood commercial centers are dispersed throughout the Urban Service Area to provide convenience shopping to the residential population.

Regional Commercial - Includes a mix of retail, service and business establishments on a medium to large scale. Commercial firms span a wide range of activities such as retail stores, business and professional services, hotel/motel operations, restaurants, theaters and gas stations. These firms are generally dependent upon visibility for customer attraction, and prefer locations with heavy traffic flows.

Large Convenience Center - Provides areas for commercial activities to meet retail shopping and service needs of the community and accommodates clusters of retail, financial, professional service business and entertainment activities that attract shoppers from an area significantly larger than a neighborhood. Regional centers may be considered appropriate when they demonstrate that they will complement, and not have a detrimental impact on existing commercial areas or surrounding land uses.

Arterial Commercial - Land uses which require high auto visibility such as restaurants, service stations, car washes, as well as wholesale and retail activities.

Central Business District (CBD) Core Commercial - The City of Yakima downtown area is the regional center for commerce, cultural and governmental land uses. This area provides for a wide variety of intense retail, office, institutional, and high density residential land uses.

Industrial Development Patterns

The Future Land Use Map includes industrial uses. Most of the land designated for industrial land use lies within the City's water service area.

Industrial - Mixture of land uses which provide a range of activities, including construction businesses, manufacturing, transportation, communication, utilities, and wholesale and warehouse activities, which may include some accessory office and retail use.

Industrial development is concentrated along Interstate 82, Fruitvale Boulevard, North 6th Avenue and the Burlington Northern Railroad tracks, making for convenient transportation of products. The Boise Cascade plant and storage area, highly visible from the Interstate 82 system has been located at that site since the turn of the century. The Airport region continues to provide industrial opportunities for warehouse and light industrial activities.

Another unusual feature of the Yakima Urban Service Area is the amount of land which surrounds the railroad corridor. The railroad corridor creates a large linear pattern which bisects the entire city and limits access to adjoining land uses. Due to this fact, is difficult to maximize the development potential of much of the vacant land near the railroad corridor.

2.3.2 Projected Population

RCW 43.62.35 directs the OFM to prepare 20 year Growth Management Act (GMA) planning projections every five years. Each county's GMA projection is expressed as a range within a reasonable "High" & "Low" projection. Counties select a GMA planning population within the range released by OFM. This provides counties with reasonable discretion in determining a GMA planning target. It is the responsibility of county and city governments in each county to allocate the projected planning population to the cities and unincorporated area in their county.

As described in Sections 1.4.1 and 1.4.3 of this water system plan, Yakima County and the City of Yakima are currently updating the County and City Comprehensive Plans, respectively, which should be available by 2017. For the County and City Comprehensive Plans, Yakima County and the City of Yakima decided on a planning horizon out to the year 2040. Though this time frame extends slightly beyond the GMA mandated twenty-years, the year 2040 corresponds to the Federal decennial Census date and the time frame used by the OFM for their county-wide population projections. State law requires Yakima County to use a population projection from the range developed by OFM (low, medium or high). Based on an evaluation of OFM population estimates and recent Census results, the County determined that the medium OFM projection was the most appropriate for planning purposes. This projection was also adopted by the City of Yakima. As such, the medium projection was also applied to the demand forecast in this water system plan.

Table 2-15 presents the population projection selected by the City of Yakima for the Yakima Urban Area Comprehensive Plan update. This table also shows the projected annual growth rates for the City of Yakima.

Table 2-15. Projected Population and Annual Growth Rate from Yakima County's Preferred Alternative

	2015	2020	2025	2030	2035	2040
City of Yakima Population Projections[1]	93,825	97,493	100,993	104,288	107,433	110,387
City of Yakima Annual Growth Rate (%)[1]	0.80	0.75	0.68	0.62	0.58	0.52
City of Yakima Water Service Area Annual Growth Rate (%)[2]	0.40	0.38	0.34	0.31	0.29	0.26

1. Source: Yakima County, Public Services Department
2. The population growth rate within the City's water service area is assumed to be half of the growth rate for the full City. This is because there are limited infill and redevelopment opportunities within the City's water service area. Population growth in the City is expected to be primarily within the western portion of the City, which is served by Nob Hill Water Association.

As discussed in Section 2.1, the population of the City of Yakima water service area was estimated using GIS to overlay the water service area boundaries with the 2010 Census block boundaries and population data. The population within the entire service area, as well as the populations within the individual pressure zones, was estimated in this manner. For the purpose of this water system plan, the population data developed from the 2010 Census was extrapolated to 2015 using the OFM's annual population growth rate estimate for the City of Yakima between 2010 and 2014 (0.51 percent).

To estimate future population growth, Yakima County used OFM's twenty-year medium annual growth rate, which has a steady annual decline. Yakima County adjusted this future growth rate to estimate the growth within individual cities. The future growth rate developed for the City of Yakima provided the basis for estimating growth within the City's water service area (Table 2-15). As noted in Section 2.1.1, the City's water service area includes only a portion of the City. The water service area is expected to experience a slower growth rate than other parts of the City because there are limited opportunities for infill or redevelopment within this area. Therefore, the population growth rate within the City's water service area is assumed to be half of the growth rate expected City-wide (Table 2-15). This slower population growth rate was applied to all customer classifications (single-family, multi-family, commercial, and industrial).

Table 2-16 summarizes the population projections for each pressure zone and the total water service area in five-year increments. The total population for the water service area in 2027 (ten-year planning period) is projected to be 75,852. The total population for the water service area in 2037 (twenty-year planning period) is projected to be 78,159.

Table 2-16. City of Yakima Water Service Area Population Projections by Pressure Zone

	2015	2020	2025	2035	2040
Level 1	57,694	58,813	59,861	61,743	62,588
Level 2	12,711	12,958	13,189	13,603	13,789
Level 3	2,219	2,262	2,302	2,374	2,407
Totals	**72,624**	**74,033**	**75,352**	**77,721**	**78,784**

2.3.3 Projected Water Demands

Average Day Demand

Projecting future water demand is one of the key elements of the water system planning process. Identification of system improvements such as supply, pumping, storage and piping requirements are all related to demand projections.

For this water system plan, future water demands for single-family, multi-family, commercial, and industrial customers was projected using the same annual growth rates applied to the water service area population projection (Table 2-15). The growth rate for interdepartmental water use was assumed to be zero. Interdepartmental water use is primarily associated with irrigation of parks and public areas. Because there are limited opportunities for infill and redevelopment in the water service area, the City does not anticipate development of any new parks or irrigated lands within this area. In addition, the City would likely use the City's non-potable water irrigation system to serve any large, new outdoor water uses that may be developed.

ADD estimates for 2015 were calculated based on the total consumption (Table 2-10). Table 2-17 summarizes the ADD projections by customer class for each pressure zone and the total water service area. The total water service area ADD in 2027 and 2037 is projected to be 10.9 and 11.3 MGD, respectively.

Figure 2-5 and Figure 2-6 graphically show the forecasted ADD by pressure zone and customer class, respectively.

Table 2-18 summarizes the projected water use in terms of ERUs for each customer class. The total ERUs for the water service area in 2027 and 2037 are projected to be 46,950 and 48,285, respectively.

Table 2-17. City of Yakima Water Service Area Water Use Projections by Pressure Zone and Customer Class (MGD)

	Customer Class[1,2]	2015	2020	2025	2030	2035	2040
Level 1	Single-family	2.0	2.0	2.1	2.1	2.1	2.2
	Multifamily	1.5	1.5	1.6	1.6	1.6	1.6
	Commercial	3.4	3.5	3.6	3.6	3.7	3.7
	Industrial	0.9	0.9	0.9	0.9	0.9	0.9
	Interdepartmental[3]	0.5	0.5	0.5	0.5	0.5	0.5
	Level 1 Subtotal	*8.3*	*8.5*	*8.6*	*8.7*	*8.9*	*9.0*
Level 2	Single-family	1.0	1.1	1.1	1.1	1.1	1.1
	Multifamily	0.2	0.2	0.2	0.2	0.2	0.2
	Commercial	0.3	0.3	0.3	0.3	0.3	0.3
	Industrial	0.003	0.003	0.003	0.003	0.003	0.003
	Interdepartmental[3]	0.2	0.2	0.2	0.2	0.2	0.2
	Level 2 Subtotal	*1.70*	*1.73*	*1.76*	*1.78*	*1.81*	*1.83*
Level 3	Single-family	0.4	0.4	0.4	0.5	0.5	0.5
	Multifamily	0.03	0.03	0.03	0.03	0.03	0.03
	Commercial	0.04	0.04	0.04	0.04	0.04	0.04
	Industrial	-	-	-	-	-	-
	Interdepartmental[3]	-	-	-	-	-	-
	Level 3 Subtotal	*0.49*	*0.50*	*0.51*	*0.52*	*0.53*	*0.54*
Total		10.5	10.7	10.9	11.0	11.2	11.3

1. Assumes Single-Family, Multi-Family, Commercial, and Industrial use is proportionate to the land area for each customer class within each pressure zone. For Interdepartmental use, assumes 75% will be in Level 1, 25% will be in Level 2, and no Interdepartmental use occurs in Level 3.
2. Water use includes water use inside and outside Yakima City Limits and non-revenue water consumption.
3. Interdepartmental water use is not expected to grow in the future. This is because there are limited opportunities for infill and redevelopment in the water service area. Therefore, the City does not anticipate development of new interdepartmental water uses, such as a park, in this area.

Table 2-18. City of Yakima Water Service Area Projected ERUs

Customer Class	2015	2020	2025	2030	2035	2040
Single-family	14,862	15,150	15,420	15,670	15,905	16,123
Multifamily	7,460	7,604	7,740	7,865	7,983	8,092
Commercial	15,978	16,288	16,578	16,847	17,099	17,333
Industrial	3,711	3,782	3,850	3,912	3,971	4,025
Interdepartmental	3,073	3,073	3,073	3,073	3,073	3,073
Total	**45,083**	**45,898**	**46,661**	**47,368**	**48,032**	**48,646**

Figure 2-5. Forecasted ADD by Pressure Zone 2015 to 2040

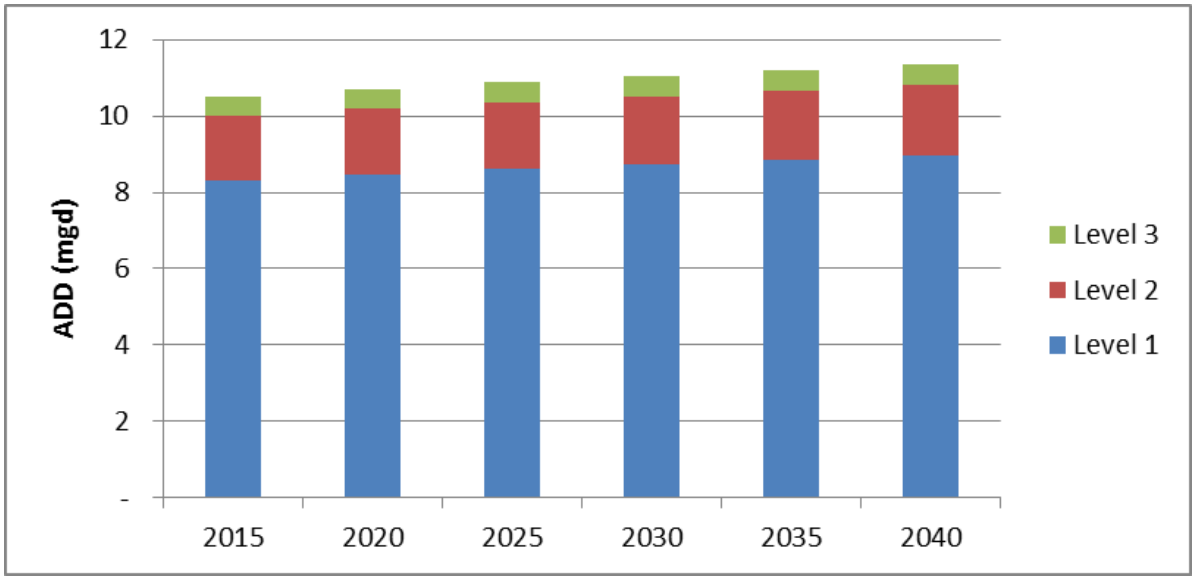


Figure 2-6. Forecasted ADD by Customer Class 2015 to 2040

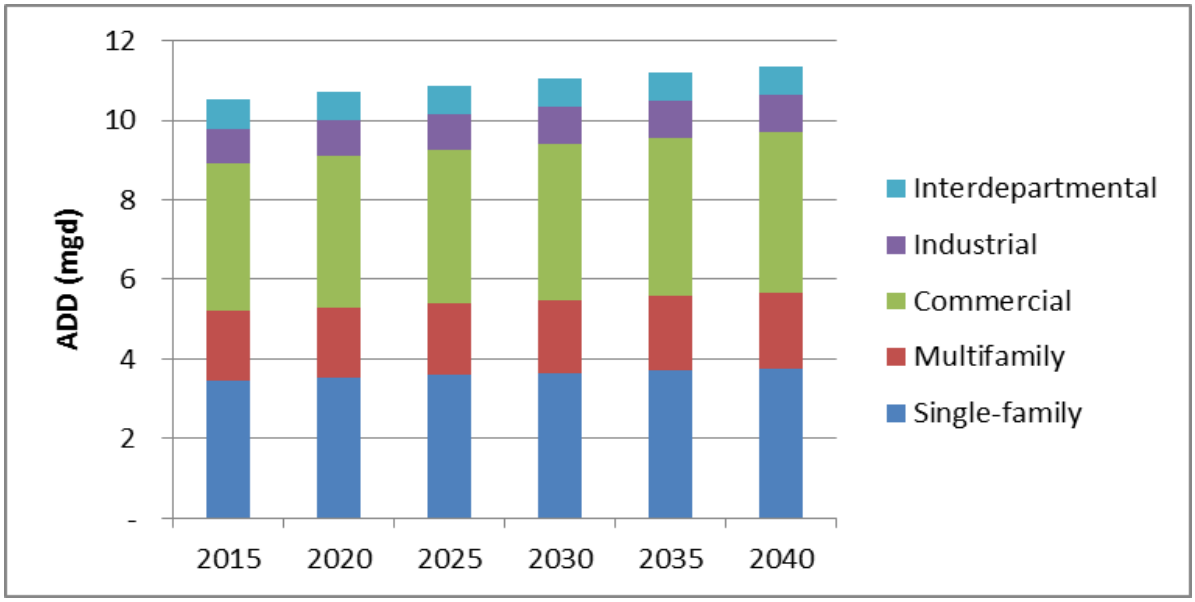
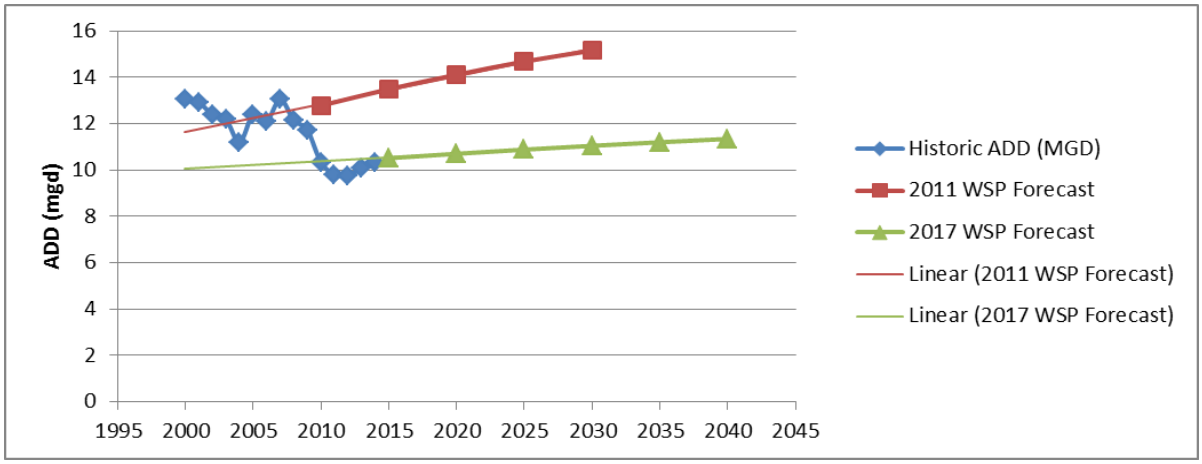


Figure 2-7 shows the historic and projected future demands. For comparison, Figure 2-7 also shows the 2011 Water System Plan projected future demands and a linear regression analysis of future demands. From this figure, it can be seen that historic water use has declined in the last 15 years. This is partially due to economic factors and the spread of water conservation technologies and practices.

Figure 2-7. Historic ADD (2000 to 2014) and Forecasted ADD (2015 to 2040)



Maximum Day Demands

Historical water use can also be described in terms of maximum day demand (MDD). Determination of the MDD is critical for the system analysis to evaluate the maximum demand on the water system, such as supply capability, pump station discharge rates, and pump sizes. MDD is determined by the maximum daily water production at the City's WTP and wells. Table 2-19 summarizes the historic MDD for each year from 2000 through 2014. Also shown in this table are the ADDs for each year and the ratio of the MDD to ADD.

Table 2-19. Historic MDD and MDD to ADD Ratios

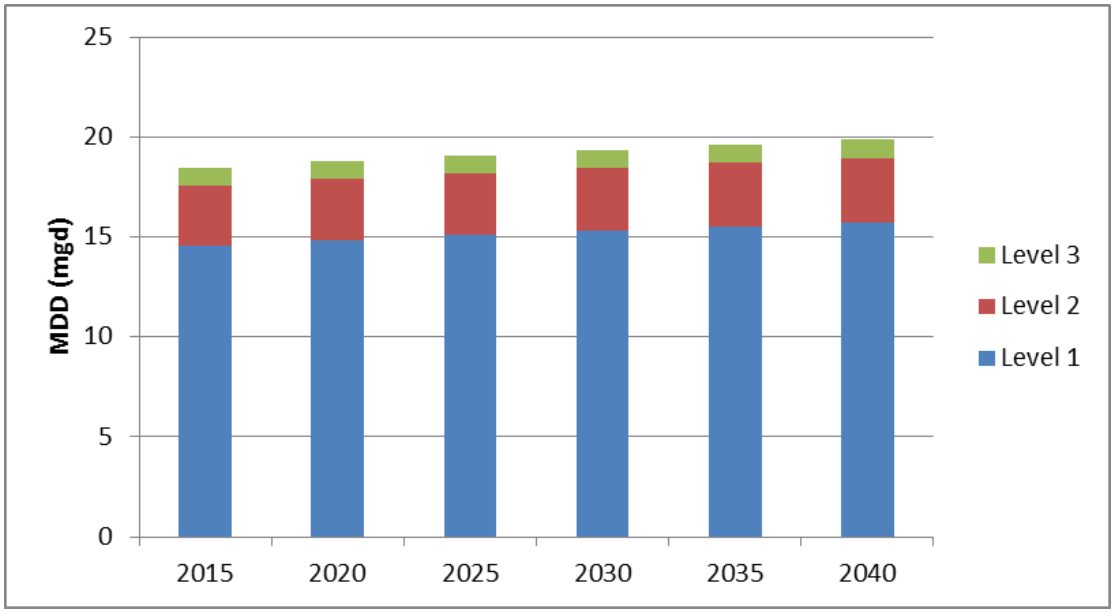
Year	MDD (MGD)	Date of MDD	ADD (MGD)	MDD/ADD ratio
2000	22.85	8/2/2000	13.06	1.75
2001	21.13	8/16/2001	12.91	1.64
2002	20.41	7/19/2002	12.40	1.65
2003	24.39	7/26/2003	12.19	2.00
2004	23.92	7/15/2004	11.19	2.14
2005	19.86	7/27/2005	12.40	1.60
2006	21.01	8/9/2006	12.10	1.74
2007	23.00	8/2/2007	13.05	1.76
2008	20.30	8/7/2008	12.15	1.67
2009	20.42	8/1/2009	11.72	1.74
2010	18.25	7/9/2010	10.34	1.77
2011	16.27	7/7/2011	9.81	1.66
2012	16.65	7/12/2012	9.75	1.71
2013	19.62	7/23/2013	10.08	1.95
2014	17.42	7/11/2014	10.31	1.69
5-Year Avg.				**1.75**
15-Year Avg.				**1.76**

The 15-year average of the MDD to ADD ratio is 1.76. The 5-year average of the MDD to ADD ratio is 1.75. For the purpose of projecting MDDs through the planning period, the 5-year MDD to ADD ratio was used (1.75). Table 2-20 summarizes the projected MDDs for each pressure zone and the water service area through the planning period. Figure 2-8 graphically shows the forecasted MDD by pressure zone. The total water service area MDD in 2027 and 2037 is projected to be 19.2 MGD and 19.7 MGD, respectively.

Table 2-20. City of Yakima Water Service Area Projected MDD by Pressure Zone (MGD)

Pressure Zone	2015	2020	2025	2030	2035	2040
Level 1	14.6	14.8	15.1	15.3	15.5	15.7
Level 2	3.0	3.0	3.1	3.1	3.2	3.2
Level 3	0.9	0.9	0.9	0.9	0.9	0.9
Total	**18.4**	**18.8**	**19.1**	**19.4**	**19.6**	**19.9**

Figure 2-8. Forecasted MDD by Pressure Zone 2015 to 2040



Peak Hour Demand

Determination of the peak hour demand (PHD) is also critical for analyzing stresses on the water system. To calculate the PHD, the Washington State Department of Health *Water System Design Manual* (DOH #331-123) recommends using the following equation:

PHD = (MDD/1440) x [(C) x (N) + F] + 18 (Equation 5-1 from DOH #331-123)

Where:
PHD = Peak Hourly Demand, (gallons per minute, gpm)
C = Coefficient Associated with Ranges of ERUs (C = 1.6)
N = Number of Service Connections, ERUs (N = 45,083 [Table 2-18])
F = Factor Associated with Ranges of ERUs (F = 225)
MDD = Maximum Day Demand, (gpd/ERU)

The DOH equation and the 2015 MDD (Table 2-20) were used to calculate PHD. Based on the DOH equation for PHD, the City has a peak hour factor of 1.6. Table 2-21 summarizes the forecasted PHDs for each pressure zone and the water service area. The total water service area PHD in 2027 and 2037 is projected to be 30.8 MGD and 31.7 MGD, respectively.

Table 2-21. Forecasted Peak Hour Demand by Pressure Zone (MGD)

	2015	2020	2025	2030	2035	2040
Level 1	23.4	23.9	24.3	24.6	25.0	25.3
Level 2	4.8	4.9	5.0	5.0	5.1	5.2
Level 3	1.4	1.4	1.5	1.5	1.5	1.5
Total	**29.7**	**30.2**	**30.7**	**31.2**	**31.6**	**32.0**

3 System Analysis

This chapter includes a description of the general condition of each system facility as well as an analysis of the physical capacity of each facility. These analyses consider each facility individually, and as a functional component group, (i.e., source, treatment, storage, and distribution). The description of the general condition of system facilities includes a summary of the physical condition of the facility as well as the facility's anticipated remaining life expectancy. The overall system analysis also includes a comparison of the existing facility capacity with the existing and projected water demands identified in Chapter 2 and in Section 3.1.5.

The objective of the system description and analysis presented in this chapter is the identification of the extent and timing of any individual facility and/or functional group deficiencies. Deficiencies identified in the first 10 years of the planning period are addressed and remedied by a specific project or action, according to a project schedule. Deficiencies identified in years 10 through 20 are, in most cases, placed in the capital improvement program without identifying a specific schedule for implementation.

3.1 Description of Water System

This section provides a description of the components of the City of Yakima water system including distribution, the Naches River Water Treatment Plant (WTP), groundwater wells, and storage reservoirs.

The water system is divided into three pressure zones, further described in Section 3.1.1. The current supply sources for the water system consist of a surface water treatment plant on the Naches River and four groundwater wells.

3.1.1 Distribution System

General Description and Condition

A map of the City of Yakima water distribution system piping is shown in Figure 3-1. A summary of the pipe diameters and the respective lengths of each diameter in the system are shown in Table 3-1. The majority of the pipe material in the system is either ductile iron or cast iron (about 50% of each). There is about 5,280 feet of asbestos cement (AC) pipe in the distribution system, representing less than 0.5% of all piping. All new water mains are constructed using ductile iron pipe in accordance with the City standards (refer to Chapter 7 of this plan for additional information regarding construction standards).

Table 3-1. Water Distribution System Pipe Diameters and Lengths

Pipe Diameter (inch)	Length (feet)	Length (miles)
2	15,400	2.9
3	300	0.1
4	6,200	1.2
6	514,400	97.4
8	556,800	105.5
10	3,800	0.7
12	308,200	58.4
16	79,100	15.0
18	6,200	1.2
20	11,900	2.3
24	15,900	3.0
30	3,300	0.6
36	200	0.04
48	45,100	8.5
54	3,500	0.7
Totals	1,575,300	298.4

Source: City of Yakima GIS (2016)
Note: Pipes smaller than 2 inches not included.

The pressure zones which make up the distribution system are also shown in Figure 3-1. The City of Yakima water system has three major pressure zones, designated as the 1st Level, 2nd Level, and 3rd Level zones, plus a separate pressure zone for Gleed, a small census-designated area between the WTP and the City which includes less than 30 service connections consisting primarily of single-family residential, a fruit warehouse, and the Naches Valley Primary School (the school will be decommissioned in 2017). A water system hydraulic profile schematic is shown in Figure 3-2. The relationship between the pressure zones is discussed below.

1st Level Pressure Zone

The gravity supply from the 48-inch diameter transmission main flows to the 1st Level Reservoir, a 6-MG reservoir located at North 40th Avenue and Englewood Avenue. This reservoir supplies water to the 1st Level zone. Flows from the WTP are manually adjusted to maintain a nominal hydraulic elevation of 1,264 feet, resulting in a static pressure range in the 1st Level zone of approximately 54 to 110 psi.

The flow adjustments at the WTP are based on a judgment call by each shift operator. During the day shift in summer months, an operator may determine early in the day that an increase in treated water flow is required due to forecasting of high temperatures. An additional adjustment may take place later in the day depending on the observed water use. During the summer months, night shift operators will tend to raise flow in the evening too (as late as midnight) in anticipation of domestic water irrigation activities that generally start between 1 am to 3 am.

In the course of day shift and night shift, during the winter months, shift operators will make effluent flow adjustments primarily due to drop in level at the 1st Level Reservoir and the amount of water being pumped to the 2nd Level.

The 1st Level pressure zone can also be served from the four groundwater wells which are used seasonally to augment the WTP supply.

During fire flow events or short-term pressure drops within the zone, the 1st Level pressure zone can be served by nine pressure reducing valve stations that allow water to flow from the 2nd Level pressure zone and by an intertie with the Nob Hill Water Association.

2nd Level Pressure Zone

The 2nd Level pressure zone is served by the 2nd Level Reservoirs, two 12-MG reservoirs located on City Reservoir Road. The Stone Church and 40th Avenue Pump Stations pump water from the 1st Level zone to the 2nd Level Reservoirs. Pump station operation is controlled based on the water surface elevation within the 2nd Level Reservoirs. The nominal hydraulic elevation is 1,380 feet, which results in a static pressure range of 43 to 105 psi.

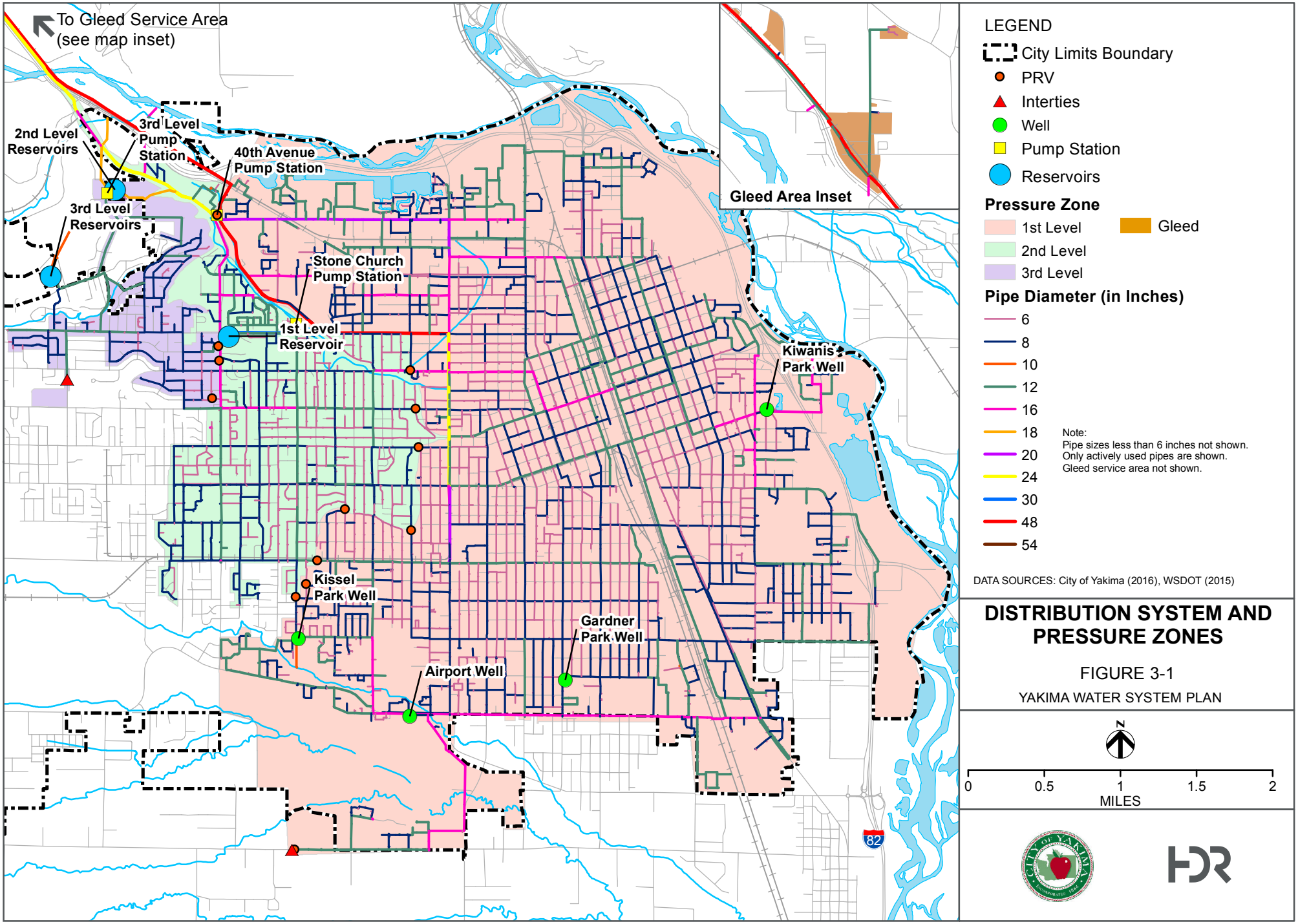
During fire flow events or short-term pressure drops within the zone, the 2nd Level pressure zone can be supplied by three pressure reducing valve stations that allow water to flow from the 3rd Level pressure zone.

From 2006 to 2009, improvements were made to the 2nd Level zone by replacing the existing steel transmission main that filled the reservoirs with ductile iron pipe. Improvements also included installation of fill lines to the two 12-MG reservoirs separate from the discharge lines; providing for improved mixing and water quality within the reservoirs; replacement of all transmission valves associated with the isolation of the reservoirs; replacement of the access ladders and overflow standpipes within the reservoirs; and installation of intrusion alarms on the reservoir access hatches.

3rd Level Pressure Zone

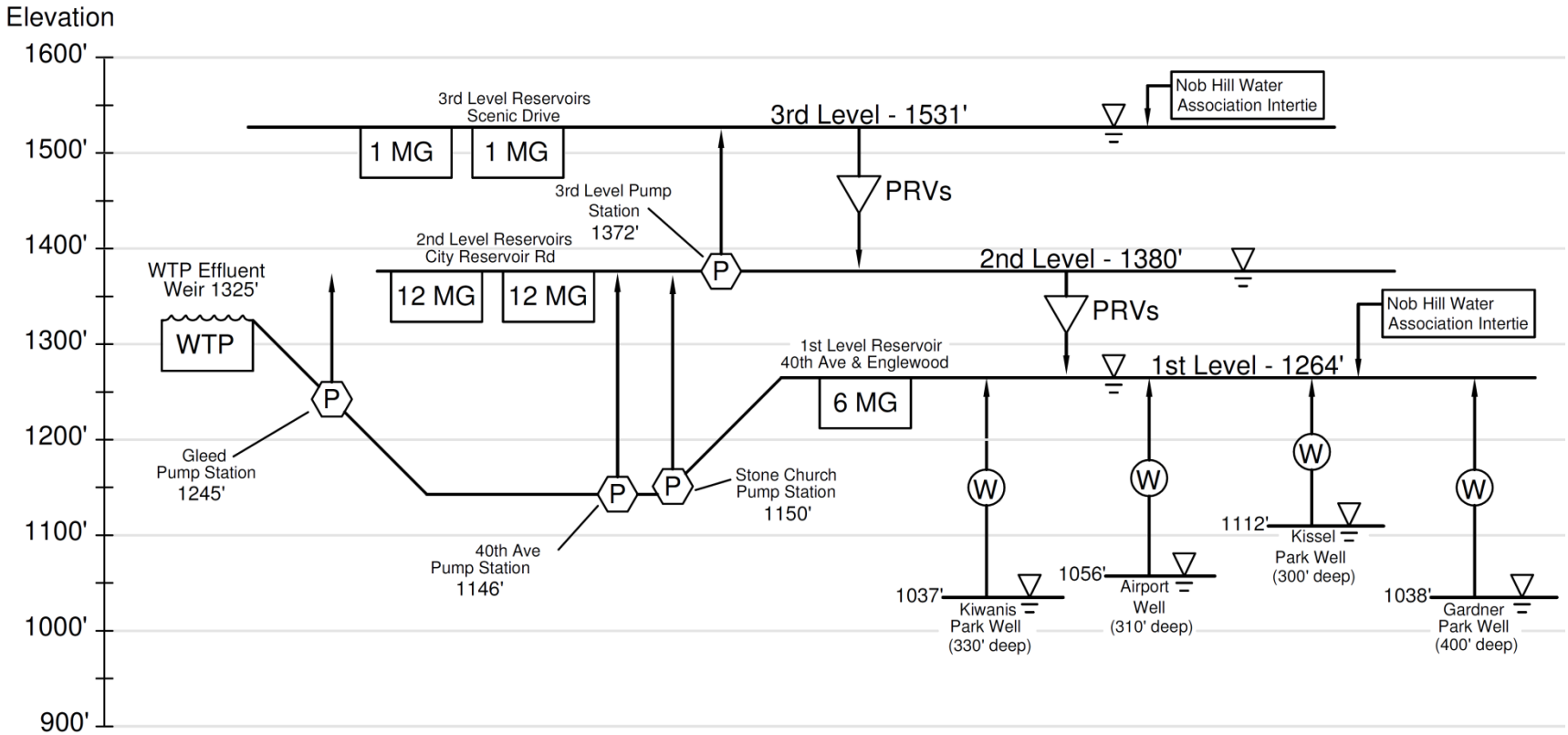
The 3rd Level pressure zone is served by the 3rd Level Reservoirs, two 1-MG reservoirs located off of Scenic Drive. The 3rd Level Pump Station located at the site of the 2nd Level Reservoirs pumps water from the 2nd Level zone to the 3rd Level Reservoirs. The pump station operation is controlled by the water surface elevation within the 3rd Level Reservoirs. The nominal hydraulic elevation is 1,531 feet, resulting in a static pressure range of 70 to 115 psi.

During emergencies, the 3rd Level zone can be supplemented by operating one pressure reducing valve station (a two-way valve station) that controls the intertie from the Nob Hill Water Association.



PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-1.MXD - USER: DKUHNS - DATE: 12/12/2016

Figure 3-2. Water System Hydraulic Profile Schematic



System Conditions and Leakage

The distribution system is generally in very good condition. In 2008/09, the City of Yakima conducted an extensive leak detection program. The program used extremely sensitive sound amplification instruments and a computer-based leak correlation program to help pinpoint the location of the leaks. Approximately 280 miles of the distribution system were included in the program. In this evaluation, 15 leaks were detected and repaired in water mains, meters, hydrants, service lines, service connections, and valves. Additional leak detection and repair programs had been previously conducted in 1996, 1997, 1999, and 2000. When the new advanced metering infrastructure (AMI) program is fully implemented, distribution system losses will be reevaluated and, if necessary, additional leak detection surveys will be conducted. Funding for these surveys has been programed into the utility rate model.

Distribution system mapping is included in the City's Geographic Information System (GIS). This system enables Water Division personnel to continually update the map to record changes. The GIS mapping also facilitates recordkeeping for tracking the age and condition of the distribution system pipe segments. In 2013, the City also implemented a Cayenta maintenance management system. This program includes information about all of the City's facilities and equipment. This system replaced an aging system that was no longer supported. Refer to Chapter 6 for more complete information regarding the Cayenta system.

3.1.2 Water Treatment Plant

Background and General Information

The WTP was constructed at Rowe Hill between 1967 and 1970, with a design capacity of 25 MGD, to replace the Oak Flats supply. The nominal capacity was maintained at 25 MGD after filter upgrades in 1991 in which a filter performance study was conducted.

Treated water from the plant flows over a weir into a 48-inch transmission main and to the City by gravity. The condition and performance characteristics of the WTP plant along with recommended capital improvements are described in detail in Section 3.4. The existing WTP is rated at 21.6 MGD (14,976 gpm) in normal water supply years with the potential to possibly increase capacity pending a filter flow study. However, during 2001 due to drought conditions, the USBR reduced water available from USBR contract water to 29 percent. This was one of the most severe reductions in water availability since the Naches WTP was placed into service and is therefore assumed to be a worst case scenario for the purpose of this source capacity analysis. Additional reductions were seen in 2005 (42%) and 2015 (44%).

Since original construction, the City has made process renovations to the plant from 1991 through 2014 as described below.

In 1991, the four filters were rehabilitated. Components of that project were as follows:

- Drilled out plugged orifices in the Leopold block underdrains.
- Replaced gravel support layers.
- Replace original filter media with new multi-media design.

As part of the filter rehabilitation project, the State of Washington maintained the rated capacity of the WTP at 25 MGD based on results of a concurrent pilot filter demonstration study.

In 1993, a new supervisory control and data acquisition (SCADA) system was installed, and it included the following items:

- Continuous individual filter monitoring.
- Greater capacity to gather water quality data.
- Change in flow control to reduce influent flow rate during a filter backwash cycle to prevent a sudden flow increase to the remaining filters in service.

In 1997, the City completed installation of a bulk soda ash storage and feed system. This was in response to exceeding the copper action level of 1.3 mg/L in 1993. To achieve compliance with Lead and Copper Rule guidelines, the soda ash feed system is used to increase filtered water pH to 7.4.

A 1998 report by Carollo Engineers titled *Evaluation of the Naches River Water Treatment Plant* (Carollo Engineers, August 1998) provided an assessment of the existing treatment plant components. This report identified deficiencies and recommended improvements to the WTP as needed to meet current and anticipated performance requirements. Many of the recommendations in this report were implemented in projects that were implemented in 2003, 2004, and 2005.

A new fluoridation facility was constructed in 2001 and placed into service during the spring of 2002. The facility included a new building containing hydrofluosilicic acid storage tanks and chemical feed equipment. The fluoridation equipment also included fluoride monitoring instrumentation and a containment tank to prevent the release of hydrofluosilicic acid in the event of an accidental spill.

In 2003, a major upgrade to the raw water intake facility was completed. The improvements included the installation of a flat panel screen with continuous backwash and a continuous air curtain to mitigate the build-up of ice in winter months.

In 2004, the then existing rapid mix coagulation system was replaced with a new pump diffusion mix system. The new flash mix/coagulation system, together with related piping modifications, enabled the WTP to achieve compliance with the Filter Backwash Recycling Rule which went into effect on June 8, 2004.

In 2004, the existing gas chlorination system was replaced with an on-site sodium hypochlorite generator system. Chlorine is used for both primary disinfection (CT compliance) and as a secondary disinfectant (distribution system residual). Chlorine is added upstream of the contact basins (prechlorination) and downstream of the filters (post chlorination). The primary deficiency with the gas chlorination system was related to safety due to the lack of a chlorine scrubber system. The hypochlorite system had been recommended in the 1998 and 2004 planning documents as the preferred alternative to adding a scrubber and the other safety equipment which would be required if a gas chlorination system were to be maintained.

The on-site sodium hypochlorite generator system was installed in a new Chemical Handling Building. The chemical storage and handling facilities for aluminum chlorohydrate, alum, and filter aid polymer, were also relocated to the new building in the 2004 project. The new building included spill containment for all of the bulk chemical storage facilities, and corrected the other chemical handling facilities deficiencies which had been identified in the above-referenced planning documents.

In 2005, a major upgrade to the filters was completed to address the deficiencies which were identified in the 1998 Carollo report and in the 2004 Water System Plan Update. The filter upgrade included: replacing the clay block underdrains with an IMS type underdrain and the elimination of the gravel support system; replacing the multimedia filter media configuration with a dual media design; and modifications to the surface wash system. As part of this upgrade, the maximum filtration rate decreased from the

previously used 7 gpm/ft^2 to 6 gpm/ft^2, consistent with the filtration operation criteria of WAC 246-290-654. The reduced maximum filtration rate reduced the WTP capacity back to 21.6 MGD. If the WTP capacity needs to increase, a flow study could be performed to determine the media's capability of providing consistent 2-log removal of *Giardia lamblia cysts* and *Cryptosporidium oocysts*.

The 2005 filter system upgrade also included the recommended upgrades to the filter-to-waste facilities, thereby correcting the deficiencies which had also been identified in the 1998 report and the 2004 WSP Update.

In 2014, improvements were made for residual solids handling by constructing four new common wall concrete settling basins of 500,000 gallons each for a total settling basin volume of 2 MG. The new settling basins provide adequate settling time for particles in the filter backwash stream. A new pump station was also added to recycle the settled backwash and filter-to-waste water back to the WTP influent. The improvements also included a new auxiliary power generator, new electrical service, and upgrades to the SCADA system.

The design criteria for existing WTP unit processes are shown in Table 3-2. A process flow schematic of the existing WTP is shown in Figure 3-3. A site plan is shown in Figure 3-4.

Table 3-2 Existing Design Criteria Naches River WTP

Description	Units	Criteria
Plant Capacity		
Plant Capacity - Nominal	MGD (gpm)	21.6 (14,976)
Raw Water Supply		
Source: Diversion Structure on the Naches River		
Screens: Mechanical		
Raw Water Pipeline		
Diameter	in	54
Length (approximate)	ft	4,000
Velocity @ 25 MGD	ft/sec	2.1
Contact Time @ 25 MGD	min	32
Flash Mix		
Type: Pump diffusion		
Number of units	--	1
Mixing Energy (G-Value)	seconds^{-1}	750
Pump Capacity	gpm	869
Pump Power	HP	5

Table 3-2 Existing Design Criteria Naches River WTP (Cont'd.)

Description	Units	Criteria
Contact Basins		
Type: Rectangular, inlet orifices, outlet ports, inlet and outlet submerged gates		
Number of Basins	--	2
Dimensions per Basin	ft x ft	36 x 131
Water Depth (varies due to sloped bottom)	ft	15.0
Volume per Basin	ft^3 (gal)	71,000 (530,000)
Total Volume	ft^3 (gal)	142,000 (1,060,000)
Detention Time @ 21.6 MGD	min	71
Surface Loading Rate @ 25 MGD	gpm/ft^2	1.6
Filters		
Type: Gravity, dual-media, rate of flow control, gravity backwash, Leopold Plastic Tri-Lateral Block Underdrains		
Number of Filters	--	4
Dimensions per Filter	ft x ft	26 x 24
Surface Area Per Filter (Total Surface Area)	ft^2	624 (2,496)
Filter Box Depth	ft	13.5
Filtration Rate @ 21.6 MGD	gpm/ft^2	6.0
Depth of Water Above Media	ft	5.3
Headloss Available for Solids	ft	9.9
Filter Media		
Anthracite Coal		
Depth	in	30
Effective Size	mm	1.0 - 1.1
Uniformity Coefficient	--	1.4
Specific Gravity	--	1.6 – 1.7
Sand		
Depth	in	12
Effective Size	mm	0.55 - 0.65
Uniformity Coefficient	--	1.4

Table 3-2 Existing Design Criteria Naches River WTP (Cont'd.)

Description	Units	Criteria
Specific Gravity	--	2.6
Total Length to Depth Media Ratio	--	1,230
Distance from Media to Top of Backwash Trough	in	51
Distance from Media to Bottom of Backwash Trough	in	26
Distance from Media to Surface Wash	in	2 to 4
Filter Backwash		
Type: Gravity, elevated storage tank		
Backwash Rate (and Duration)	gpm/ft^2 (min)	17 (5.0)
Backwash Storage Tank		
Type: steel, cylindrical, above grade	--	--
Diameter	ft	40
Height	ft	80
Volume	ft^3 (gal)	100,000 (750,000)
Number of Supply Pumps	--	2
Pump Capacity	gpm (HP)	1,725 (40)
Surface Wash		
Type: Rotating arms		
Wash Rate	gpm/ft^2	0.8
Duration	min	3
Number of pumps	--	1
Pump Capacity	gpm (HP)	520 (50)
Filter Waste Wash Water and Solids Handling Settling Basins		
Type: 4 concrete lagoons, partitioned, with ramp		
Dimensions (approx.) each lagoon	ft x ft	86 x 86
Depth (approx.)	ft	9
Volume (approx.) each lagoon	ft^3 (gal)	67,000 (500,000)
Recycle Pipeline		
Diameter	in	16, 12

Table 3-2 Existing Design Criteria Naches River WTP (Cont'd.)

Description	Units	Criteria
Length	ft	516, 200
Recycle Pump Capacity	gpm (HP)	1,600 (10)
Filtered Water Clearwell		
Type: Buried concrete, rectangular, 2 compartments)		
Dimensions (of both West and East compartments)	ft x ft	13 x 19.3
Water Depth @ 25 MGD Minimum (Maximum)	ft	8.9 (9.8)
Volume @ Minimum Water Depth	ft^3 (gal)	2,200 (17,000)

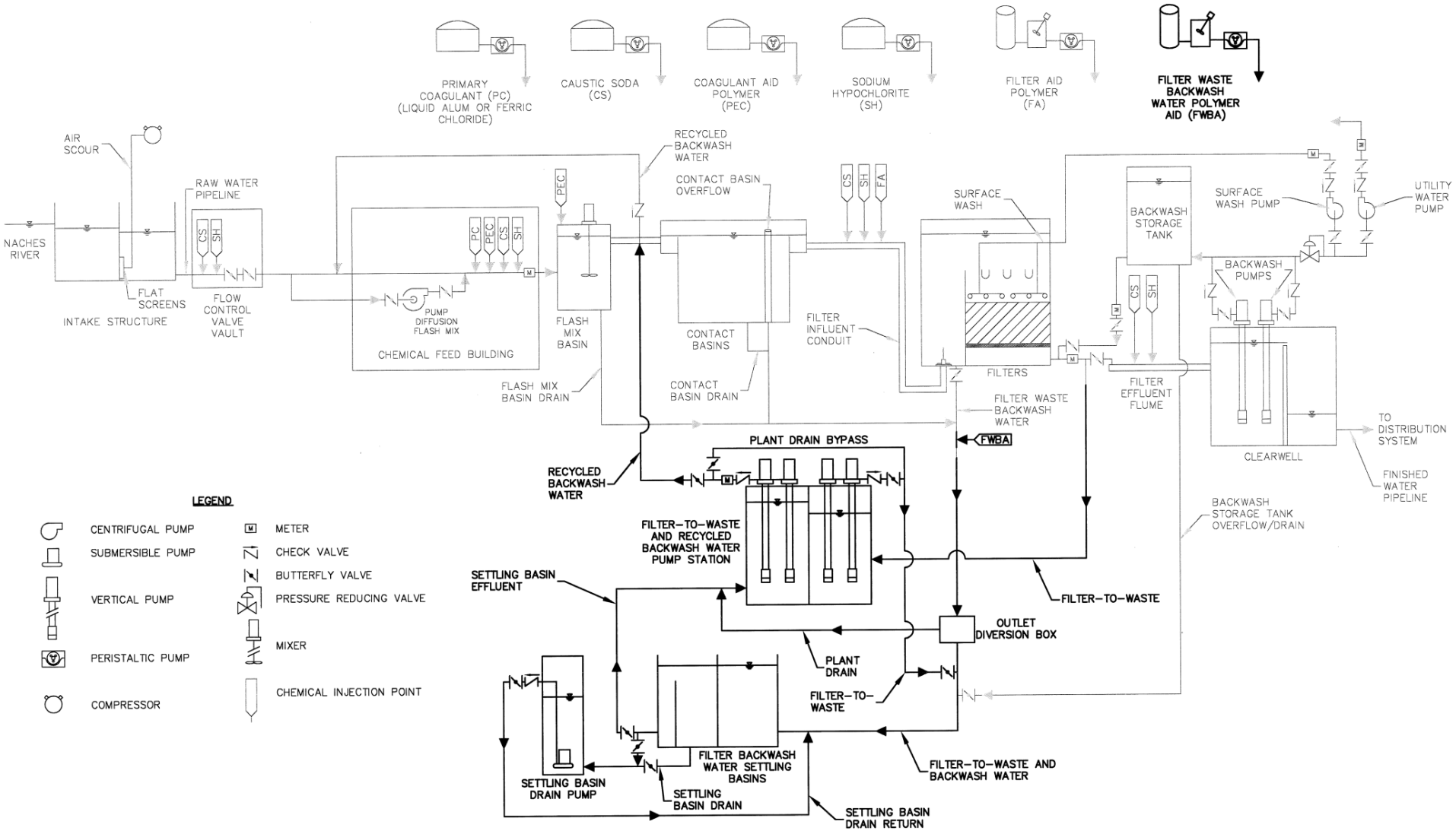


Figure 3-3 Water Treatment Plant Process Schematic

Note:
Items in black are part of 2014 upgrade project.

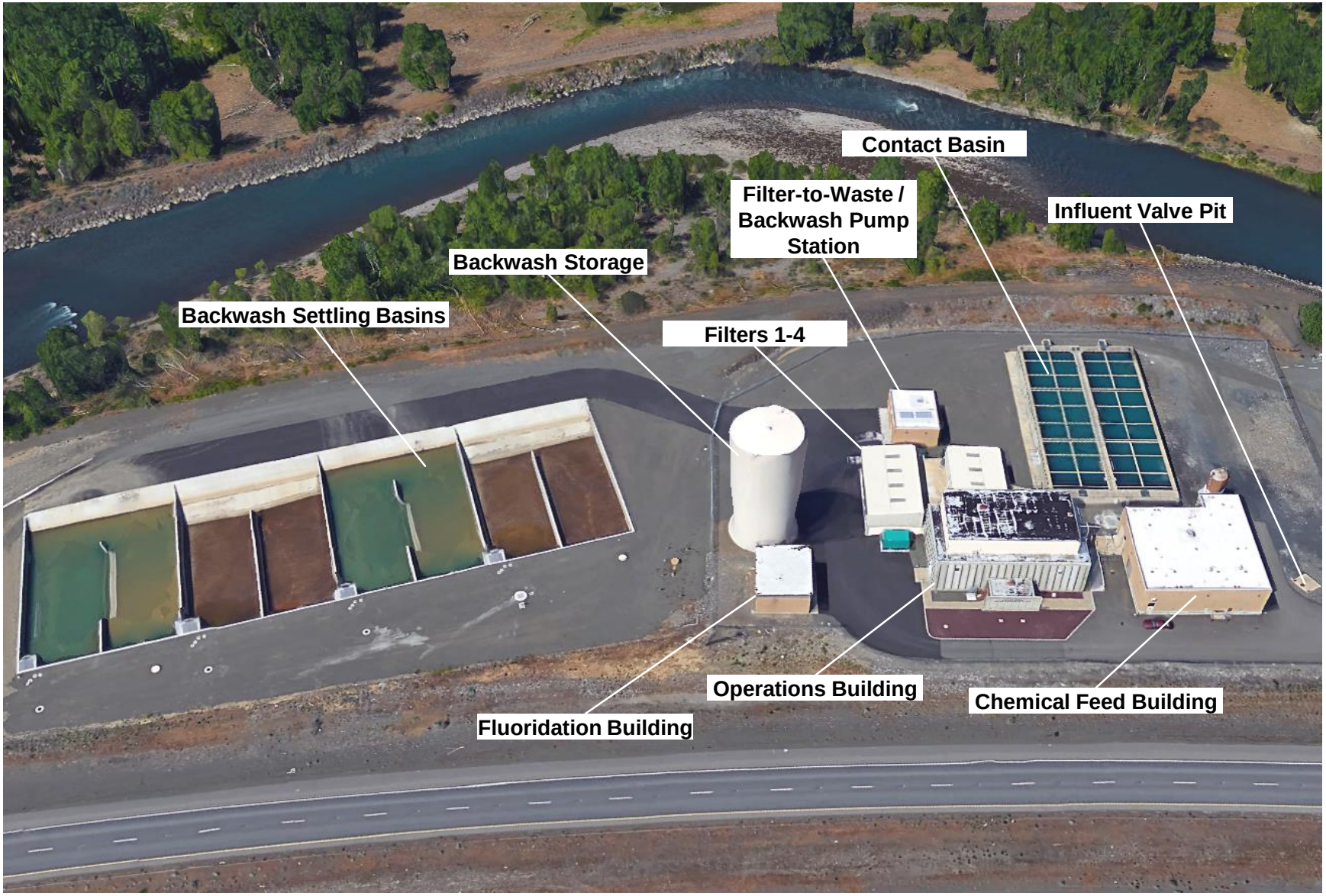


Figure 3-4 **Naches Water Treatment Plant Site Plan**

3.1.3 Groundwater Wells

The City of Yakima water system currently has four groundwater wells: Airport, Kiwanis Park, Kissel Park, and Gardner Park. The Airport and Kiwanis Park wells were developed in 1962 and 1965, respectively, to further supplement the Oak Flats supply. Both of these wells are in service today and are used for seasonal purposes. The Kissel Park Well was constructed in 1993. The Kissel Park Well partially replaced the Ranney collector, which was located on the Naches River and was previously used to supplement the City's water supply. The Kissel Park Well is also used for seasonal use only. In 2012, the City brought online the Gardner Park Well which is considered a permanent source. The Gardner Park Well uses the remaining 3,000 gpm of the Ranney Well water right (the other 2,000 gpm of the original 5,000 gpm Ranney Well water right was transferred to the Kissel Park Well, abandoning the original Kissel Park Well water right).

Table 1-1 in Chapter 1 shows the capacity, zone served, and other pertinent information about the wells. A discussion of the hydrogeology of the aquifers from which these wells withdraw water is presented in Chapter 4 of the WSP. The static water levels in the Kiwanis and Airport Wells have declined over the years due to increased regional water withdrawals from the aquifer. The planned development of the City's ASR program will assist in alleviating this trend.

3.1.4 Storage

The City of Yakima water system currently has three storage locations, one in each of the three pressure zones. Based on recent inspections (completed in 2015) and cleaning, all of the reservoirs are in good condition. The one million gallon steel 3rd Level Reservoir was last coated October 1995. The steel reservoir is typically recoated every 25 years or as dictated by conditions at time of inspection. Vent and overflow screens are inspected two times per year and repairs made as necessary. All four reservoir access hatch covers have been replaced: two in May 2002, and two in March 2003.

3.1.5 Demands

Average and Maximum Day Demands

The average day demand (ADD) and the maximum day demand (MDD) projections, based on the basic planning data presented in Chapter 2, are summarized in Table 3-3 and Table 3-4, respectively. The MDD is estimated as 1.75 times the ADD based on historical data.

Table 3-3. Current and Forecasted Average Day Demands

Pressure Zone	Demand (mg)		
	2017	2027	2037
1st Level	8.32	8.61	8.86
2nd Level	1.70	1.76	1.81
3rd Level	0.49	0.51	0.53
Total	**10.51**	**10.88**	**11.20**

Table 3-4. Current and Forecasted Maximum Day Demands

Pressure Zone	Demand (mgd)		
	2017	2027	2037
1st Level	14.58	15.10	15.54
2nd Level	2.98	3.08	3.17
3rd Level	0.87	0.90	0.93
Total	**18.43**	**19.07**	**19.63**

Peak Hour Demands

The peak hour demand (PHD) projections, based on the basic planning data presented in Chapter 2, are summarized in Table 3-5. The PHD is estimated as 1.6 times the MDD based on historical data and DOH guidelines.

Table 3-5. Current and Forecasted Peak Hour Demands

Pressure Zone	Demand (mgd)		
	2017	2027	2037
1st Level	23.43	24.25	24.96
2nd Level	4.81	4.97	5.11
3rd Level	1.42	1.47	1.51
Total	**29.66**	**30.69**	**31.59**

Diurnal Use Pattern

System demand was analyzed to determine typical diurnal curves for the summer and winter seasons. Demand was established using SCADA information recorded at 15-minute intervals for source production and reservoir water levels. The summer diurnal curve was established based on three days centered around the day of maximum demand in 2015 (July 2nd, 2015), while the winter diurnal curve was established based on data from December 8th through 10th, 2015, a timeframe that depicts typical winter day usage.

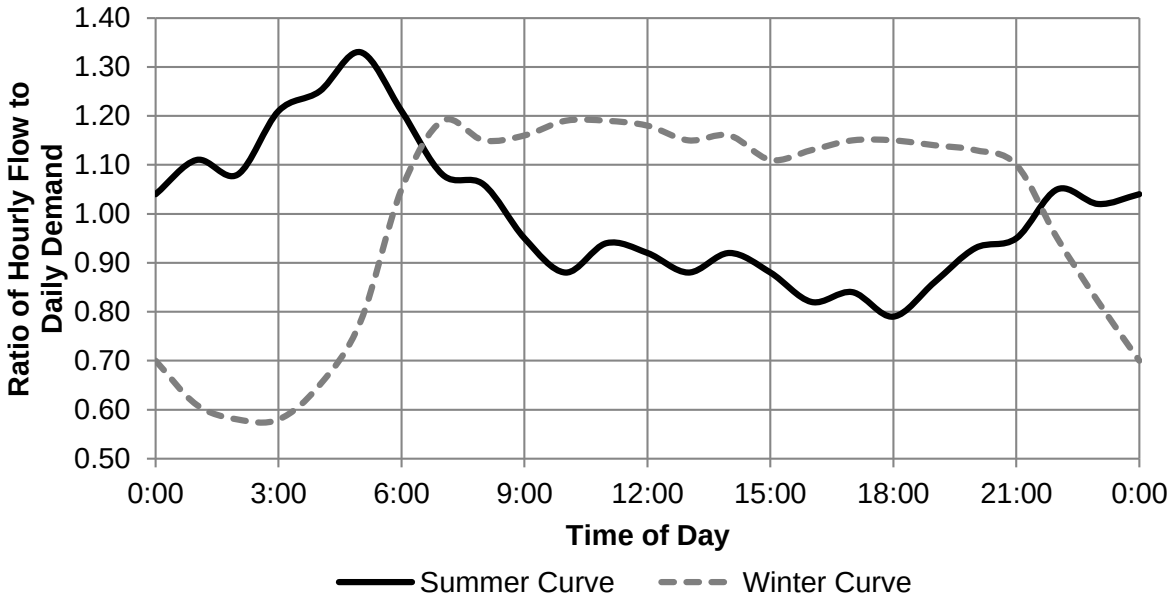
Table 3-6 and Figure 3-5 summarize the diurnal use patterns during the summer and winter. The summer ratios were used during extended period simulation (EPS) runs of the water system model as discussed in Section 3.6.1.

Table 3-6. Diurnal Use Pattern

Hour	Factor to Daily Demand [1]	
	Summer	Winter
0:00	1.04	0.70
1:00	1.11	0.61
2:00	1.08	0.58
3:00	1.21	0.58
4:00	1.25	0.65
5:00	1.33	0.78
6:00	1.21	1.05
7:00	1.08	1.19
8:00	1.06	1.15
9:00	0.95	1.16
10:00	0.88	1.19
11:00	0.94	1.19
12:00	0.92	1.18
13:00	0.88	1.15
14:00	0.92	1.16
15:00	0.88	1.11
16:00	0.82	1.13
17:00	0.84	1.15
18:00	0.79	1.15
19:00	0.86	1.14
20:00	0.93	1.13
21:00	0.95	1.10
22:00	1.05	0.95
23:00	1.02	0.82

1. Factors should be used with the daily demand of the particular day being analyzed, not necessarily the annual average day demand.

Figure 3-5. Diurnal Use Pattern



3.2 System Design Standards

The purpose of this section is to identify and describe the design standards which apply to the City of Yakima water system. Standards which are incorporated by reference include the Washington State Department of Health *Water System Design Manual* (DOH #331-123, December 2009, or latest edition) and Chapter 246-290 WAC Group A *Public Water Supplies* (April 8, 2016 update, or latest revision).

Specific design standards applicable to the City of Yakima Water System established and listed in this Water System Plan Update include:

- Water Quality Standards;
- Average and Maximum Day Demands;
- Peak Hour Demand;
- Storage Requirements;
- Fire Flow Rate and Duration;
- Minimum System Pressure;
- Minimum Pipe Sizes;
- Telemetry Systems;
- Backup Power Requirements;
- Valve and Hydrant Spacing; and
- Other System Policies and Design Standards (e.g., looping).

3.2.1 Source

According to DOH planning requirements, the design of sources to the system and for each pressure zone must be adequate to support current and projected future levels of maximum day water demand. The design of sources for the City is based on facilities operating at full capacity for 24 hours per day to meet the maximum day demand.

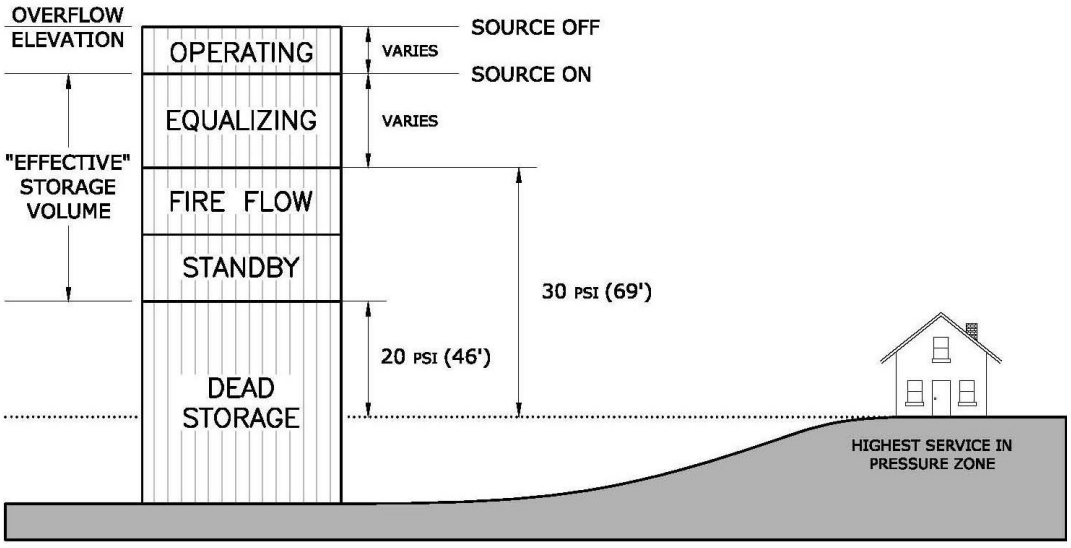
3.2.2 Storage

The design of storage requirements must consider each of the five storage components listed below (reference WAC 246-290-235(3)):

1. Operational storage (OS);
2. Equalizing storage (ES);
3. Standby storage (SB),
4. Fire suppression storage (FSS); and
5. Dead storage (DS), if any.

These required volume components are illustrated in Figure 3-6. All storage components are described in more detail below.

Figure 3-6. Storage Components



Operational Storage (OS)

Operational storage is the volume of water that lies between low and high water storage elevations set by City operations staff to control system pumps and flow control valves. Operational storage does not apply to systems operating under a continuous pumping mode or a gravity fed supply such as from the WTP.

Equalizing Storage (ES)

Equalizing storage is the total volume needed to moderate daily fluctuations in diurnal demands during periods when the demand exceeds the capacity of the supply system. Equalizing volume requirements are greatest on the day of maximum demand. Operation of a properly balanced system results in replenishment of storage facilities during times of day when the demand curve is below the capacity of the supply system and depletion of storage facilities when the demand exceeds the supply capacity. The equalizing volume of a storage reservoir must be located at an elevation that provides a minimum pressure of 30 pounds per square inch (psi) to all customers served by the reservoir.

Standby Storage (SB)

Standby storage is required to supply reasonable system demands during a foreseeable system emergency or outage. A key concept is that establishing standby storage involves planning for reasonable system outages – those that can be expected to occur under normal operating conditions, such as a pipeline failure, power outage or valve failure. Major system emergencies, such as those created by an earthquake, are intended to be covered by emergency system operations planning, since construction of sufficient reserve volume to accommodate sustained system demands under emergency conditions is not economically feasible.

DOH has established guidelines for determining minimum required standby storage volume. This component is calculated as the greater of: two times the average day demand, less multi-source credit; or 200 gallons times the number of ERUs served by the storage facility. The multi-source credit is applicable only for pressure zones that have multiple sources of supply, and allows the required standby storage volume in such instances to be reduced. The credit assumes the largest source of supply is out of service; thus, it is calculated as the total source available to a particular pressure zone, or zone combination, less the capacity of the largest source. No credit is allowed for zones having only one source of supply. For a pump station with multiple pumps operating in parallel, each pump can be considered a source.

Fire Suppression Storage (FSS)

The required fire suppression storage volume for a given pressure zone is calculated as the required fire flow multiplied by the required duration, as established by the local fire authority. Required fire flows and durations vary across the service area, as it includes multiple zoning designations.

The fire suppression storage volume of a storage reservoir must be located at an elevation that provides a minimum pressure of 20 psi to all customers served by the reservoir. DOH allows for the “nesting” of standby and fire flow storage, with the larger used for the storage volume. For the purpose of this plan, the nesting of standby and fire flow storage is considered. A letter of approval for the nesting of these storage volumes from the local fire authority is provided in Appendix H.

Dead storage (DS)

Dead storage (effective only to provide adequate pressure) is the volume of stored water not available to all consumers at the minimum design pressure.

3.2.3 Distribution

Refer to Chapter 7 of this plan for a discussion of the City of Yakima Development Standards and Water System Specifications and Details. These standards cover pipe and valve materials, valve and hydrant spacing, and water/sewer separation.

Minimum System Pressure

The minimum system pressure design standard which has been established by the City of Yakima provides that during peak-hour demands, the distribution system should provide a minimum service pressure of 30 psi to all customers. Under fire-flow conditions, service pressures across the City should not drop below 20 psi. These design standards are consistent with the DOH Design Manual requirements and the applicable portions of WAC 246-290-230.

Minimum Pipe Size

Title 12 of the Yakima Municipal Code establishes development standards for water service extensions. Chapter 12.04 covers water system development standards. Article 12.04.030 requires that all water lines shall be looped. Article 12.04.040 requires that all new water lines within the City of Yakima water service area shall be a minimum of eight inches in diameter and be constructed of Class 52 ductile iron pipe.

Telemetry Systems

The existing telemetry system provides for monitoring and control of booster pumps, reservoir levels, the water treatment plant, and each of the wells. Each telemetry location can communicate with the water treatment plant and with each of the other telemetry locations. Each telemetry unit consists of a programmable logic controller (PLC) and a VHF radio transmitter which communicates via a digital packet burst protocol. Any new telemetry points must be compatible with the existing system.

Backup Power

Backup power is provided for the various components of the water system in accordance with the DOH Design Manual and applicable regulations. Currently, full backup power is available at the WTP, Stone Church Pump Station, and 3rd Level Pump Station.

Valve and Hydrant Spacing

Fire hydrant location and number requirements are stipulated in Article 10.10.070 of the Yakima Municipal Code. The maximum distance between fire hydrants in single-family zones shall be 600 feet. In all other areas, including areas of single-family zones impressed with public buildings, and/or schools, the maximum distance between fire hydrants shall be 400 feet.

With regard to valve spacing, each project is reviewed to determine valve spacing based on main isolation for minimal disruption in service. In addition, valves are required at each intersection.

Other Requirements

Section 12.04.030 of the Yakima Municipal Code requires that all water lines shall be looped. Temporary dead-end lines may be permitted based on an agreement between the developer and the City with provisions for timely completion of looping.

3.3 Water Quality Analysis

This section provides a summary of the City's compliance with applicable water quality regulations and monitoring requirements.

3.3.1 Water Quality Standards

Overview

The quality of drinking water in the United States is regulated by the Environmental Protection Agency (EPA). The 1974 Safe Drinking Water Act (SDWA) and its 1986 and 1996 amendments established specific legislation for regulation of public water systems by federal and state governments. Under provisions of the SDWA, the EPA is allowed to delegate primary enforcement responsibility for water quality control to each state.

In the State of Washington, the DOH is the agency responsible for implementing and enforcing the 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 has published drinking water regulations that are contained in Chapter 246-290 of the Washington Administrative Code (WAC) which establishes monitoring requirements, maximum contaminant levels, and requirements for follow-up actions. Minimum standards for water quality are often specified in terms of Maximum Contaminant Levels (MCLs). Primary MCLs are based on chronic and/or acute human health effects. Secondary MCLs are based on factors other than health effects, such as the aesthetic quality of the water. Maximum Contaminant Level Goals (MCLGs) are based on the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.

According to WAC 246-290, a Group A public water system is defined as serving 15 or more residential connections or 25 or more people per day for 60 or more days per year. As a Group a public water system, the City is required to satisfy drinking water quality regulations and conform to monitoring and reporting requirements as described by WAC 246-290.

Existing Regulations

A list of existing regulations and the parameters each regulates is given in Table 3-7.

Table 3-7. Existing Regulations

Rule	Parameters Regulated
Source Water Quality Regulations	
VOC Rule - Phase I	VOCs
Total Trihalomethane Rule	Trichloromethane, Bromodichloromethane, Dibromochloromethane, Tribromomethane
SOCs and IOCs Rule- Phase II, IIb, & V	Inorganics, SOCs
Radionuclide Rule	Radium-226, Radium-228, Gross alpha particle activity, beta particle/photon activity.
Arsenic	Arsenic
Surface Water Treatment Rule	Turbidity, Giardia, viruses, Legionella, HPC
Interim Enhanced Surface Water Treatment Rule	Turbidity, Cryptosporidium
Wellhead Protection	Source water protection
Groundwater Rule	Bacteriological
Unregulated Contaminant Monitoring Rule	Monitoring of unregulated contaminants
Long Term 2 Enhanced Surface Water Treatment Rule	Cryptosporidium and other disease-causing microorganisms
Filter Backwash Rule	N/A
Distribution System Water Quality Regulations	
Total Coliform Rule	Bacteriological
Lead and Copper Rule	Lead, Copper, water quality parameters
Stage 1 Disinfectant/Disinfection Byproduct Rule	Chlorine, chloramines, chlorine dioxide, HAA5, Chlorite, Bromate, TTHMs
Stage 2 Disinfectant/Disinfection Byproduct Rule	TTHMs, HAA5, Disinfectant Residuals
Revised Total Coliform Rule	Bacteriological
System-Wide Regulations	
Consumer Confidence Reports and Public Notification Rules	Requires annual report addressing drinking water quality
Operator Certification Rule	N/A

Proposed and Anticipated Regulations

A list of proposed and anticipated regulations is given in Table 3-8. The City tracks the development of future rules and rule changes, and plans for accommodating such rules through its budgeting process.

Table 3-8. Future Rules or Contaminants

Future Rules or Contaminants	Expected Date of Proposal / Final
Contaminant Candidate List 4 (CCL4)	2016 (final)
Lead and Copper Rule Long-Term Revisions (LCR-LTR)	2016 (draft) 2017-2018 (final)
Perchlorate Rule	2018 (draft) Uncertain for final
Carcinogenic Volatile Organic Compound (cVOC) Rule	2018 (draft) Uncertain for final
Final Fourth Unregulated Contaminant Monitoring Rule (UCMR 4)	2018
Cyanotoxins	Draft no earlier than 2023
Strontium	2018 (draft) 2019 (final)
Hexavalent Chromium	2018 (draft) Uncertain for final
Nitrosamines	Uncertain
Chlorate	Uncertain
Perfluorinated Compounds	Uncertain
Prohibition on Use of Lead Pipes, Solder, and Flux	2016 (Draft) 2017 (Final)

3.3.2 Water Quality Monitoring Program

The City conducts water quality monitoring in compliance with EPA and DOH requirements. Annually, the City reviews its Water Quality Monitoring Schedule (WQMS), as issued by DOH, and communicates any issues, or asks for clarification, with the State. A copy of the 2016 WQMS is in Appendix I.

The approaches to monitoring for various parameters are outlined below, along with a summary of any recent (last six years) monitoring violations. Details regarding the City's water quality results are contained within DOH's Sentry database system, accessible online at DOH's website: https://fortress.wa.gov/doh/eh/portal/odw/si/.

Monitored Parameters

Nitrate

Nitrate levels are monitored for each source on an annual basis. Details of nitrate monitoring are contained in the Inorganic Monitoring Plan in Appendix J. There have been no recent violations.

Inorganic Chemicals (IOCs)

IOC levels are monitored for each source, with the WTP sampled annually and the wells sampled on a three year cycle. As of 2016, the WQMS has waivers for completing a full IOC test panel for all sources. However, the WQMS requires iron monitoring for the Airport Well. Details of IOC monitoring are contained in the Inorganic Monitoring Plan in Appendix J. There have been no recent violations.

Volatile Organic Chemicals (VOCs)

VOC levels are monitored at the WTP on an annual basis while the wells have waivers. Details of VOC monitoring are contained in the Organic Monitoring Plan in Appendix K. There have been no recent violations.

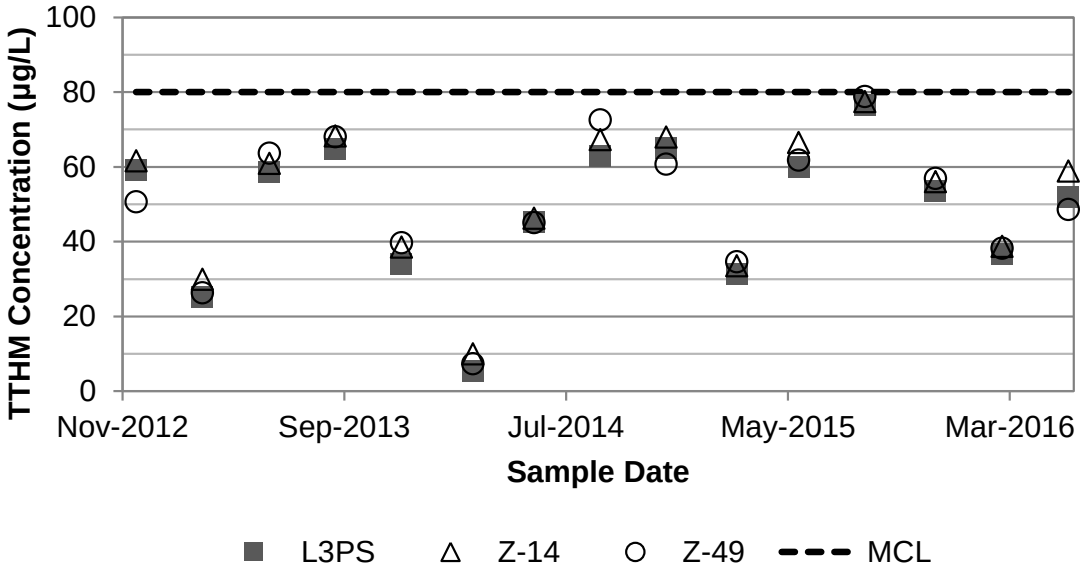
Synthetic Organic Chemicals (SOCs)

SOCs are a large group of contaminants that include pesticides, herbicides, and soil fumigants and are typically monitored at sources for the water system. The City currently has a waiver for all sources to perform SOC monitoring.

Disinfection Byproducts (DBPs)

DBPs, including total trihalomethanes (TTHMs) and haloacetic acids (HAA5) are a group of organic compounds that can be formed as a result of drinking water disinfection by oxidants such as chlorine, chlorine dioxide, and ozone. For drinking water quality, TTHMs and HAA5 are monitored on a quarterly basis with eight samples taken for each parameter per cycle. Details of DBP monitoring are contained in the Stage 2 D/DBPR Monitoring Plan in Appendix L. There have been no recent drinking water quality violations. However, several sample locations have seen elevated levels of TTHMs approaching near the TTHM MCL of 80 µg/L. Since 2012, monitoring locations L3PS, Z-14, and Z-49 have had a number of samples that had TTHM concentrations above 75% of the MCL (60 µg/L) as seen in Figure 3-7. Although there have been no MCL violations, the City is monitoring TTHM trends to keep TTHMs below the MCL and taking actions to lower concentrations as necessary.

Figure 3-7. TTHM Concentrations at Select Sample Locations



In addition to monitoring DBPs for drinking water quality, DBPs are monitored as part of the City's ASR operating permit (issued by the Washington State Department of Ecology) to maintain groundwater quality. The permit requires TTHMs and HAA5 levels in water injected into the aquifer to be less than 50 percent of the MCL. Monitoring of injected water takes place at the recharge wells at the beginning of recharge, every 30 days during recharge, and at the end of recharge. Monitoring is also required during the storage of ASR water, and annually at downgradient monitoring wells. Details related to DBP monitoring for ASR operations are discussed in the City's ASR permit regarding reservoir application number R4-34552.

Radionuclides

Radionuclides for gross alpha and radium 228 are monitored on a six year cycle at the WTP and for the four ground water wells. Details of radionuclide monitoring are contained in the Inorganic Monitoring Plan in Appendix J. There have been no recent violations.

Lead and Copper

Lead and copper levels are monitored at targeted homes throughout the distribution system that meet the criteria as prescribed in the Lead and Copper Rule. Samples from at least 30 sites are required on a three year cycle. Details of lead and copper monitoring are contained in the Inorganic Monitoring Plan in Appendix J. There have been no recent violations.

Coliform

Indicator organisms are often used to test for bacterial and other microbial contamination in drinking water. Total coliform, fecal coliform, and *E. Coli* are typical indicator organisms. The absence of coliform bacteria generally assures the water purveyor that pathogenic bacteria are not present. Samples are collected monthly to cover each pressure zone, reservoir outfall, and source distribution area. A minimum of 80 samples are required each month. Details of coliform monitoring are contained in the Coliform Monitoring Plan in Appendix M.

Coliform was present in four samples since the start of 2011, with those samples collected in May 2011, November 2012, July 2013, and March 2015. *E. Coli* was absent for all four samples. There were no other recent violations, as less than 5% of collected samples were positive for coliform for each month.

Asbestos

A small quantity of asbestos cement pipe is located within the distribution system. Because of this, asbestos sampling is required once every nine years at this location. Details of this are contained in the Inorganic Monitoring Plan in Appendix J. There have been no recent violations.

Continuous Monitoring Parameters

Residual disinfectant in the distribution system is imparted through the use of on-site generated sodium hypochlorite at the WTP and calcium hypochlorite at the wells. Free chlorine residual is continuously monitored via SCADA at all sources, the 3rd Level Pump Station, and the connection with the Gleed service area. Additionally, grab samples for free chlorine residual are taken daily at three locations in the distribution system.

Fluoridation of the system occurs through the use of hydrofluorosilicic acid at the WTP and sodium fluoride at the Gardner Park Well. Fluoride residual is continuously monitored at two locations via SCADA.

At the WTP, turbidity is continuously monitored at various points in the treatment process, while alkalinity and hardness are sampled weekly.

Details of the parameters with continuous monitoring are contained in the Continuous & Miscellaneous Monitoring Plan in Appendix N. There have been no recent violations.

Certified Laboratories

For water quality testing that is not performed by the City, the certified laboratories listed in Table 3-9 are used.

Table 3-9. Certified Laboratories for Water Quality Monitoring

Laboratory	Contact Information	Typical Analyses
Cascade Analytical	1008 Ahtanum Rd. Union Gap, WA 98903 (509) 542-7707	IOCs, coliform, Total Organic Carbon (TOC), nitrate, fluoride, lead & copper, radionuclides
Edge Analytical Services	1620 S Walnut St. Burlington, WA 98233 (800) 755-9295	DBPs, VOCs, SOCs, UCMR constituents
Lab/Cor Inc.	7619 6th Ave NW Seattle, WA 98117 (206) 781-0155	Cryptosporidium, asbestos

Customer Complaints

See Chapter 6 – Operations and Maintenance for a discussion on the City's customer complaint program procedures. Consumer Confidence Report

The final rule for the Consumer Confidence Report (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 1996 Amendments to the SDWA. All community water systems 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 1 of each year thereafter.

The CCR is a report on the quality of water that was delivered to the system during the previous 12 months. The reports 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, include 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.

The City is in compliance with the CCR Rule, with annual CCRs published as required. A copy of the latest CCR is located in Appendix O.

3.3.3 TTHM Reduction and ASR

As part of the City's ASR permit, the quality of water being injected into the aquifer is required to have TTHM and HAA5 concentrations below 50 percent of their respective drinking water MCLs. While TTHM and HAA5 concentrations have consistently been below the drinking water MCLs, their concentrations have occasionally exceeded the 50% MCL level.

The formation of DBPs such as TTHM and HAA5 are heavily influenced by the chlorine residual, presence of natural organic matter (NOM), and water age. When any of these parameters are reduced, the formation of DBPs decreases.

A number of potential treatment methods and operational strategies exist that can remove or reduce DBPs. These are typically related to either the removal of DBP precursors (such as NOM), change in disinfection strategies, or direct removal of DBPs after they formed.

Treatment methods of reducing NOM include:

- Enhanced coagulation
- Granular activated carbon (GAC)
- Nanofiltration
- Biological filtration

Alternate disinfection strategies to chlorination include the use of:

- Chloramines
- Chlorine dioxide
- Ozone
- UV disinfection

Treatment methods that can be used for the direct removal of DBPs include:

- Biological filtration
- Granular activated carbon (GAC)
- Reverse osmosis (RO)
- Aeration

During the course of permitting for its ASR program, the City considered the options above in its AKART analysis. In addition to DBP reduction, the City is considering installation of online or real-time TOC monitoring. As a condition of its ASR permit, the City will complete an engineering technical memorandum that will describe and evaluate a range of treatment and monitoring options. The City will include the preferred option in its capital improvement program for implementation. The technical memorandum is planned for completion in the first half of 2017.

3.3.4 Lead Appurtenances in Water System

In 2015 and 2016, the City has conducted research into whether lead materials exist in the City-owned portions of the water system. Through this research, no lead piping is known to exist within the public water system. However, in older portions of the system there is the potential for lead gooseneck connections. A lead gooseneck is a short segment of pipe that was used in the past as a flexible fitting for connecting service lines to water mains. The City is identifying through records all possible locations for lead goosenecks and actively replacing all that are found. Research and removal of lead gooseneck connections is planned to be completed by the end of 2020. Lead sampling has not found any levels above the lead EPA MCL.

3.3.5 Identified Improvements

No water quality improvements are required to meet drinking water quality standards. However, while not needed to correct any existing drinking water quality deficiencies, the following improvements are included as part of the City's on-going efforts to maintain and upgrade the quality of the system to meet current and future needs, as well as meet ASR program and permit requirements.

Removal of Lead Appurtenances

The City will continue its efforts to remove lead gooseneck connections as well as any other lead appurtenances in the water system as they are discovered. This will be completed as part of water main replacement projects and programs identified in Section 3.7.4.

TOC Monitoring and/or TTHM Treatment (WQ-1)

As a condition of its ASR permit, the City will complete an engineering technical memorandum that will describe and evaluate a range of treatment and monitoring options. TOC monitoring and/or TTHM treatment will be developed following the completion of the engineering technical memorandum.

3.4 Water Treatment Plant Analysis

3.4.1 Existing Water Treatment Plant – Analysis and Discussion

The WTP has contact basins upstream of the filters and it meets the EPA definition of "direct filtration" because it does not include a sedimentation step prior to filtration. This distinction is important because a "direct filtration" plant must provide a higher level of disinfection than a conventional water treatment plant. The applicability of direct filtration is generally limited to facilities which have high quality source water (< 15 NTU turbidity). Actual operating experience has shown that the plant can handle intermittent periods of higher raw water turbidity. Sustained periods of high turbidity are rare. When they do occur they are typically due to rain on snow flooding during the winter months or from spring snowmelt. During periods when it is not feasible or not economical to treat the Naches River water, the WTP is shut down and the seasonal use wells are activated to meet demand until the raw water turbidity returns to treatable levels.

Existing Conditions

Raw Water Intake

The intake for the water system is located on the Naches River about 6 miles west of Yakima. Water is diverted from the Naches River approximately one quarter mile upstream from the WTP intake structure through three head gates. The intake structure has a number of fish protection facilities. Water leaves the intake and travels to the WTP through a 54-inch diameter concrete main. The intake is located on the left bank of the river. However, river flow has shifted towards the right bank causing intake capacity issues.

Contact Basins

Two rectangular contact basins are located between the flash mix basin and the filters. Coagulated water must flow through them before it goes into the filters. No mechanical mixing or sludge removal equipment exists in the basins, and plant staff does not currently have the capability to add chemicals to the basins.

Disinfection Facilities

Chlorine is used for both primary disinfection (CT compliance) and as a secondary disinfectant (distribution system residual). Chlorine is added upstream of the flash mix basins (pre-chlorination) and downstream of the filters (post chlorination).

An on-site hypochlorite generation system was installed in 2004 to replace the gas chlorination system.

Residuals Handling

Four new common wall concrete settling basins of 400,000 gallons each for a total settling basin volume of 1,600,000 gallons collect filter waste wash water streams and settled solids from the contact basins. Decanted water is recycled back to the plant upstream of the flash mix basins. The recycle rate is about 10 percent of the influent flow and is operated based on water level within the basins. Settled sludge is removed out of the basins on an as-needed basis.

3.4.2 Identified Improvements

No improvements are currently required to meet current or upcoming regulatory requirements. The following improvement is included as part of the City's on-going efforts to maintain and upgrade the quality of the system to meet current and future needs.

Rechanneling River Intake (WT-1)

The WTP's intake is located on the left bank of the Naches River. However, the Naches River has experience significant changes in the location of the river's channel. The channel has migrated away and has lowered in elevation to the intake causing intake capacity issues. To alleviate the issues, the City plans on potentially doing a combination of: (1) maintaining or adding to the existing grade control structure downstream of the main intake; (2) adding to the existing grade control structure at the auxiliary intake to encourage flows towards the intake; and (3) installing in-river structures upstream of the intake to redirect the river's channel toward the intake gates.

Residual Handling Improvements (WT-2)

Due to climate change and the changing turbidity conditions within the Naches River, the WTP has been handling an increased turbidity loading on the filtration process. The higher turbidity levels observed in the last couple years before 2016, have caused an increase in the amount of solids sent to the filter backwash waste lagoons. Future options for supplementing the residual handling process during fall and winter operations, when turbidity is typically at its highest, should be explored in order to accommodate the increased loading conditions in the treatment process.

3.5 Source Capacity Analysis

The source capacity analysis examines the adequacy of the sources serving the water system to support current and projected future levels water demand. According to DOH planning requirements, sources of supply must be sufficient to meet needs on a MDD basis. This must hold true for the system as a whole, as well as for each pressure zone that has storage.

The source capacity analysis was broken into the following analyses:

- System Wide – Compares the demands of all pressure zones with the source capacity of the groundwater wells and WTP.
- 2nd and 3rd Level pressure zones – Compares the demands of the 2nd and 3rd Level pressure zones with the source capacity of the 40th Avenue and Stone Church Pump Stations.
- 3rd Level pressure zone – Compares the demands of the 3rd Level pressure zone with the source capacity of the 3rd Level Pump Station.

3.5.1 System Wide Source Capacity

The system wide source capacity analysis uses the demand for the entire system and compares this with the source capacity of the groundwater wells and WTP which provide water to the complete system. The system wide source capacity analysis considers three planning scenarios:

- Non-Drought Year – This analysis assumes the WTP is able to deliver at its full rated capacity. The groundwater wells are not used as a source.
- Drought Year – This analysis assumes the WTP capacity is reduced due to drought conditions similar to those experienced in 2001. All groundwater wells are able to be used as sources.
- Treatment Plant Offline – This analysis assumes the WTP must be taken completely offline. All groundwater wells are able to be used as sources.

Demands remain the same between the three planning scenarios for each year (no additional conservation or curtailment of demands is assumed for the drought year or treatment plant offline scenarios). The source capacity analysis for the complete system for years 2017 through 3037 is presented in Table 3-10.

As seen in the table, given a non-drought year scenario, the WTP is capable of meeting current and projected demands. In the drought-year scenario, the sources are capable of meeting current and projected demands; however, with the reduced capacity of the WTP, seasonal use wells will have to be activated. When using the existing inventory of groundwater wells in addition to the curtailed WTP supply, the total available source does exceed the full capacity of the WTP on its own. In the scenario of the WTP taken completely out of service, the existing sources of supply are not capable of meeting current nor projected maximum day demand without activating additional ASR wells. The City is actively pursuing the installation of new ASR wells to add to the City's source portfolio to remove this deficiency and have complete redundancy in the event the WTP must be taken entirely offline. Development of the new ASR wells is further discussed in Chapter 4.

Table 3-10. System Wide Source Capacity Analysis for Years 2017 through 3037

	Year			Max [1]
	2017	2027	2037	
Projected Equivalent Residential Units (ERUs) [2]	45,112	46,691	48,062	52,889
Projected System Wide Demand [3]				
Average Day (mgd)	10.5	10.9	11.2	12.3
Maximum Day (mgd)	18.4	19.1	19.6	21.6
Non-Drought Year [4,5]				
Naches River WTP	14,976	14,976	14,976	14,976
Total Available Source (gpm)	14,976	14,976	14,976	14,976
Total Available Source (mgd)	21.6	21.6	21.6	21.6
Drought Year [4,6]				
Naches River WTP [7]	8,263	7,092	6,441	
Gardner Park Well	3,000	3,000	3,000	
Kiwanis Park Well [9]	2,100	2,100	2,100	
Airport Well [9]	1,950	1,950	1,950	
Kissel Park Well [9]	2,500	2,500	2,500	
ASR Well #1 (planned)		3,000	3,000	
ASR Well #2 (planned)		3,000	3,000	
Total Available Source (gpm)	17,813	22,642	21,991	
Total Available Source (mgd)	25.7	32.6	31.7	
Treatment Plant Offline [4, 6, 8]				
Naches River WTP	0	0	0	
Gardner Park Well	3,000	3,000	3,000	
Kiwanis Park Well [9]	2,100	2,100	2,100	
Airport Well [9]	1,950	1,950	1,950	
Kissel Park Well [9]	2,500	2,500	2,500	
ASR Well #1 (planned)		3,000	3,000	
ASR Well #2 (planned)		3,000	3,000	
Total Available Source (gpm)	9,550	15,550	15,550	
Total Available Source (mgd)	13.8	22.4	22.4	
Source Surplus/(Deficiency), Non-Drought Year (mgd)	3.1	2.5	1.9	0.0
Source Surplus/(Deficiency), Drought Year (mgd)	7.2	13.5	12.0	
Source Surplus/(Deficiency), WTP Offline (mgd)	(4.7)	3.3	2.8	

Notes:
1. Maximum ERUs to be served with available sources based on maximum production rate (operating 24 hours per day) for a non-drought year.
2. ERUs calculated as average day demand / ERU water use factor (233 gpd/ERU).
3. Details of projected demands are in Chapter 2.
4. Assumes sources are operating at their maximum production rate (operating 24 hours per day).
5. Non-drought year sources exclude seasonal use wells.
6. Drought year sources includes seasonal use wells as well as when the WTP is taken offline.
7. During 2001, due to extreme drought conditions, the USBR reduced the storage control capacity of the water treatment plant to 29% and is assumed as a worst case scenario for a drought given current climate conditions (10 cfs + 29% of 29 cfs). Due to climate change, more severe reductions are possible in the future. It is assumed the control capacity is reduced to 20% in 2027 and 15% in 2037.
8. Assumes the WTP is completely offline.
9. Well capacities differ from those provided in Chapter 1 and the Water Facilities Inventory (WFI) Form which are nominal capacities while the capacities provided in this table are based on current operating conditions which yields more conservative values.

3.5.2 2nd and 3rd Level Pressure Zone Source Capacity

The 2nd and 3rd Level pressure zone source capacity analysis compares the demands of the 2nd and 3rd Level pressure zones with the source capacity of the 40th Avenue and Stone Church Pump Stations, which both pump water from the 1st Level pressure zone into the 2nd Level Reservoirs. Since water for the 3rd Level pressure zone originates from the 2nd Level pressure zone, these two pump stations are considered the sources for both zones.

Table 3-11. 2nd & 3rd Level Zone Source Capacity Analysis for Years 2017 through 3037

	Year			
	2017	2027	2037	Max [1]
Projected Equivalent Residential Units (ERUs) [2]	9,413	9,738	10,020	34,256
Projected 2nd and 3rd Level Demand [3]				
Average Day (gpd)	2.19	2.27	2.33	7.98
Maximum Day (gpd)	3.85	3.98	4.09	13.97
Existing Sources [4]				
40th Avenue Pump Station				
40 HP Pump (gpm)	1,000	1,000	1,000	1,000
60 HP Pump (gpm)	1,500	1,500	1,500	1,500
100 HP Pump (gpm)	2,500	2,500	2,500	2,500
Stone Church Pump Station				
50 HP Pump (gpm)	700	700	700	700
100 HP Pump (gpm)	1,500	1,500	1,500	1,500
125 HP Pump (gpm)	2,500	2,500	2,500	2,500
Total Available Source (gpm)	9,700	9,700	9,700	9,700
Total Available Source (mgd)	14.0	14.0	14.0	14.0
Source Surplus/(Deficiency) (mgd)	10.1	10.0	9.9	0.0

Notes:
1. Maximum ERUs to be served with available sources based on maximum production rate (operating 24 hours per day).
2. ERUs calculated as average day demand / ERU water use factor (233 gpd/ERU).
3. Details of projected demands are in Chapter 2.
4. Assumes sources are operating at their maximum production rate (operating 24 hours per day).

The source capacity analysis for these zones for years 2017 through 3037 is presented in Table 3-11. As seen in the table, the 40th Avenue and Stone Church Pump Stations are capable of meeting current and projected demands.

3.5.3 3rd Level Pressure Zone Source Capacity

The 3rd Level pressure zone source capacity analysis compares the demands of the 3rd Level pressure zone with the source capacity of the 3rd Level Pump Station which pumps water from the 2nd Level Pressure Zone into the 3rd Level Reservoirs.

The source capacity analysis for this zone for years 2017 through 3037 is presented in Table 3-12. As seen in the table, the 3rd Level Pump Station is capable of meeting current and projected demands.

Table 3-12. 3rd Level Pressure Zone Source Capacity Analysis for Years 2017 through 3037

	Year			
	2017	2027	2037	Max (1)
Projected Equivalent Residential Units (ERUs) (2)	2,121	2,201	2,270	7,416
Projected 3rd Level Demand (3)				
Average Day (mgd)	0.49	0.51	0.53	1.73
Maximum Day (mgd)	0.87	0.90	0.93	3.02
Existing Sources (4)				
3rd Level Pump Station				
30 HP Pump (gpm)	400	400	400	400
125 HP Pump (gpm)	1,700	1,700	1,700	1,700
Total Available Source (gpm)	2,100	2,100	2,100	2,100
Total Available Source (mgd)	3.0	3.0	3.0	3.0
Source Surplus/(Deficiency) (mgd)	2.2	2.1	2.1	0.0

Notes:
1. Maximum ERUs to be served with available sources based on maximum production rate (operating 24 hours per day).
2. ERUs calculated as average day demand / ERU water use factor (233 gpd/ERU).
3. Details of projected demands are in Chapter 2.
4. Assumes sources are operating at their maximum production rate (operating 24 hours per day).

3.5.4 Water Rights Analysis

The City of Yakima holds a number of water rights that supply the City's domestic and municipal irrigation distribution systems. All of these water rights are described in Chapter 4 of this plan and in Table 4-5and Table 4-6 (see Section 4.3). The City holds several other water rights that are not considered in this source capacity analysis, because they are not part of the City's municipal water distribution systems and are not used for domestic purposes. See Chapter 4 for the water right self-assessment.

3.5.5 Identified Improvements

Additional Source Wells (S-1)

The only deficiency found in the source analysis is for the scenario of the Naches WTP being taken out of service or having its capacity limited to under 4.7 mgd (3,264 gpm) which is the deficiency for current maximum day demand when the WTP is taken out of service. The City plans to develop additional well sources to remove this deficiency given this scenario. The sources could be designated for seasonal/emergency use. Development of additional ASR wells (as described in Chapter 4) would address the deficiency.

Stone Church Pump Station Improvements (S-2)

The Stone Church Pump Station was installed in 2000 near the intersection of North 32nd Avenue and Englewood Avenue. This pump station system provides an alternative (to the 40th Avenue Pump Station) for supplying the 2nd Level zone, which bolsters reliability and the ability to satisfy emergency demands. The Stone Church Pump Station is equipped with three booster pumps with motors rated at 50 hp, 100 hp, and a 125 hp. This project would install a new Variable Frequency Drive (VFD) for the 125 hp pump and motor, along with required SCADA equipment and programming. This will provide for improved system operation for the 2nd Level zone should the 2nd Level Reservoirs and 40th Avenue Pump Station become isolated from the system due to a main break or other system failure.

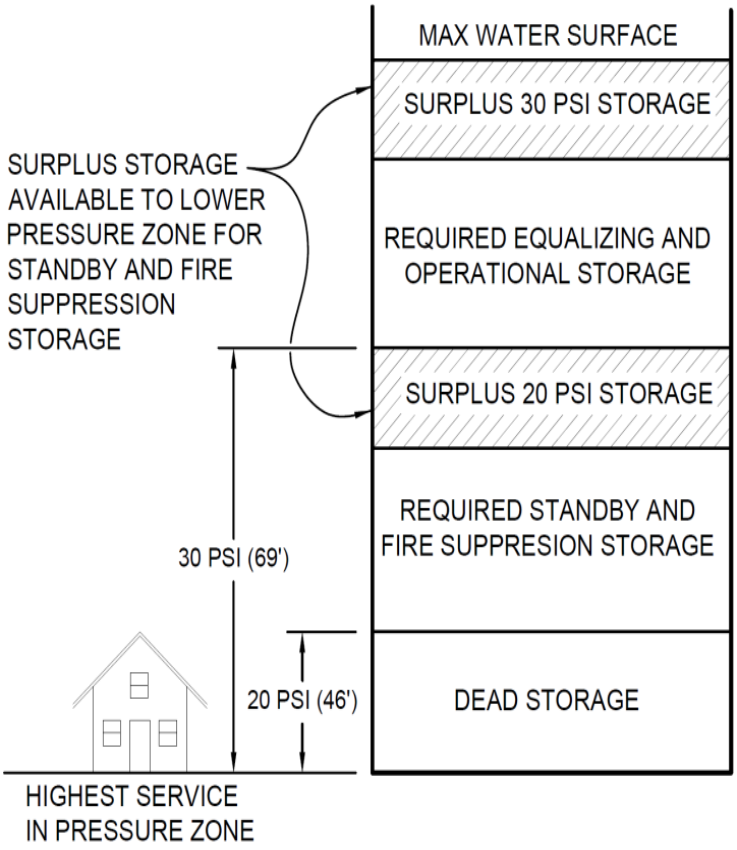
3.6 Storage Capacity Analysis

The storage capacity analysis is based on an evaluation of the existing storage reservoirs and their ability to meet the demands of the areas in which they serve. This is based upon two primary calculations:

1. Comparison of available versus required storage located at an elevation that provides at least 30 psi to the highest customer in the zone. This evaluates the ability of existing storage facilities to provide required operational and equalizing storage volumes under current and future conditions.
2. Comparison of available versus required storage located at an elevation that provides at least 20 psi to the highest customer in the zone. This evaluates the ability of existing storage facilities to provide required operational, equalizing, standby, and fire flow storage volumes under current and future conditions.

For each pressure zone, the required volumes for operational, equalizing, standby, and fire suppression storage are calculated. These storage volumes are based upon the demands of the individual pressure zone each reservoir directly serves. In the analysis, if there is a surplus of storage that is available at 20 psi or more for a pressure zone, that storage is made available to the next lower pressure zone for use in meeting standby or fire suppression storage needs. PRVs in the distribution system allow for movement of water from upper to lower zones under certain pressure conditions. An illustration of this is shown in Figure 3-8. Because of this, the storage capacity analysis uses a top to bottom approach where the analysis starts with an evaluation of the highest pressure zone and ends with the lowest pressure zone.

Figure 3-8. Illustration of Surplus Storage



3.6.1 3rd Level Reservoirs Evaluation

The 3rd Level Reservoirs evaluation examines the adequacy of the 3rd Level Reservoirs to meet the demands of the area they serve. The 3rd Level Reservoirs serve by gravity the demands of the 3rd Level pressure zone and are filled from the 2nd Level Pressure zone via the 3rd Level Pump Station. Being the highest zone, the analysis of fire suppression and standby storage volumes for the 3rd Level zone (which must be provided from elevations so as to provide a minimum of 20 psi to customers in this zone) considers storage only available in the 3rd Level Reservoirs.

Table 3-13 provides a summary of the storage capacity evaluation for the 3rd Level Reservoirs. The evaluation found that the 3rd Level Reservoirs have no storage deficiencies during the forecast period for the area that it serves. However, this is based on a highest service elevation of 1,460 ft, the elevation that creates a net zero surplus/deficiency in storage required at 30 psi.

At elevations higher than 1,460 ft in the 3rd Level pressure zone, water service to residences is provided by a combination of City water and Nob Hill Water Association.

Figure 3-9 shows the residences and hydrants served by the City and the 3rd Level pressure zone. As shown in Figure 3-9 one fire hydrant and seven single-family residences are located above the 1,460 ft elevation contour, with the hydrant at an elevation of 1,465 ft and the highest residence having a service connection at 1,490 ft.

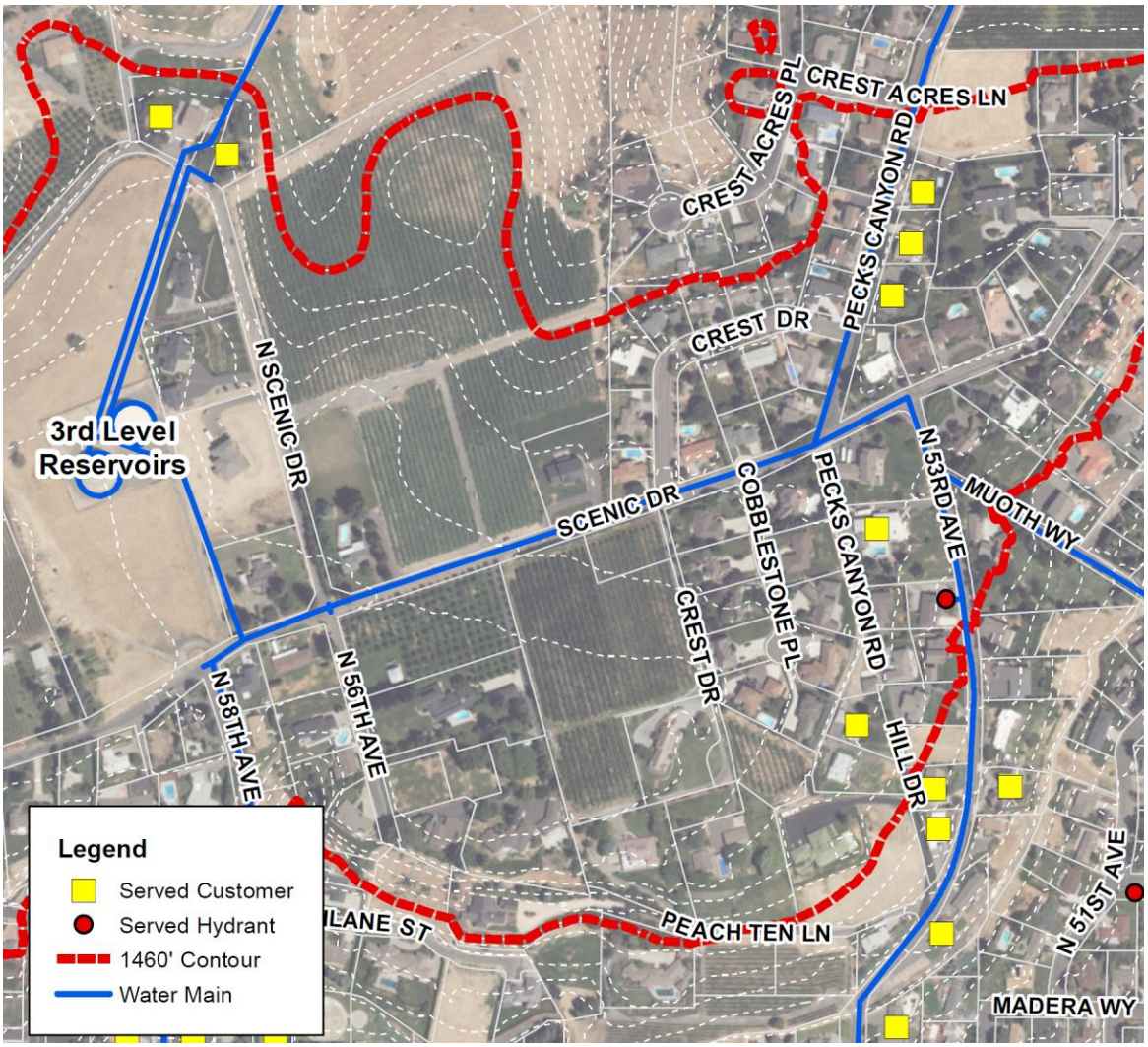
Table 3-13. 3rd Level Reservoir Storage Capacity Analysis for Years 2017 through 3037

	Year		
	2017	2027	2037
Projected 3rd Level Equivalent Residential Units (ERUs) [1]	2,121	2,201	2,270
Projected 3rd Level Demand [2]			
Average Day (mgd)	0.49	0.51	0.53
Maximum Day (mgd)	0.87	0.90	0.93
Peak Hour Demand (mgd)	1.42	1.47	1.51
Existing 3rd Level Sources			
3rd Level Pump Station			
30 HP Pump (gpm)	400	400	400
125 HP Pump (gpm)	1,700	1,700	1,700
Total Available Source (gpm)	2,100	2,100	2,100
Required Storage Calculations			
Operational Storage (gal) [3]	106,000	106,000	106,000
Equalizing Storage (gal) [4]	0	0	0
Standby Storage (gal) [5]	424,000	440,000	454,000
Fire Suppression Storage (gal) [6]	960,000	960,000	960,000
Required Storage			
Greater than 30 psi at highest meter (gal) [7]	106,000	106,000	106,000
Greater than 20 psi at highest meter (gal) [8]	1,066,000	1,066,000	1,066,000
Existing Storage Greater than 30 psi			
North 3rd Level Reservoir (gal)	53,000	53,000	53,000
South 3rd Level Reservoir (gal)	53,000	53,000	53,000
Total Existing Storage at 30 psi (gal)	106,000	106,000	106,000
Storage Surplus/(Deficiency) at 30 psi (gal) [9]	0	0	0
Existing Storage Greater than 20 psi			
North 3rd Level Reservoir (gal)	954,000	954,000	954,000
South 3rd Level Reservoir (gal)	1,007,000	1,007,000	1,007,000
Total Existing Storage at 20 psi (gal)	1,961,000	1,961,000	1,961,000
Storage Surplus/(Deficiency) at 20 psi (gal) [10]	895,000	895,000	895,000

Notes:
1. ERUs calculated as average day demand / ERU water use factor (233 gpd/ERU).
2. Details of projected demands are in Chapter 2.
3. Required operational storage based on storage reservoir levels of lowest pump call and highest pump release.
4. Required equalizing storage = (PHD - total available source) x 150 minutes, but no less than zero.
5. Required standby storage = greater of 2×(ADD - total source with largest source out of service) or 200 gallons per ERU.
6. Fire flow storage = 4,000 gpm × 4 hours.
7. Equal to the combined volume of operational and equalizing storage.
8. Equal to the combined volume of operational and equalizing storage plus the greater of standby or fire flow storage (nested fire flow storage).

9. Storage surplus/deficiencies based on a service elevation of 1,460 ft, the elevation that creates a net zero surplus/deficiency in storage required at 30 psi. One fire hydrant and 7 single-family residences are located above this elevation with the hydrant at an elevation of 1,465 ft and the highest residence having a service connection at 1,490 ft.
10. Available to meet standby and fire suppression storage needs for the 2nd Level Pressure zone.

Figure 3-9. Low Pressure Service Connections in 3rd Level Pressure Zone



Several of these residences use private, individual booster pumps to raise their water pressure. No recent complaints about low water pressure by these residences have been received.

These low pressure service connections have been in existence for more than 20 years. Given the low number of service connections located higher than 1,460 ft, the established operation of the system in the current configuration, and the high cost for increasing storage, the City does not have any plans to make improvements related to pressures for these few service connections. In this area above 1,460 ft, no new service connections to the City distribution system will be made unless a new pressure zone is created in this area. Any properties in this area requesting a new water service connection will be considered for potential service by the Nob Hill Water Association instead of the City system.

3.6.2 2nd Level Reservoirs Evaluation

The 2nd Level Reservoirs evaluation examines the adequacy of the 2nd Level Reservoirs to meet the demands of the area they serve.

The 2nd Level Reservoirs serve by gravity the demands of the 2nd Level pressure zone and are filled from the 1st Level pressure zone via the Stone Church and 40th Avenue Pump Station.

However, due to PRV connections, the surplus water stored in the higher 3rd Level Reservoirs is also available by gravity to meet emergency storage requirements in the 2nd Level pressure zone. Therefore, the analysis of fire suppression and standby storage volumes for the 2nd Level zone (which must be provided from elevations so as to provide a minimum of 20 psi to customers in this zone) considers the storage available in the 2nd Level Reservoirs and the surplus storage in the 3rd Level Reservoirs

Table 3-14 provides a summary of the storage capacity evaluation for the 2nd Level Reservoirs. The evaluation found that the 2nd Level Reservoirs have no storage deficiencies during the forecast period for the area that it serves.

Table 3-14. 2nd Level Reservoir Storage Capacity Analysis for Years 2017 through 3037¶

	Year		
	2017	2027	2037
Projected 2nd Level Equivalent Residential Units (ERUs) [1]	7,292	7,537	7,750
Projected 2nd Level Demand [2]			
Average Day (mgd)	1.70	1.76	1.81
Maximum Day (mgd)	2.98	3.08	3.17
Peak Hour Demand (mgd)	4.81	4.97	5.11
Existing 2nd Level Sources			
40th Avenue Pump Station			
40 HP Pump (gpm)	1,000	1,000	1,000
60 HP Pump (gpm)	1,500	1,500	1,500
100 HP Pump (gpm)	2,500	2,500	2,500
Stone Church Pump Station			
50 HP Pump (gpm)	700	700	700
100 HP Pump (gpm)	1,500	1,500	1,500
125 HP Pump (gpm)	2,500	2,500	2,500
Total Available Source (gpm)	9,700	9,700	9,700
Required Storage Calculations			
Operational Storage (gal) [3]	6,473,000	6,473,000	6,473,000
Equalizing Storage (gal) [4]	0	0	0
Standby Storage (gal) [5]	1,458,000	1,507,000	1,550,000
Fire Suppression Storage (gal) [6]	1,080,000	1,080,000	1,080,000
Required Storage			
Greater than 30 psi at highest meter (gal) [7]	6,473,000	6,473,000	6,473,000
Greater than 20 psi at highest meter (gal) [8]	7,931,000	7,980,000	8,023,000
Existing Available Storage Greater than 30 psi [10]			
North 2nd Level Reservoir (gal)	12,945,000	12,945,000	12,945,000
South 2nd Level Reservoir (gal)	12,945,000	12,945,000	12,945,000
Total Existing Storage at 30 psi (gal)	25,890,000	25,890,000	25,890,000
Storage Surplus/(Deficiency) at 30 psi (gal)	19,417,000	19,417,000	19,417,000
Existing Available Storage Greater than 20 psi [9, 10]			
North 2nd Level Reservoir (gal)	12,945,000	12,945,000	12,945,000
South 2nd Level Reservoir (gal)	12,945,000	12,945,000	12,945,000
3rd Level Excess Storage at 20 psi (gal) [11]	895,000	895,000	895,000
Total Existing Storage at 20 psi (gal)	26,785,000	26,785,000	26,785,000
Storage Surplus/(Deficiency) at 20 psi (gal) [12]	18,854,000	18,805,000	18,762,000

Notes:
1. ERUs calculated as average day demand / ERU water use factor (233 gpd/ERU).
2. Details of projected demands are in Chapter 2.

3. Required operational storage based on storage reservoir levels of lowest pump call and highest pump release.
4. Required equalizing storage = (PHD - total available source) x 150 minutes, but no less than zero.
5. Required standby storage = greater of 2×(ADD - total source with largest source out of service) or 200 gallons per ERU.
6. Fire flow storage = 4,500 gpm × 4 hours.
7. Equal to the combined volume of operational and equalizing storage.
8. Equal to the combined volume of operational and equalizing storage plus the greater of standby or fire flow storage (nested fire flow storage).
9. Includes storage volumes in reservoirs of higher pressure zones (excluding operational and equalizing storage).
10. Highest service connection is at approx. 1,270 ft near the intersection of Summitview Ave. and N 40th Ave.
11. Storage surplus at 20 psi from Table 3 13.
12. Available to meet standby and fire suppression storage needs for the 1st Level Pressure zone.

3.6.3 1st Level Reservoir Evaluation

The 1st Level Reservoir evaluation examines the adequacy of the 1st Level Reservoir to meet the demands of the area it serves.

The 1st Level Reservoir serves by gravity the demands of the 1st Level pressure zone and are filled primarily from gravity flows from the WTP with supplemental flows from the seasonal groundwater wells, Gardner Park, Kissel Park, Airport, and Kiwanis Park. As a conservative approach to including the seasonal wells, from the ground water wells, only the Gardner Park Well is included as a source.

However, due to PRV connections, the surplus water stored in the higher 2nd Level Reservoirs is also available by gravity to meet emergency storage requirements in the 1st Level pressure zone. Therefore, the analysis of fire suppression and standby storage volumes for the 1st Level zone (which must be provided from elevations so as to provide a minimum of 20 psi to customers in this zone) considers storage available in the 1st Level Reservoir and the surplus storage in the 2nd Level Reservoirs, which in turn account for surplus storage in the 3rd Level Reservoirs as well.

The Gardner Park Well, which operates on a VFD, is manually operated on an as needed basis and is not automatically operated based on levels in the 1st Level Reservoir. The WTP provides a constant gravity flow which is manually increased or decreased depending on predicted near-term demand.

Because of these operating conditions, the storage analysis assumes zero operating storage for the reservoir. Equalizing storage was estimated by running an extended period simulation (EPS) in the water system model using the maximum day demands and summer diurnal curve presented in Section 3.1.5. During the EPS run, the only source contributing water into the system was the WTP. The flow from the WTP was adjusted until the storage levels in the 1st Level Reservoir reached an equilibrium (reservoir level did not have a losing or gaining pattern) across the EPS run. The difference between reservoir level high and low points is then used as the equalizing storage. Plots of this analysis for the forecast years are shown in Figure 3-10, Figure 3-11, and Figure 3-12. The figures show a slight increase in equalizing storage through the forecast period beginning with a current equalizing storage height of 3.3 ft and increasing to 3.4 ft and 3.5 ft in years 2027 and 2037, respectively. These heights are then translated into volumes, considering the dimensions of the 1st Level Reservoir.

Figure 3-10. 2017 EPS Run for Determining Equalizing Storage

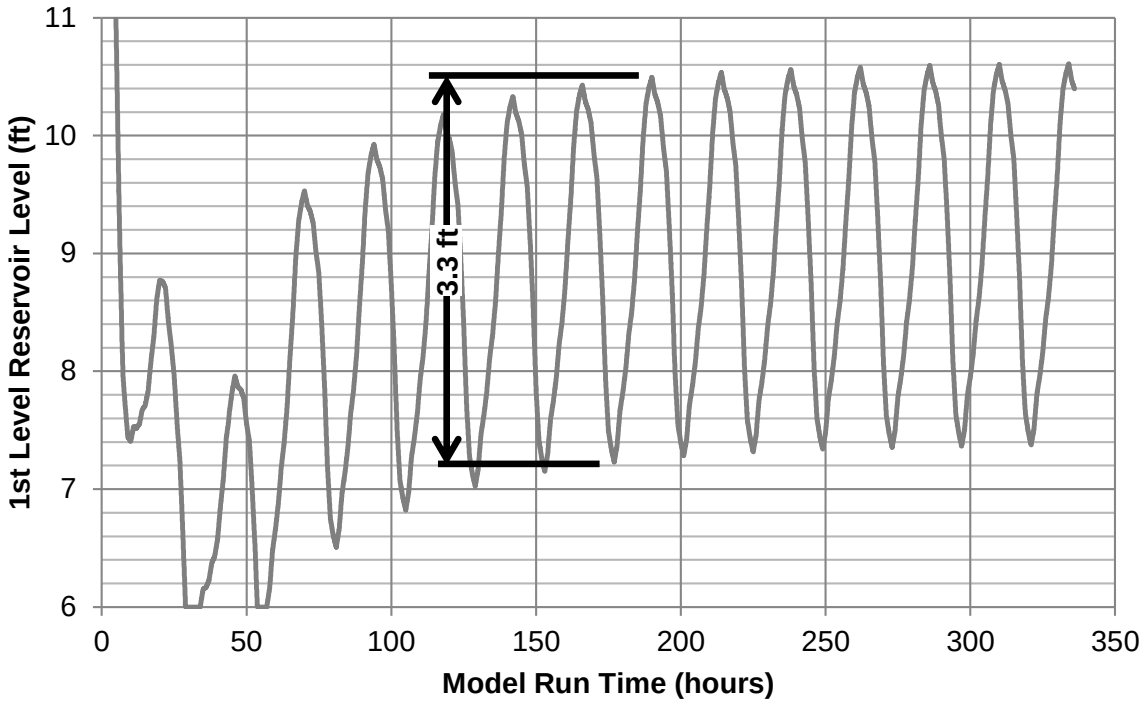


Figure 3-11. 2027 EPS Run for Determining Equalizing Storage

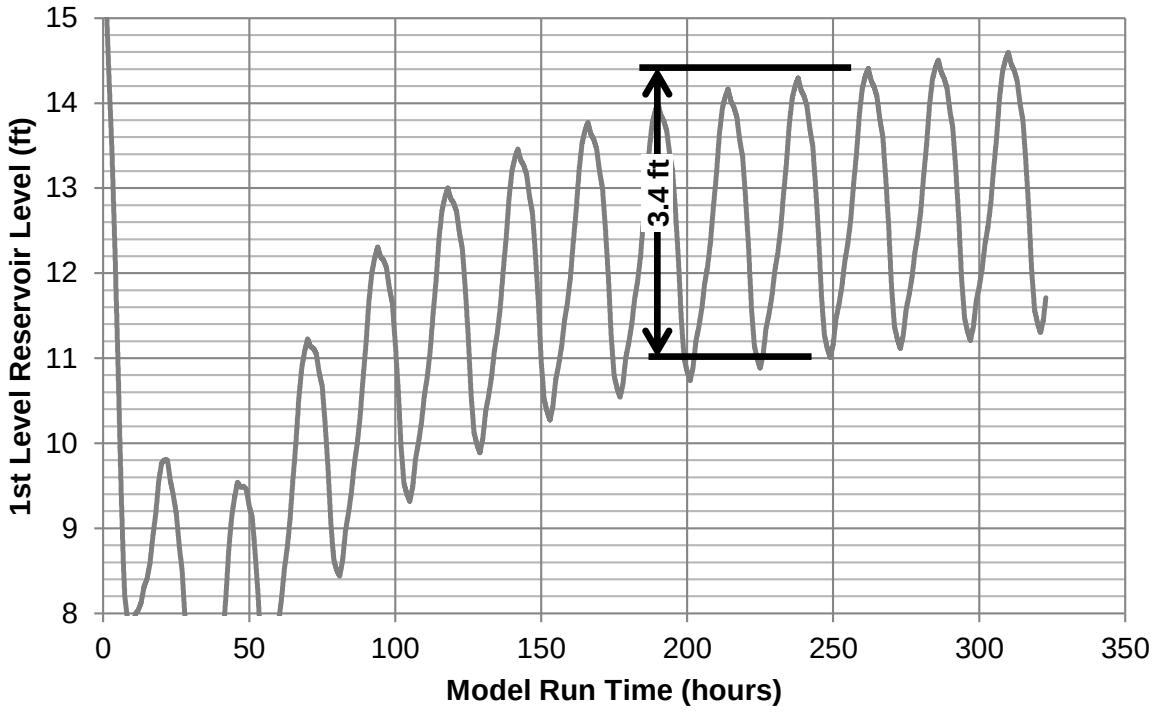
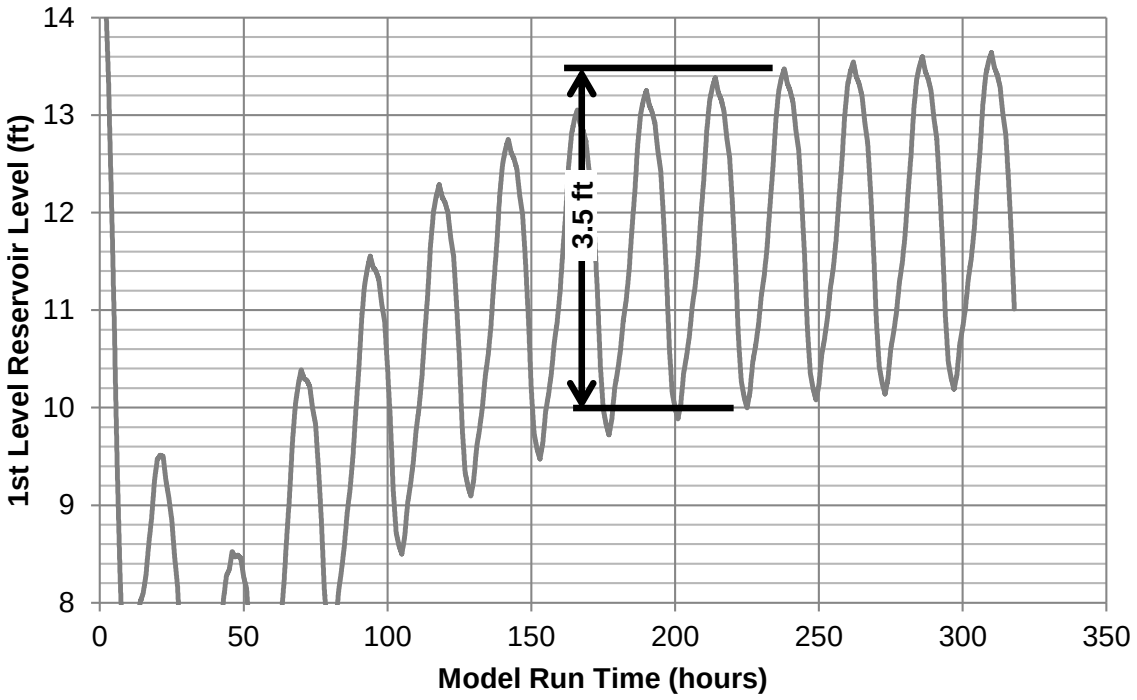


Figure 3-12. 2037 EPS Run for Determining Equalizing Storage



The modeled equalizing storage was validated by looking at the high and low levels in the 1st Level Reservoir as recorded by the City's SCADA system around the maximum day demand in 2015 and when the WTP was delivering a constant flow. This is shown in Figure 3-13. The conservative values of equalizing storage from the EPS runs of the model were used for the storage capacity analysis.

Figure 3-13. 1st Level Reservoir Water Surface Elevations Near Maximum Day Demand

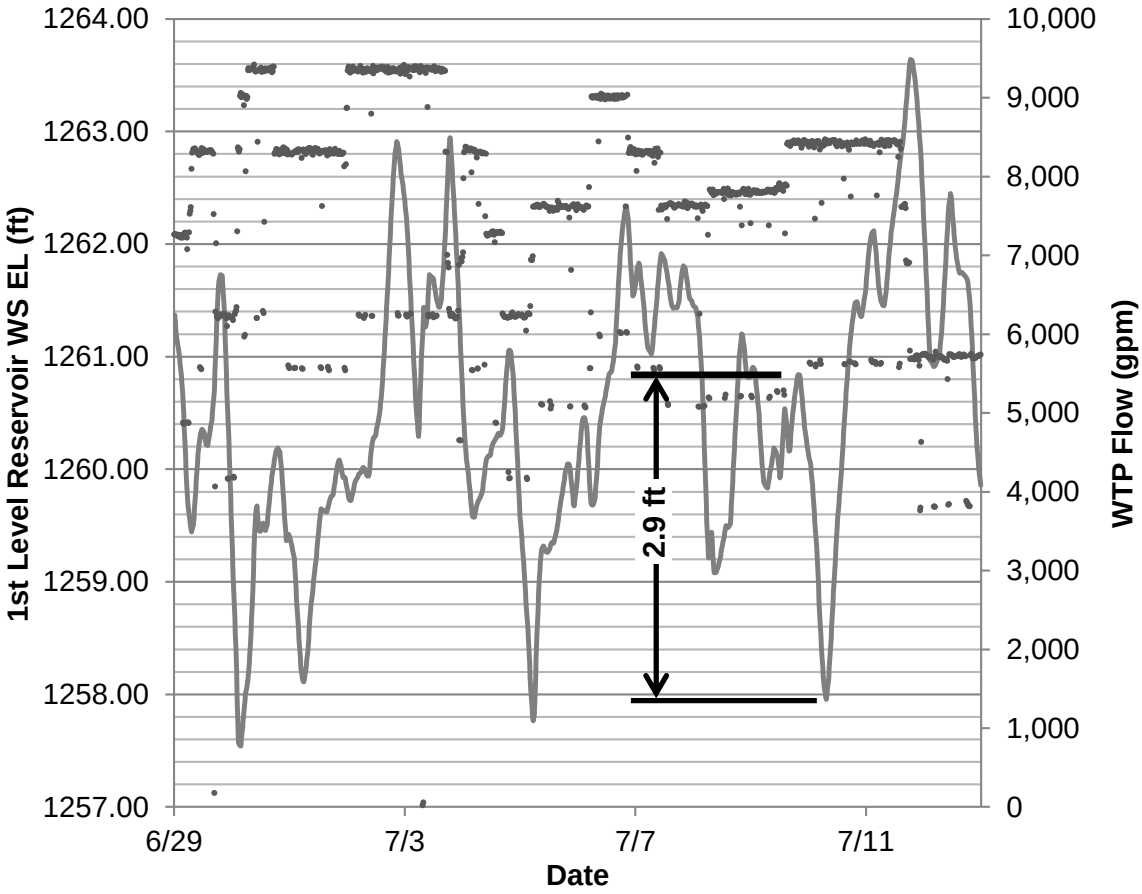


Table 3-15 provides a summary of the storage capacity evaluation for the 1st Level Reservoir. The evaluation found that the 1st Level Reservoir has no storage deficiencies during the forecast period for the area that it serves. It is noted that surplus storage in the 2nd Level Reservoirs is used to meet the standby storage requirement in the 1st Level pressure zone.

Table 3-15. 1st Level Reservoir Storage Capacity Analysis for Years 2017 through 3037

	Year		
	2017	2027	2037
Projected 1st Level Equivalent Residential Units (ERUs) [1]	35,698	36,953	38,042
Projected 1st Level Demand [2]			
Average Day (mgd)	8.32	8.61	8.86
Maximum Day (mgd)	14.58	15.10	15.54
Peak Hour Demand (mgd)	23.43	24.25	24.96
Existing 1st Level Sources			
Naches River WTP (gpm)	14,976	14,976	14,976
Gardner Park Well (gpm)	3,000	3,000	3,000
Total Available Source (gpm)	17,976	17,976	17,976
Required Storage Calculations			
Operational Storage (gal) [3]	0	0	0
Equalizing Storage (gal) [4]	850,000	876,000	902,000
Standby Storage (gal) [5]	7,995,000	8,580,000	9,088,000
Fire Suppression Storage (gal) [6]	1,500,000	1,500,000	1,500,000
Required Storage			
Greater than 30 psi at highest meter (gal) [7]	850,000	876,000	902,000
Greater than 20 psi at highest meter (gal) [8]	8,845,000	9,456,000	9,990,000
Existing Available Storage Greater than 30 psi [10]			
1st Level Reservoir	5,696,000	5,696,000	5,696,000
Total Existing Storage at 30 psi (gal)	5,696,000	5,696,000	5,696,000
Storage Surplus/(Deficiency) at 30 psi (gal)	**4,846,000**	**4,820,000**	**4,794,000**
Existing Available Storage Greater than 20 psi [9, 10]			
1st Level Reservoir (gal)	5,696,000	5,696,000	5,696,000
2nd Level Excess Storage at 20 psi (gal) [(11)]	18,854,000	18,805,000	18,762,000
Total Existing Storage at 20 psi (gal)	24,550,000	24,501,000	24,458,000
Storage Surplus/(Deficiency) at 20 psi (gal)	15,705,000	15,045,000	14,468,000

Notes:
1. ERUs calculated as average day demand / ERU water use factor (233 gpd/ERU).
2. Details of projected demands are in Chapter 2.
3. Because the 1st Level is primarily fed by a continuous source (Naches River WTP) there is no operational storage.
4. Required equalizing storage based on an extended period simulation run of the system's water model.

5. Required standby storage = greater of 2×(ADD - total source with largest source out of service) or 200 gallons per ERU.
6. Fire flow storage = 6,250 gpm × 4 hours.
7. Equal to the combined volume of operational and equalizing storage.
8. Equal to the combined volume of operational and equalizing storage plus the greater of standby or fire flow storage (nested fire flow storage).
9. Includes storage volumes in reservoirs of higher pressure zones (excluding operational and equalizing storage).
10. Highest service connection is at approx. 1,160 ft near the intersection of W Chestnut Ave. and S 19th Ave.
11. Storage surplus at 20 psi from Table 3 14.

3.6.4 Identified Improvements

No improvements are currently identified for the storage reservoirs in the system.

3.7 Distribution System Analysis

The purpose of the hydraulic analysis is to evaluate the hydraulic capacity and operational behavior of the City's water distribution system and to determine how the supply, pumping, and storage components interact.

3.7.1 Description of Analysis Approach

Computer Hydraulic Model

As part of the development of the 1995 Water Comprehensive Plan, the City developed an EPANET water system model based on information from the City's GIS system. In subsequent water system plans, the model has been continually updated to keep the model current with changes to the City's water infrastructure. The City currently keeps the water system model in EPANET Version 2.0 and uses the model to perform static and dynamic hydraulic and water quality analyses.

For the conveyance system analysis for this Water System Plan Update, the City's existing EPANET model was exported into Bentley WaterCAD V8i Select Series 5 to complete the modeling work.

After exporting to WaterCAD, the physical parameters of the model were checked and updated as needed. This work included:

- Updating pump curves in the model
- Updating PRV settings
- Updating model node elevations to most recent contour data (2-ft interval) available
- Updating pump operational rules/controls

After the physical parameters of the model were updated, demands were then allocated into the model.

Demand Allocation

Demands are allocated to junction nodes in the model. Junctions are located at the intersections of pipe mains and, in some locations, between intersections. Junction nodes are not included for every service connection.

Thiessen polygons were created for the junctions in the model to determine the contributing area for each model junction. Some nodes in the model were excluded as they were either on transmission piping or nodes used to represent the reservoir, pump

station, and well components in the model and therefore do not include any demands. The Thiessen polygons were then overlaid with 2016 parcel land use data to determine the junction each parcel should be assigned to.

Existing and forecasted demands were developed for each customer class for each pressure zone. After subtracting the demand of the top 20 users from the associated customer class demand, the remaining customer class demand in each pressure zone was evenly distributed to each parcel related to that customer class. The demand of each of the top 20 users was then applied to specific junctions in the model that were near each user.

For each pressure zone, a correction factor was globally applied to all the demand junctions within a pressure zone to make minor adjustments to make the pressure zone wide demands in the model match the demands developed in the demand forecast.

For EPS runs of the model, demand curves were added to junction demands based on the diurnal curve discussed in Section 3.1.5.

Calibration

A steady-state calibration of the model was completed using data collected from fourteen fire hydrant flow tests performed throughout the distribution system. The static and residual pressures measured from the flow tests were then compared to the predicted values in the model. Calibration of the model was performed primarily by adjusting roughness factors for pipes. Table 3-16 summarizes the measured field data and predicted model values after performing the model calibration.

Data on pipe materials and age were not readily available for the majority of the pipes in the system. Instead of using an automated calibration process where pipes of similar materials and age are grouped together with a similar roughness factor, a manual calibration process was followed that grouped areas of the system together based on proximity to hydrant test locations with roughness factors adjusted.

There are no standard industry adopted criteria for calibrating a water system model. However, for a model used for general water system planning, general guidelines include keeping predicted hydraulic grade line results to within 10 feet (4.3 psi) of measured values and, in the case of hydrant flow testing, keeping the difference in the measured pressure drop to predicted pressure drop under 5 psi. After calibration, the model meets both these criteria in all hydrant test locations.

After review of the data collected from the field and model, it was determined that any discrepancies between the field and model were within a reasonable margin of error and that the model was sufficiently calibrated to performed the required analysis.

Table 3-16. Calibration Test Data

Test Location	Zone	Hydrant Flow (gpm)	Field Static Pressure (psi)	Model Static Pressure (psi)	Static Pressure Difference (psi)	Field Residual Pressure (psi)	Model Residual Pressure (psi)	Residual Pressure Difference (psi)	Field Pressure Drop (psi)	Model Pressure Drop (psi)	Difference in Field and Model Pressure Drop (psi)
4710 Avalanche Ave	3rd Lvl	1,047	109	107.8	1.2	48	51.1	-3.1	61	56.7	-4.3
6006 Douglas Dr	3rd Lvl	1,324	78	80.0	-2.0	48	47.8	0.2	30	32.2	2.2
4102 Donald Dr	3rd Lvl	1,443	88	88.8	-0.8	70	68.8	1.2	18	20.0	2.0
1201 S 45th Ave	2nd Lvl	1,147	96	96.7	-0.7	56	57.9	-1.9	40	38.8	-1.2
3210 W Lincoln Ave	2nd Lvl	1,047	72	75.5	-3.5	44	46.4	-2.4	28	29.1	1.1
411 S 32nd Ave	2nd Lvl	1,147	54	54.7	-0.7	36	38.4	-2.4	18	16.3	-1.7
3711 W Wash. Ave	1st Lvl	1,752	74	70.6	3.4	62	61.5	0.5	12	9.1	-2.9
1317 S 16th Ave	1st Lvl	1,047	90	89.0	1.0	70	71.6	-1.6	20	17.4	-2.6
1626 Rudkin Rd	1st Lvl	1,047	106	106.4	-0.4	96	98.3	-2.3	10	8.1	-1.9
1118 Jefferson Ave	1st Lvl	1,047	74	73.6	0.4	54	51.9	2.1	20	21.7	1.7
2104 Jerome Ave	1st Lvl	1,405	66	64.6	1.4	46	43.3	2.7	20	21.3	1.3
710 E “F” St	1st Lvl	1,060	82	78.1	3.9	46	44.1	1.9	36	34.0	-2.0
102 N Fair Ave	1st Lvl	1,931	90	91.2	-1.2	80	82.1	-2.1	10	9.1	-0.9
1009 Madison Ave	1st Lvl	1,783	70	66.8	3.2	54	53.8	0.2	16	13.0	-3.0

Conditions and Scenarios

In accordance with WAC 246-290-230, a minimum pressure of 30 psi must be maintained at all customer connections under peak hour demand (PHD) conditions with operational and equalizing storage volumes depleted in the reservoirs. DOH also recommends keeping velocities under 8 ft/s during PHD conditions. A minimum of 20 psi must be maintained for fire flows under MDD conditions with operational, equalizing, and fire flow storage depleted.

A number of steady state hydraulic analyses were completed for each pressure zone for existing (2017), 10-year (2027), and twenty-year (2037) demand conditions. These considered peak hour demand and fire flow demand (MDD plus fire flow) conditions. Table 3-17 describes the modeling scenarios conducted, and the sequence within which they were performed. The results of the peak hour and fire flow analyses are described in greater detail below.

Table 3-17. System Analysis Modeling Scenarios

Scenario Description	Demand
Existing year (2017) peak hour	2017 peak hour demand
Existing year (2017) fire flow	2017 maximum day demand plus fire flow
Plan year 10 (2027) peak hour	2027 peak hour demand
Plan year 10 (2027) fire flow	2027 maximum day demand plus fire flow
Plan year 20 (2037) peak hour	2037 peak hour demand
Plan year 20 (2037) fire flow	2037 maximum day demand plus fire flow

All system analysis modeling results are based on a steady state analysis; however, EPS simulations were completed to determine equalizing storage for the 1st Level Reservoir as discussed in Section 3.6.1. All scenarios in Table 3-17 place the WTP and Gardner Park Well operating at full capacity, while the three seasonal wells are not in operation for any of the scenarios, which represents a typical operating condition for the system. Reservoir water surface levels used for the scenarios are summarized in Table 3-18.

The operating conditions of having the WTP capacity reduced or completely offline are not typical operating conditions and therefore were not modeled in the distribution system analysis. Incorporation of potential new ASR wells in the 2027 and 2037 model scenarios were not included. Modeling of these new sources will be conducted as plans for the ASR facilities develop.

Table 3-18. Reservoir Water Surface Elevations for Scenarios

Scenario	Depleted Storage Volumes	1st Level Reservoir	2nd Level Reservoirs	3rd Level Reservoirs
2017 PHD	ES, OS	1,260.70	1,374.00	1,529.00
2017 Fire Flow	ES, OS, FSS	1,254.88	1,373.00	1,519.95
2027 PHD	ES, OS	1,260.60	1,374.00	1,529.00
2027 Fire Flow	ES, OS, FSS	1,254.78	1,373.00	1,519.95
2037 PHD	ES, OS	1,260.50	1,374.00	1,529.00
2037 Fire Flow	ES, OS, FSS	1,254.68	1,373.00	1,519.95

Deficiencies evaluated for each condition and scenario are described herein. Under the peak hour condition, the water system was evaluated to identify any areas of the system that may have a pressure below 30 psi or pipes with a velocity exceeding 8 ft/s. Under the maximum day plus fire flow condition, the water system was evaluated for its ability to provide the required fire flow capacity while maintaining residual pressures above 20 psi within the pressure zone of the hydrant being analyzed.

3.7.2 Peak Hour Demand Analysis Results

2017 Peak Hour Demand

When running the model for the existing (2017) peak hour demand, all service connections had pressures that exceeded 30 psi. The only model nodes with pressures less than 30 psi were located near the 2nd and 3rd Level Reservoirs or on the 1st Level Reservoir transmission line. Additionally, all pipes in the system have a velocity under 8 ft/s, with the exception of the Gardner Park Well discharge pipe. When the well operates at full capacity (3,000 gpm) the velocity in its 20 foot long, 12-inch discharge pipe is 8.5 ft/s. There are a number of nodes at the lowest portions of the 3rd Level and 2nd Level pressure zones that have pressures that exceed 100 psi. The City is not aware of any current high pressure issues or complaints in these areas. Therefore, no modification of the pressure zones will be made to lower system pressures.

The results of the 2017 peak hour demand analysis is shown in Figure 3-14.

2027 Peak Hour Demand

When running the model for the 10-year (2027) peak hour demand, all service connections had pressures that exceeded 30 psi. The only model nodes with pressures less than 30 psi were located near the 2nd and 3rd Level Reservoirs or on the 1st Level Reservoir transmission line. Additionally, all pipes in the system have a velocity under 8 ft/s, with the exception of the Gardner Park Well.

The results of the 2027 peak hour demand analysis is shown in Figure 3-15.

2037 Peak Hour Demand

When running the model for the 20-year (2037) peak hour demand, all service connections had pressures that exceeded 30 psi. The only model nodes with pressures less than 30 psi were located near the 2nd and 3rd Level Reservoirs or on the 1st Level Reservoir transmission line. Additionally, all pipes in the system have a velocity under 8 ft/s, with the exception of the Gardner Park Well.

The results of the 2027 peak hour demand analysis is shown in Figure 3-16.

Note: <20 psi node is on transmission pipe to/from 1st Level Reservoir

LEGEND

City Limits Boundary

Pressure Zone

- 1st Level
- 2nd Level
- 3rd Level

Pipe Diameter (in Inches)

- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 48
- 54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Pressure (psi)

- <30
- 30-50
- 50-100
- >100

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2017 PEAK HOUR DEMAND RESULTS

FIGURE 3-14

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

82

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-14_2017_PHD_RESULTS.MXD - USER: DKUHNS - DATE: 12/12/2016

Note: <20 psi node is on transmission pipe to/from 1st Level Reservoir

LEGEND

City Limits Boundary

Pressure Zone

- 1st Level
- 2nd Level
- 3rd Level

Existing Pipe

Pipe Diameter (in Inches)

- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 48
- 54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Proposed Pipe

Pipe Diameter (in Inches)

- 8
- 12

Pressure (psi)

- <30
- 30-50
- 50-100
- >100

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2027 PEAK HOUR DEMAND RESULTS

FIGURE 3-15

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

82

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-15_2027_PHD_RESULTS.MXD - USER: DKUHNS - DATE: 12/12/2016

Note: <20 psi node is on transmission pipe to/from 1st Level Reservoir

LEGEND

City Limits Boundary

Pressure Zone

- 1st Level
- 2nd Level
- 3rd Level

Existing Pipe

Pipe Diameter (in Inches)

- 6
- 8
- 10
- 12
- 16
- 18
- 20
- 24
- 30
- 48
- 54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Proposed Pipe

Pipe Diameter (in Inches)

- 8
- 12

Pressure (psi)

- <30
- 30-50
- 50-100
- >100

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2037 PEAK HOUR DEMAND RESULTS

FIGURE 3-16

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

82

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-16_2037_PHD_RESULTS.MXD - USER: DKUHNS - DATE: 12/12/2016

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3.7.3 Fire Flow Analysis Results

A fire flow run of the hydraulic model was used to determine the maximum fire flow available[1] during maximum day demand (MDD) conditions. The maximum fire flow available is defined as the maximum flow that can be delivered to a fire flow node while keeping system pressures above 20 psi with operational, equalizing, and fire flow storage depleted. This is then compared to the required fire flow for the node to determine if there is a deficiency.

As part of the 2011 Water System Plan, the required fire flow for a number of locations throughout the system were determined based on the land use and building types which presently exist in the vicinity of those locations as determined by the International Fire Code Appendix B, Table B105.1, Fire Flow Requirements for Buildings. These locations, in addition to the largest fire flow demands per pressure zone (as used in Section 3.6) were entered into the model. A summary of these required fire flows at select nodes is given in Table 3-19.

For the remaining fire flow nodes throughout the water system, general fire flow goals were applied based on the following:

- Surrounding zoning is single family residential = 1,000 gpm
- Surrounding area includes zoning that is not single family residential = 1,500 gpm

Table 3-19. Specific Fire Flow Required for Select Locations

Model Node #	Location	Fire Flow (gpm)
2651	By Greenway/I-82 across from Gateway	5,000
2652	N. Fair Avenue and Gateway Center	5,000
1179	Pacific Ave. and S. 18 St.	3,000
1909	Rudkin Road and East Mead Ave.	4,000
1826	S. 1st St. and E. Washington Ave.	5,000
1920	S. 16th Ave. and Ahtanum Rd.	6,000
1794	S. 24th Ave. and W. Washington Ave.	6,000
1729	S. 36th Ave. and W. Washington Ave.	4,000
1381	W. Nob Hill Blvd. and S. 44th Ave.	4,000
142	N. 6th Ave. and River Road	6,000
1384	S. 32nd Ave. and W. Nob Hill Blvd.	5,000
842	N. 44th Ave. and Summitview Ave.	3,000
830	N. 40th Ave. and Summitview Ave.	4,000

[1] The available fire flow calculated in the hydraulic model is equivalent to what the distribution system can deliver to a location, not necessarily what a single hydrant on a lateral off the distribution main would be able to convey.

Table 3-19. Specific Fire Flow Required for Select Locations (Cont'd.)

Model Node #	Location	Fire Flow (gpm)
476	Englewood Ave. and N. 56th Ave.	3,000
332	Webster and N. 44th Ave.	3,000
817	N. 32nd Ave. and Summitview Ave.	5,000
1859	River Road and N. 16th Ave.	6,000
1821	Longfibre Rd. and W. Washington Ave.	6,000
1667	E. Mead Ave. and S. 1st St.	6,000
1640	W. Mead Ave. and S. 10th Ave.	4,000
1409	W. Nob Hill Blvd. and S. 10th Ave.	5,000
1378	W. Nob Hill Blvd. and Railroad Ave.	6,000
1442	W. Nob Hill Blvd. and S. 18th St.	4,000
871	E. Maple St. and S. Fair Ave.	4,000
966	S. Front St. and E. Pine Ave.	4,000
419	Poplar Ave. and N. 1st Ave.	5,000
128	Erickson Ln. and N. 6th St.	5,000
5872	N. 11th St. and E. "B" St.	5,000
5770	E. "S" St. and N. 4th St.	5,000
993	W. Chestnut Ave. and S. 24th Ave.	3,000
864	W. Yakima Ave. and N. 6th Ave.	5,000
651	Martin Luther King Blvd. and N. 1st Ave.	6,250
1202	S. 38th Ave. and Webster Ave.	4,500
1206	S. 36th Ave. and Webster Ave.	4,500
792	N. 41st Ave. and Snowmountain Rd.	4,000

2017 Fire Flow Analysis

Table 3-20and Figure 3-17 summarize the fire flow nodes that were found to have deficiencies. For the select fire flow nodes listed in Table 3-19, deficiencies existed for only one of the locations (#792). Improvements to solve deficiencies in other areas of the system are also provided in Figure 3-18 illustrates the current available fire flow at nodes throughout the system. Figure 3-19 illustrates the available fire flow given current demand once the identified and planned improvements are made.

2027 Fire Flow Analysis

The 2027 fire flow analysis incorporates the improvements identified in Table 3-20 as well as other system improvements currently planned by the City (see Section 3.7.4).

The analysis also incorporates infrastructure related to the development of the former Boise Cascade Mill Site to determine requirements needed for fire flow. The area was modeled by placing a 12-inch water main from the north end of N 10th Street to the east end of E Erikson Lane. Looped distribution branches using 8-inch pipe were added off of the new 12-inch main. Given this setup, ample fire flow is available for any type of development in the area (at least 7,200 gpm on the 12-inch main and at least 4,200 gpm on 8-inch looped mains).

As shown in Table 3-20 and Figure 3-20, no additional nodes were found to be deficient from the 2017 fire flow analysis. For the 2027 fire flow analysis, all nodes previously found to be deficient in the 2017 fire flow analysis had the deficiency either fully addressed by an identified improvement or had little change in available fire flow. Because of this, no further improvements are identified based on the 2027 fire flow analysis. Figure 3-21 illustrates the available fire flow at nodes throughout the system given the incorporation of improvements with 2027 demand.

2037 Fire Flow Analysis

The 2037 fire flow analysis utilizes the infrastructure used in the 2027 fire flow analysis with no other infrastructure added.

As shown in Table 3-20 and Figure 3-22, no additional nodes were found to be deficient from the 2027 fire flow analysis. For the 2037 fire flow analysis, all nodes previously found to be deficient in the 2027 fire flow analysis had the deficiency either fully addressed by an identified improvement or had little change in available fire flow. Because of this, no further improvements are identified based on the 2037 fire flow analysis. Figure 3-23 illustrates the available fire flow at nodes throughout the system given the incorporation of improvements with 2027 demand.

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Table 3-20. Fire Flow Node Deficiencies

Model Node #	Zone	Req. Fire Flow (gpm)	2017 Fire Flow Analysis							2027 Fire Flow Analysis			2037 Fire Flow Analysis		
			Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)	Select Fire Flow Node (Table 3-19)	Notes	Identified Improvements	Related CIP Improvement ID	Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)	Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)
2194	1st Lvl	1,500	721	48%	779		Located on the dead-end of a 6-inch line.	Install 12-inch DI pipe along Fruitvale Blvd connecting dead-end pipe with existing pipe in Fruitvale Blvd that ends at N 29th Ave. Additional looping could be provided to further increase fire flows by adding an additional loop on Fruitvale Blvd between River Rd and Chesterly Dr.	D-14	3,937	262%	0	3,920	261%	0
1209	1st Lvl	1,500	832	55%	669		Located on dead-end of 6-inch line	Install 6-inch DI along Peach Street connecting dead-end pipes of S 1st Ave and S 2nd Ave. Increases capable fire flow to over 1,500 gpm and provides looping of dead-end pipes. (Same project as improvement for node # 1208)	D-2	1,576	105%	0	1,567	104%	0
1208	1st Lvl	1,500	851	57%	649		Located on dead-end of 6-inch line	Install 6-inch DI connecting dead-end pipes of S 1st Ave and S 2nd Ave. Increases capable fire flow to over 1,500 gpm and provides looping of dead-end pipes. (Same project as improvement for node # 1209)	D-2	1,557	104%	0	1,548	103%	0
2330	1st Lvl	1,500	908	61%	592		Along N 3rd St between MLK Jr Blvd and East D St are two parallel water mains. One main is a 6-inch while the other is 4-inch. Deficient hydrant is located on the 4-inch main.	Shift hydrant connection from the 4-inch pipe to the 8-inch pipe by installing 6-inch DI pipe (approximately 80 LF) between the hydrant and the 8-inch main.	D-4	3,426	228%	0	3,409	227%	0
173	1st Lvl	1,500	932	62%	568		Hydrant located at the end of a dead-end main.	Add new 8-inch DI pipe to provide looping of three dead-end mains in the area. At the west end of Bartlett Pl add an 8-inch DI pipe going north. Extend the dead-end mains on E N St and Gordon Rd to connect to the 8-inch DI pipe to provide looping. (Same project as improvement for node # 113)	D-5	2,074	138%	0	2,063	138%	0
792	3rd Lvl	4,000	2,759	69%	1,241	**Yes**	Nodes in area are not capable of meeting required fire flow. Hydrants in area with a node located a block to the east within the 2nd Level zone is capable of delivering 5,955 gpm but would require hose runs > 500 ft.	N 42nd Ave and N 41st Ave between Lincoln Ave and Snowmountain Rd are populated by multifamily residential homes with fire flows from 1,900 gpm at the select fire flow node to 2,900 at nearby nodes. Due to the use of 6-inch and 8-incj pipe in this area of the 3rd Level zone. It is recommended to connect these streets to the 2nd Level zone 16-inch water main in N 40th Ave and upsize small sized mains in the area.	D-1	4,866	122%	0	4,810	120%	0
1372	1st Lvl	1,500	1,163	78%	337		Multiple hydrants in area with adjacent nodes in surrounding area capable of delivering over 5,000 gpm	None	None	1,165	78%	335	1,161	77%	339

Table 3-20. Fire Flow Node Deficiencies (Cont'd.)

Model Node #	Zone	Req. Fire Flow (gpm)	2017 Fire Flow Analysis							2027 Fire Flow Analysis			2037 Fire Flow Analysis		
			Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)	Select Fire Flow Node (Table 3-19)	Notes	Identified Improvements	Related CIP Improvement ID	Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)	Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)
113	1st Lvl	1,500	1,169	78%	331		Hydrant located at the end of a dead-end main.	Add new 8-inch DI pipe to provide looping of three dead-end mains in the area. At the west end of Bartlett Pl add an 8-inch DI pipe going north. Extend the dead-end mains on E N St and Gordon Rd to connect to the 8-inch DI pipe to provide looping. (Same project as improvement for node # 173)	D-5	2,896	193%	0	2,881	192%	0
2090	1st Lvl	1,000	858	86%	143		Hydrant is located near the end of a dead-end main. All parcels surrounding the main are developed single family residential properties making looping of line difficult. Next nearest hydrant is located 640 ft away.	Add additional hydrant on Chesterly Ln near intersection of N 34th Ave where higher fire flows are available. Although this does not increase available fire flow to the hydrant at the end of Chesterly Ln, it provides a new hydrant closer to the looped water main on N 34th Ave which has over 2,400 gpm in available fire flow.	D-6	856	86%	144	854	85%	146
367	1st Lvl	1,500	1,272	85%	228		Hydrant located at the end of a dead-end main. Main can be readily looped to provide adequate fire flow.	Add an 8-inch DI pipe on Willow St between N 4th Ave and N 3rd Ave to provide looping of existing main on N 3rd Ave.	D-7	3,402	227%	0	3,386	226%	0
2542	1st Lvl	1,500	1,297	86%	203		Current land use in area is industrial. Located on a dead-end 8-inch main, the next upstream node with a hydrant (located 450 ft away) is capable of delivering 1,560 gpm.	Installation of 12-inch DI pipe (approximately 530 LF) connecting the dead-end pipe in S 1st Ave with the dead-end of Division St. Increases capable fire flow to 4,200 gpm	D-3	3,909	261%	0	3,890	259%	0
588	2nd Lvl	1,000	879	88%	121		Hydrant located at the end of a dead-end main. Next nearest hydrant is approximately 690 ft to the south. Difficult to loop dead-end main due to street being fully developed.	Add second hydrant mid-block to meet City's 600 ft maximum spacing between hydrants in residential areas. Replace existing 6-inch pipe with 8-incj DI pipe (approximately 650 LF).	D-8	855	86%	145	852	85%	148
2448	1st Lvl	1,500	1,323	88%	177		Hydrant located at the end of a dead-end main. Main can be readily looped to provide adequate fire flow.	Installation of a 8-inch DI pipe (approximately 240 LF) connecting dead-end pipe mains to provide looping (same project as improvement for node # 2447)	D-9	2,602	173%	0	2,591	173%	0
1760	1st Lvl	1,500	1,376	92%	124		Hydrant located at dead-end main.	Add new 8 inch DI pipe (approximately 440 LF) extending dead-end main in Perry St to-the west. New 8-inch DI pipe would then go north within Gardner Park to connect to the existing main in W Pierce St to provide looping.	D-10	4,108	274%	0	4,087	272%	0
179	1st Lvl	1,500	1,390	93%	110		Adjacent nodes located to the east along N 1st St. capable of delivering 2,000 gpm. Node within 10% of goal.	None. Node is close to fire flow goal with nearby hydrant capable of meeting goal. Fire flow is also met after improvements made to nodes # 173 and # 113	D-5	1,500	100%	0	1,492	99%	8

Table 3-20. Fire Flow Node Deficiencies (Cont'd.)

Model Node #	Zone	Req. Fire Flow (gpm)	2017 Fire Flow Analysis							2027 Fire Flow Analysis			2037 Fire Flow Analysis		
			Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)	Select Fire Flow Node (Table 3-19)	Notes	Identified Improvements	Related CIP Improvement ID	Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)	Avail. Fire Flow (gpm)	% of Req. Avail.	Deficiency (gpm)
2447	1st Lvl	1,500	1,396	93%	104		Hydrant located at the end of a dead-end main. Main can be readily looped to provide adequate fire flow.	Installation of a 8-inch DI pipe (approximately 240 LF) connecting dead-end pipe mains to provide looping (same project as improvement for node # 2448)	D-6	2,654	177%	0	2,642	176%	0
2760	1st Lvl	1,500	1,443	96%	57		Fire flow restricted due to use of 4-inch pipe on part of loop.	Add a new 8-inch DI pipe on Stewart St between S 4th Ave and S 3rd Ave (approximately 310 LF)	D-11	3,874	258%	0	3,851	257%	0
1332	1st Lvl	1,500	1,473	98%	27		Fire flow restricted due to use of 4-inch pipe on part of loop.	Replace existing 4-inch pipe on S 6th St between E Yakima Ave and E Chestnut Ave (approximately 500 LF) with 8-inch DI pipe.	D-12	3,074	205%	0	3,059	204%	0

LEGEND

City Limits Boundary

Pressure Zone

1st Level

2nd Level

3rd Level

Pipe Diameter (in Inches)

6

8

10

12

16

18

20

24

30

48

54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

% of Fire Flow Goal

>100%

90-100%

75-90%

50-75%

25-50%

<25%

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2017 FIRE FLOW DEFICIENCIES

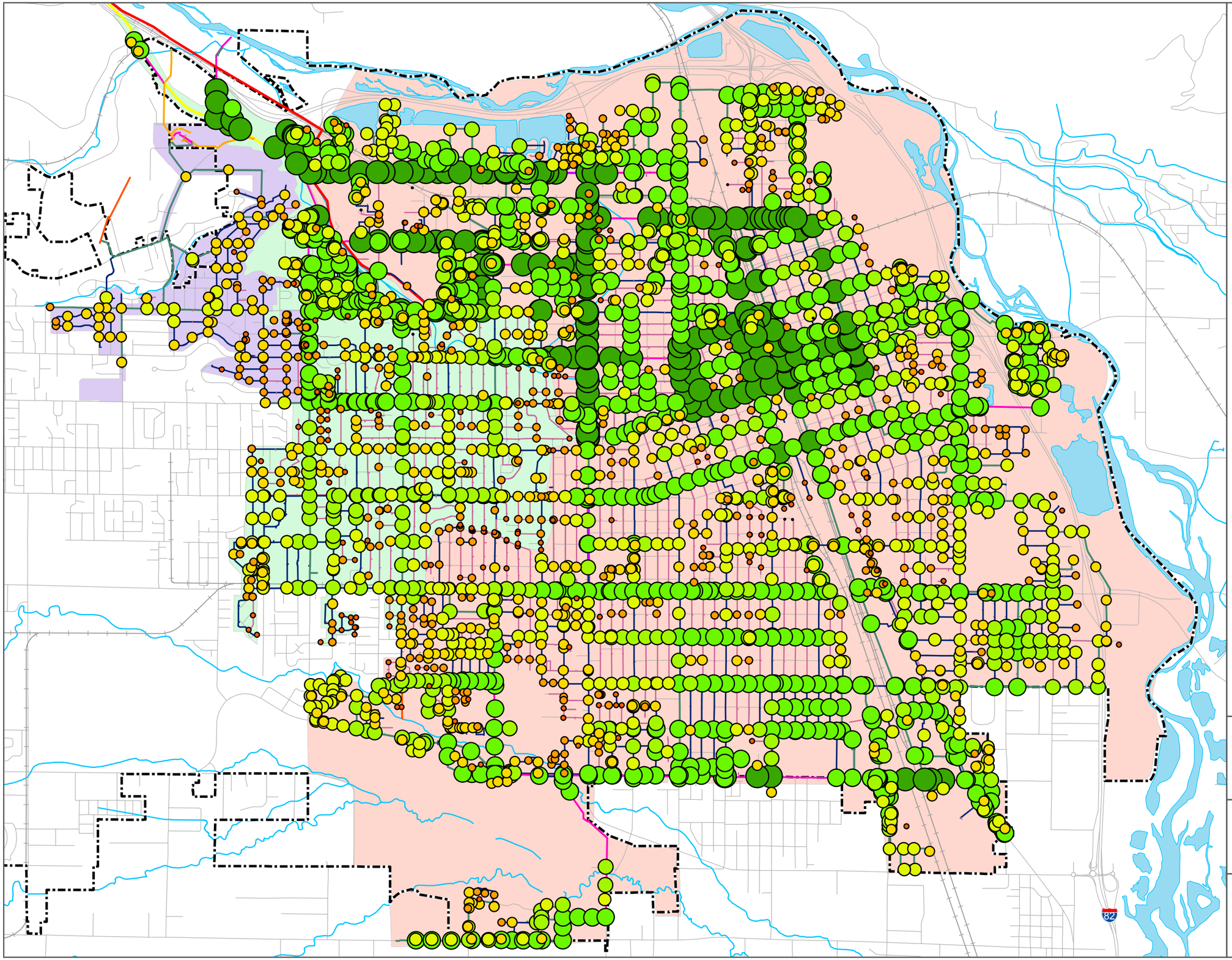
FIGURE 3-17

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES



LEGEND

City Limits Boundary

Pressure Zone

1st Level

2nd Level

3rd Level

Existing Pipe

Pipe Diameter (in Inches)

6

8

10

12

16

18

20

24

30

48

54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Available Fire Flow (gpm)

<1000

1,000-2,000

2,000-3,000

3,000-4,000

4,000-5,000

5,000-6,000

6,000-10,000

>10,000

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2017 AVAILABLE FIRE FLOW

FIGURE 3-18

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-18_2017_AVAIL_FF_WO_IMPR.MXD - USER: DKUHNS - DATE: 12/12/2016

LEGEND

City Limits Boundary

Pressure Zone

1st Level

2nd Level

3rd Level

Existing Pipe

Pipe Diameter (in Inches)

6

8

10

12

16

18

20

24

30

48

54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Available Fire Flow (gpm)

<1000

1,000-2,000

2,000-3,000

3,000-4,000

4,000-5,000

5,000-6,000

6,000-10,000

>10,000

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2017 AVAILABLE FIRE FLOW WITH IMPROVEMENTS

FIGURE 3-19

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

Model Node # 2090

Model Node # 588

Model Node # 1372

82

LEGEND

City Limits Boundary

Pressure Zone

1st Level

2nd Level

3rd Level

Existing Pipe

Pipe Diameter (in Inches)

6

8

10

12

16

18

20

24

30

48

54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Proposed Pipe

Pipe Diameter (in Inches)

8

12

% of Fire Flow Goal

>100%

90-100%

75-90%

50-75%

25-50%

<25%

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2027 FIRE FLOW DEFICIENCIES

FIGURE 3-20

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-20_2027_FF_DEFICIENCIES.MXD - USER: DKUHNS - DATE: 12/12/2016

LEGEND

City Limits Boundary

Pressure Zone

1st Level

2nd Level

3rd Level

Existing Pipe

Pipe Diameter (in Inches)

6

8

10

12

16

18

20

24

30

48

54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Proposed Pipe

Pipe Diameter (in Inches)

8

12

Available Fire Flow (gpm)

<1000

1,000-2,000

2,000-3,000

3,000-4,000

4,000-5,000

5,000-6,000

6,000-10,000

>10,000

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2027 AVAILABLE FIRE FLOW

FIGURE 3-21

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-21_2027_AVAIL_FF.MXD - USER: DKUHNS - DATE: 12/12/2016

Model Node # 2090

Model Node # 179

Model Node # 588

Model Node # 1372

82

LEGEND

City Limits Boundary

Pressure Zone

1st Level

2nd Level

3rd Level

Existing Pipe

Pipe Diameter (in Inches)

6

8

10

12

16

18

20

24

30

48

54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Proposed Pipe

Pipe Diameter (in Inches)

8

12

% of Fire Flow Goal

>100%

90-100%

75-90%

50-75%

25-50%

<25%

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2037 FIRE FLOW DEFICIENCIES

FIGURE 3-22

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE3-22_2037_FF_DEFICIENCIES.MXD - USER: DKUHNS - DATE: 12/12/2016

LEGEND

City Limits Boundary

Pressure Zone

1st Level

2nd Level

3rd Level

Existing Pipe

Pipe Diameter (in Inches)

6

8

10

12

16

18

20

24

30

48

54

Note:
Pipe sizes less than 6 inches not shown.
Only actively used pipes are shown.
Gleed service area not shown.

Proposed Pipe

Pipe Diameter (in Inches)

8

12

Available Fire Flow (gpm)

<1000

1,000-2,000

2,000-3,000

3,000-4,000

4,000-5,000

5,000-6,000

6,000-10,000

>10,000

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

2037 AVAILABLE FIRE FLOW

FIGURE 3-23

YAKIMA WATER SYSTEM PLAN

N

0 0.25 0.5 0.75 1

MILES

3.7.4 Identified Improvements

Below are brief descriptions of identified improvements for the distribution system. Several projects, while not needed to correct any existing deficiencies, are included as part of the City's on-going efforts to maintain and upgrade the quality of the system to meet current and future needs. Further information on costs and timing of these projects is provided in the Capital Improvement Program detailed in Chapter 8.

Fire Flow Improvement Projects

The fire flow improvement projects listed below include the identified improvements listed in Table 3-20 as well as additional improvements planned by the City to further raise available fire flow in areas. Fire flow improvement projects include:

- North 41st Avenue and North 42nd Avenue Waterline Fire Flow Improvements (D-1)
- Peach Street Waterline Fire Flow Improvements (D-2)
- South 1st Avenue Waterline Fire Flow Improvements (D-3)
- North 3rd Street Hydrant Improvement (D-4)
- Bartlett Place and Gordon Road Waterline Fire Flow Improvements (D-5)
- Chesterly Lane Hydrant Improvement (D-6)
- North 3rd Avenue Waterline Fire Flow Improvements (D-7)
- North 31st Avenue Hydrant Improvement (D-8)
- South 2nd Avenue and Division Street Waterline Fire Flow Improvements (D-9)
- Perry Street Waterline Fire Flow Improvements (D-10)
- South 4th Avenue Waterline Fire Flow Improvements (D-11)
- South 6th Street and East Chestnut Avenue Hydrant Improvement (D-12)
- East Mead Avenue Water Main Fire Flow Improvements (D-13)
- Fruitvale Boulevard Waterline Improvements (D-14)

North 41st Avenue and North 42nd Avenue Waterline Fire Flow Improvements (D-1)

Between West Lincoln Avenue and Snowmountain Road, North 42nd Avenue and North 41st Avenue are lined with multifamily residential housing. The area is located in the southeast corner of the 3rd Level pressure zone and is fed by a network of distribution pipes in the 3rd Level zone that have diameters of 6-inch and 8-inch. The highest fire flow requirement in the 3rd Level zone is in this area, which only have 48 percent of its required fire can flow goal met.

To the east along North 40th Avenue is a 16-inch water main within the 2nd Level pressure zone. North 41st Avenue and North 42nd Avenue between West Lincoln Avenue and Snowmountain Road would be connected to the 16-inch water main in North 40th Avenue.

The existing 6-inch pipe in Snowmountain Road between North 42nd Avenue and North 40th Avenue (approximately 670 feet) would be replaced with 12-inch pipe. The existing PRV station in Snowmountain Road would be moved to be immediately west of North 42nd Avenue to maintain a connection between the 3rd and 2nd Level zones.

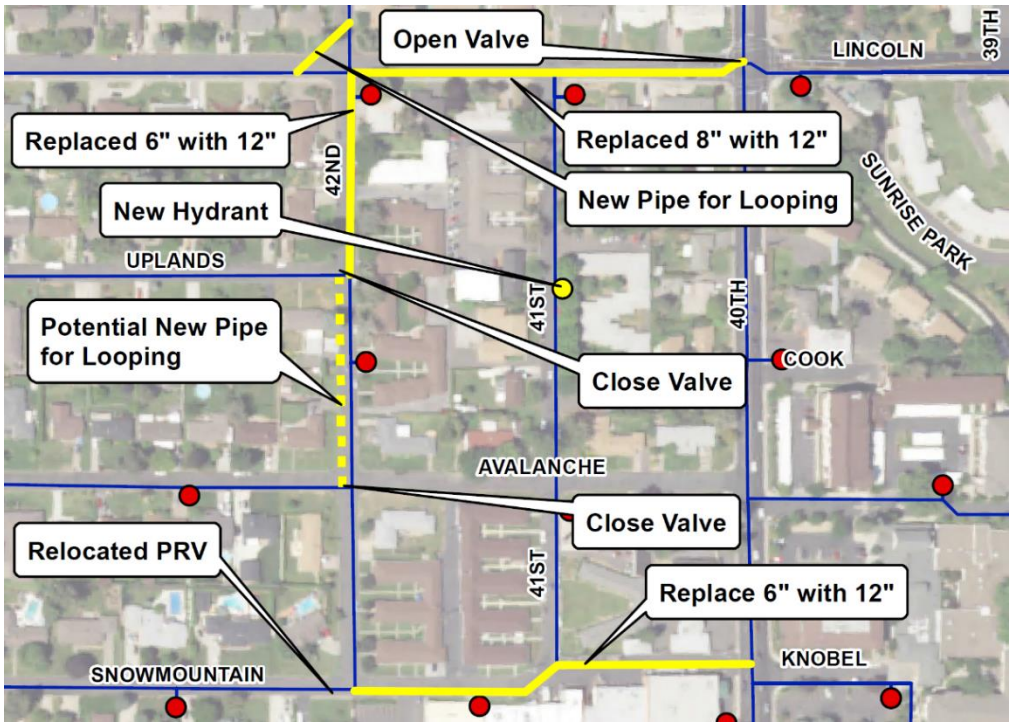
The existing 8-inch pipe in West Lincoln Avenue between North 42nd Avenue and North 40th Avenue (approximately 650 feet) and the existing 6-inch pipe in North 42nd Avenue between West Lincoln Avenue and Uplands Way (approximately 330 feet) would both be replaced with 12-inch pipe.

The 3rd Level zone would be isolated at the intersection of Snowmountain Road and North 42nd Avenue via a PRV station and at North 42nd Avenue's intersections with Avalanche Avenue and Uplands Way via closed valves. Uplands Way and Avalanche Avenue would each have a short, block-long dead-end segment. Alternatively, a new 8-inch DI pipe could connect Uplands Way and Avalanche Avenue to provide looping. Waterlines at the intersection of North 42nd Avenue and West Lincoln Avenue would be modified to separate the 3rd and 2nd Level zones while keeping looping of pipes.

A new hydrant would also be placed mid-block on North 41st Avenue between Avalanche Avenue and West Lincoln Avenue.

These improvements would substantially increase available fire flow to the area. Available fire flow would go from 69 percent of the fire flow goal to 123 percent of the fire flow goal.

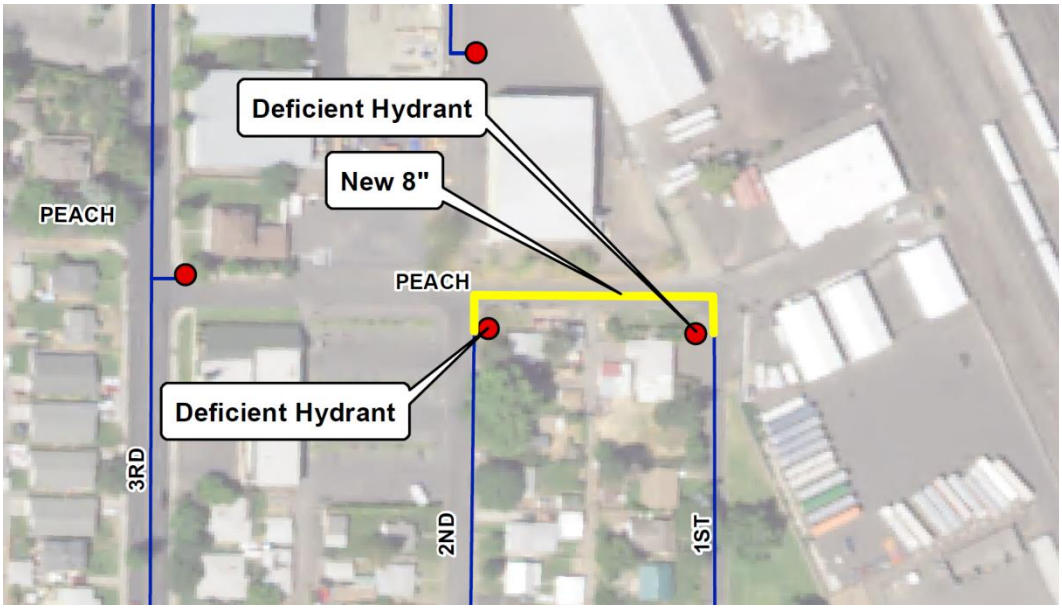
Figure 3-24. North 41st Avenue and North 42nd Avenue Waterline Fire Flow Improvements



Peach Street Waterline Fire Flow Improvements (D-2)

Project will install approximately 220 feet of 8-inch DI pipe along Peach Street, connecting dead-end pipes of South 1st Ave and South 2nd Ave. The existing pipes are unable to meet the fire flow goal in the area with the available fire flow at 55 percent of the fire flow goal. Through looping of the dead-end pipes, the improvements will increase fire flow to 106 percent of the fire flow goal.

Figure 3-25. Peach Street Waterline Fire Flow Improvements

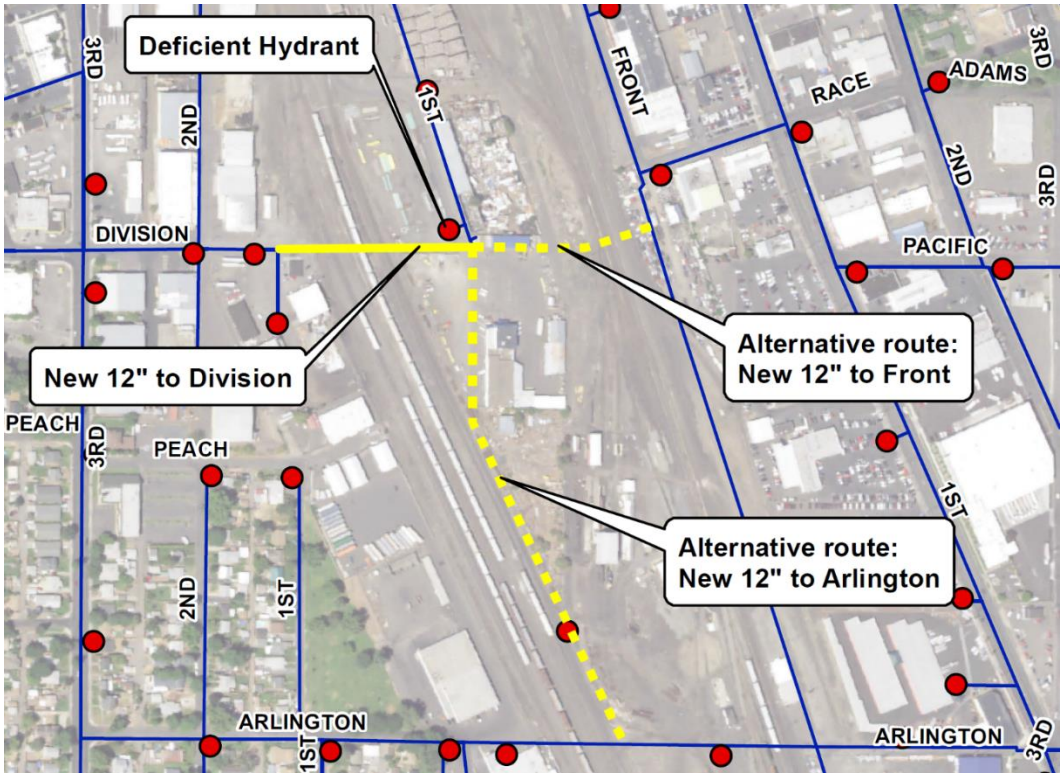


South 1st Avenue Waterline Fire Flow Improvements (D-3)

At the south end of South 1st Street, an existing 8-inch water main reaches a dead-end. The pipe serves an industrial area sandwiched between a Union Pacific Railroad right-of-way to the west and a Burlington Northern Railroad right-of-way to the east. The existing dead-end water line only has an available fire flow of 1,300 gpm at its end. The project would loop the existing main by connecting to the existing 8-inch waterline in Division Street via a new 12-inch DI pipe (approximately 600 feet). Looping would increase the available fire flow to over 4,200 gpm. Alternatively, the pipe could be looped by connecting to the existing 12-inch waterline on South Front Street to the east. Both options will require crossings within railroad right-of-ways. An alternate approach would be to extend the waterline to the south using 1,450 feet of 12-inch DI pipe to connect with the existing 8-inch water line in Arlington Street. This approach would increase the available fire flow to over 5,000 gpm.

Given the three possible routes, the project will assume the 12-inch connection to Division Street which would increase the available fire flow from 86 percent of the fire flow goal to 262 percent.

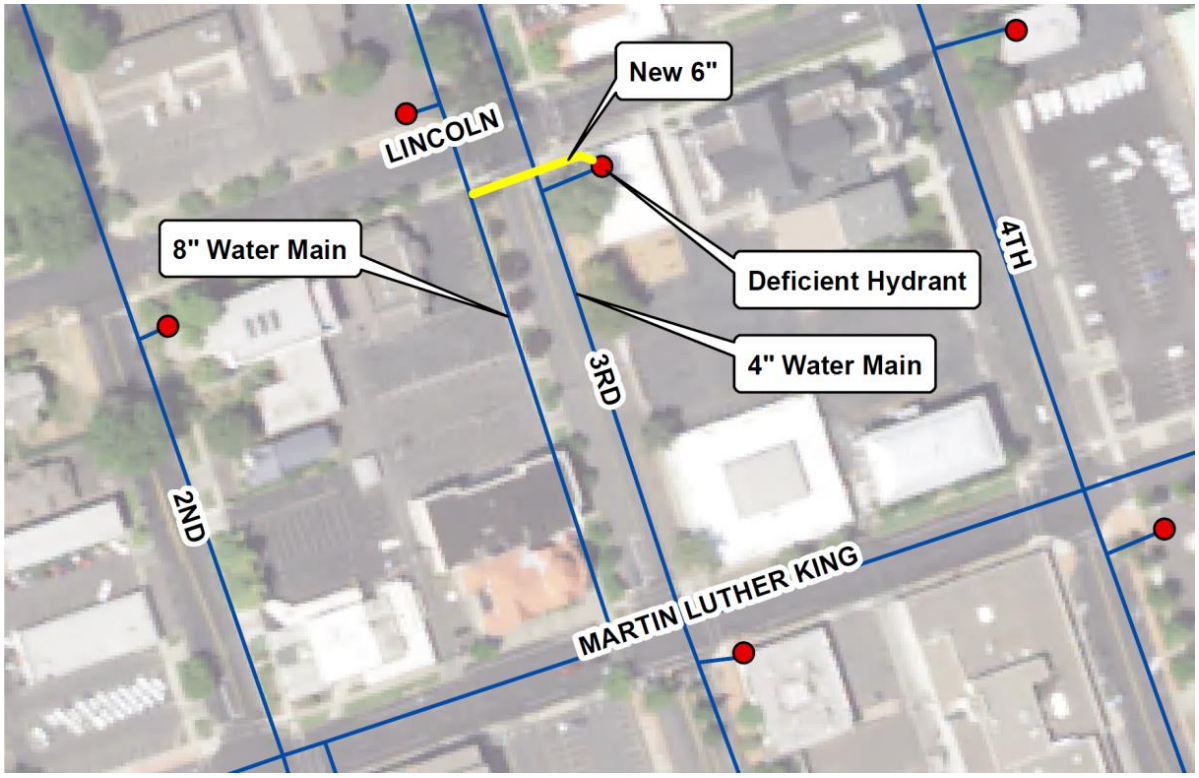
Figure 3-26. South 1st Avenue Waterline Fire Flow Improvements



North 3rd Street Hydrant Improvement (D-4)

Along North 3rd Street between Martin Luther King Jr. Boulevard and East D Street are two parallel water mains where one main is an 8-inch while the other is 4-inch. The deficient hydrant is located on the 4-inch main mid-block on the east side of North 3rd Street. The project would shift the main feeding the hydrant from the 4-inch main to the 8-inch main. The project would install approximately 80 LF of 6-inch DI pipe to make the connection. This would increase the available fire flow from 61 percent of the fire flow goal to 230 percent.

Figure 3-27. North 3rd Street Hydrant Improvement



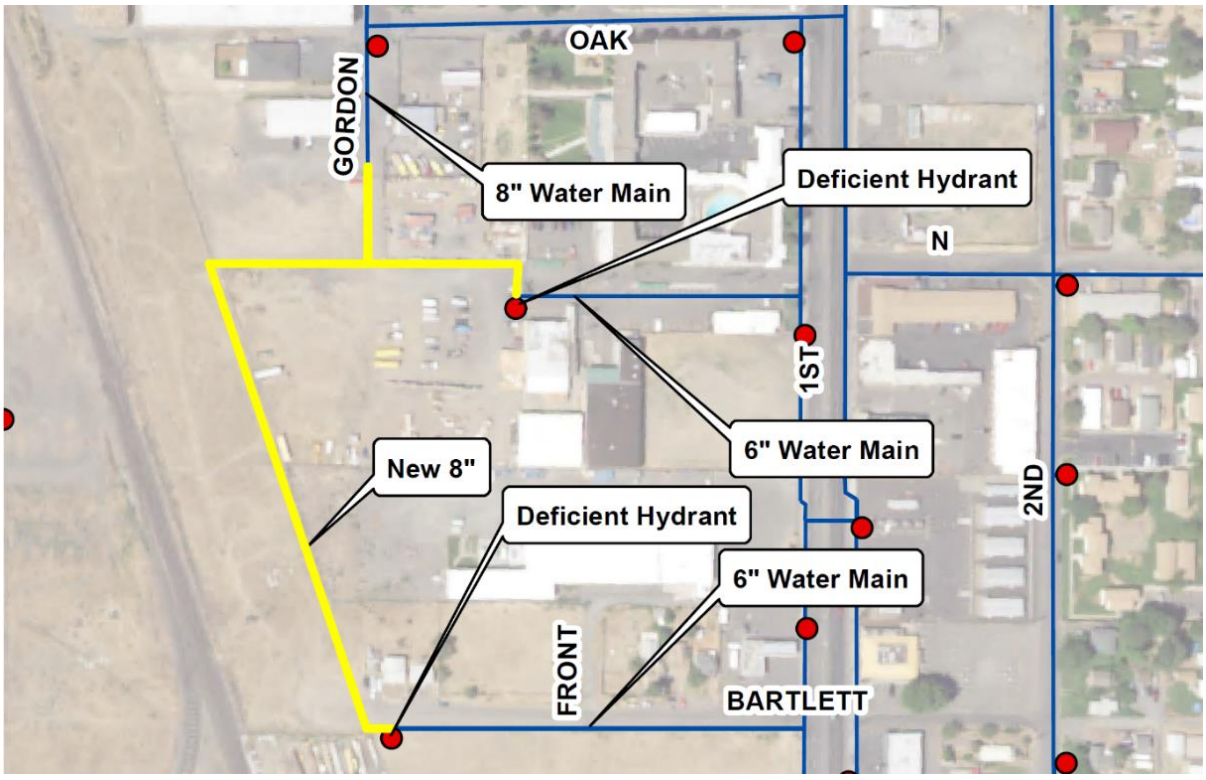
Bartlett Place and Gordon Road Waterline Fire Flow Improvements (D-5)

Three dead-end water mains would be looped as part of the project improving fire flow to the area. The first dead-end main is a 6-inch pipe that runs along Bartlett Place west of North 1st Street that dead-ends at the end of the street with a hydrant located at the end of the main. The second dead-end main is a 6-inch pipe that runs west of the North 1st Street and East N Street intersection with a hydrant located at the end of the main. Both of these hydrants were found to not meet the fire flow goal. The third dead-end main is an 8-inch pipe on the south end of Gordon Road. The project would install new 8 inch DI pipe to provide looping of three dead-end mains in the area by beginning on the west end of Bartlett Place and adding an 8-inch DI pipe going north. The dead-end mains on East N Street and Gordon Road would be extended to connect to the 8-inch DI pipe to provide looping. Approximately 1,340 LF of 8-inch DI would be installed as part of the project.

For the deficient hydrant on Bartlett Place, the project would increase the available fire flow from 62 percent of the fire flow goal to 139 percent. For the deficient hydrant west of the North 1st Street and East N Street intersection, the project would increase the available fire flow from 78 percent of the fire flow goal to 194 percent. The project would also increase fire flows to the hydrant on Gordon Road (although not currently deficient) by increasing available fire flow from 243 percent to 331 percent of the fire flow goal.

Finally, the improvements would increase the ease of water flow in the nearby vicinity. Immediately to the south of Bartlett Place, a hydrant on a dead-end main serving a Motel 6 (model node #179 in Table 3-20) would see the available fire flow increase from 93 percent to 100 percent of the fire flow goal.

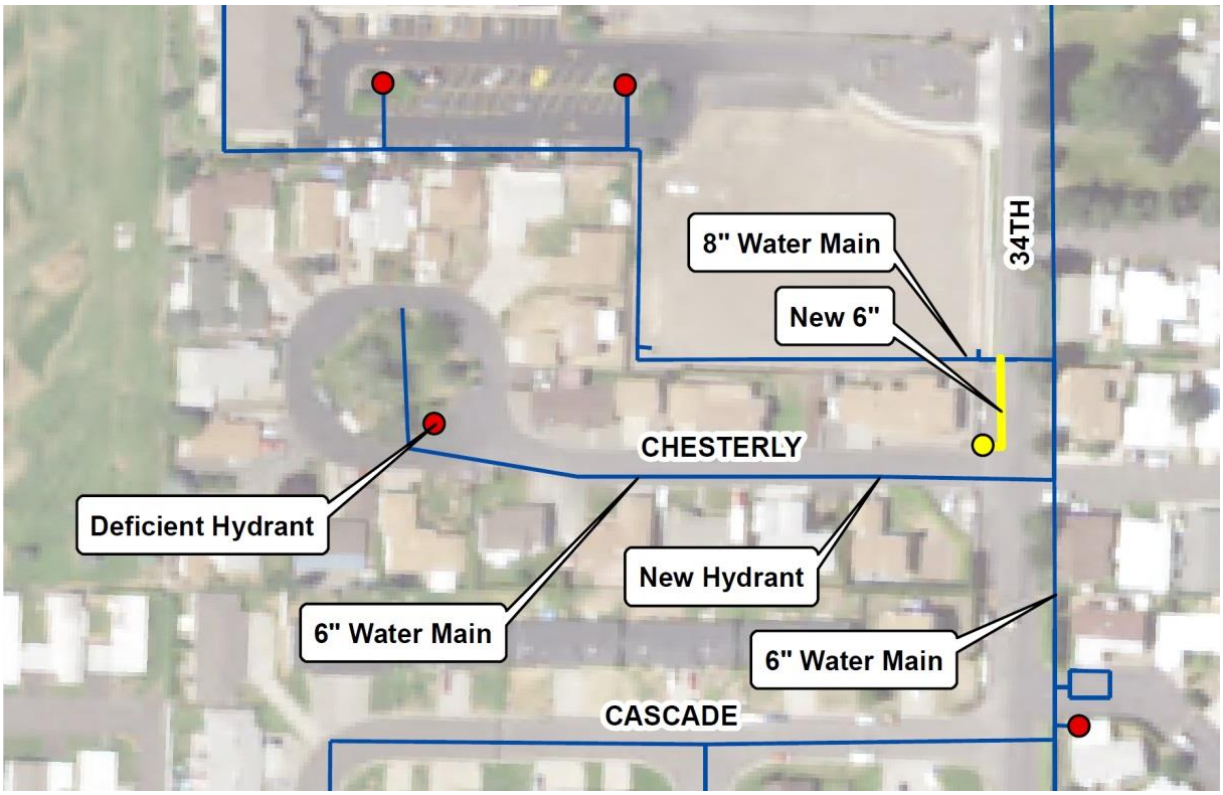
Figure 3-28. Bartlett Place and Gordon Road Waterline Fire Flow Improvements



Chesterly Lane Hydrant Improvement (D-6)

A 6-inch water main is placed on Chesterly Lane that dead-ends at the end of the street. A hydrant is located toward the end of the water main that only meets 86 percent of the fire flow goal. All parcels surrounding the water main are developed single family residential properties making looping of the line difficult and the next nearest hydrant is located 640 ft away to the east. To improve available fire flow for Chesterly Lane, the project adds an additional hydrant on Chesterly Lane near the intersection of North 34th Avenue where higher fire flows are available. Although this does not increase available fire flow to the hydrant at the end of Chesterly Lane, it provides a new hydrant closer to the looped water main on North 34th Ave which has over 2,400 gpm in available fire flow.

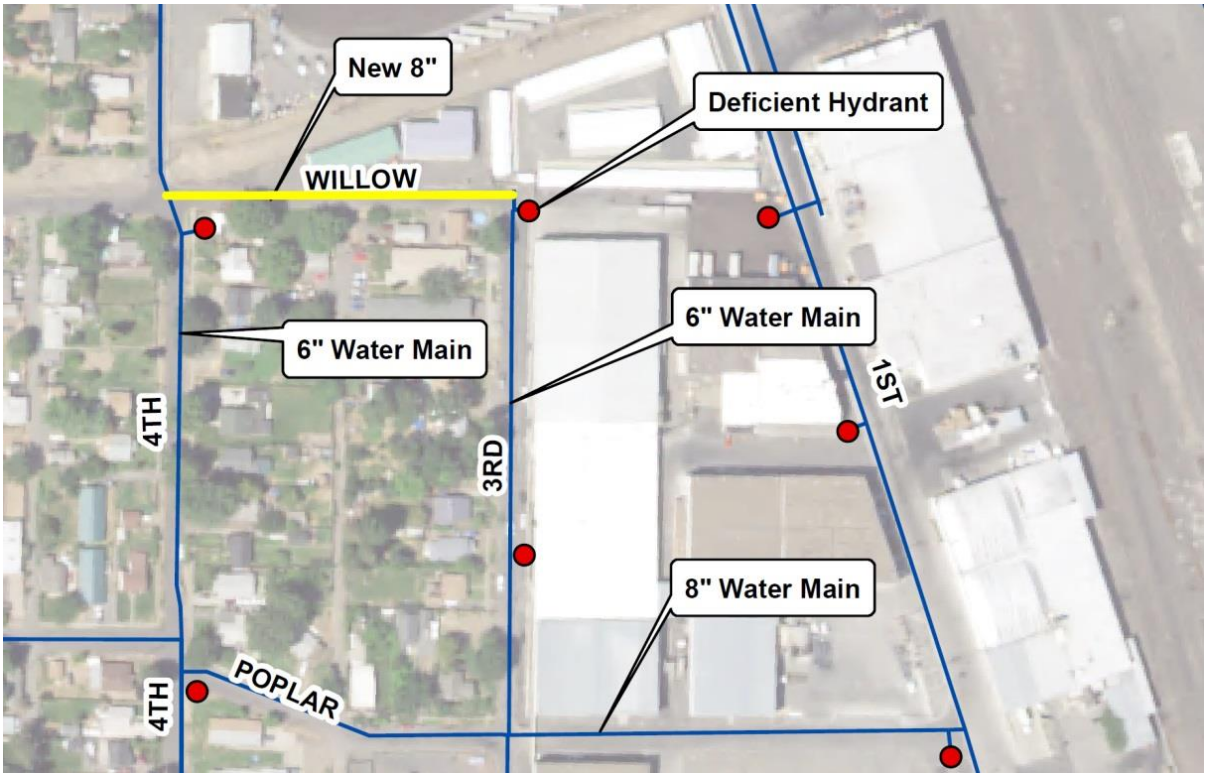
Figure 3-29. Chesterly Lane Hydrant Improvement



North 3rd Avenue Waterline Fire Flow Improvements (D-7)

A 6-inch water main dead-ends on the north end of North 3rd Avenue and has a hydrant located toward the end of the main. The project would increase fire flows to the hydrant by adding approximately 430 LF of new 8-inch DI pipe to loop the North 3rd Avenue main with the water main in North 4th Avenue. The project would increase available fire flows from 85 percent to 228 percent of the fire flow goal.

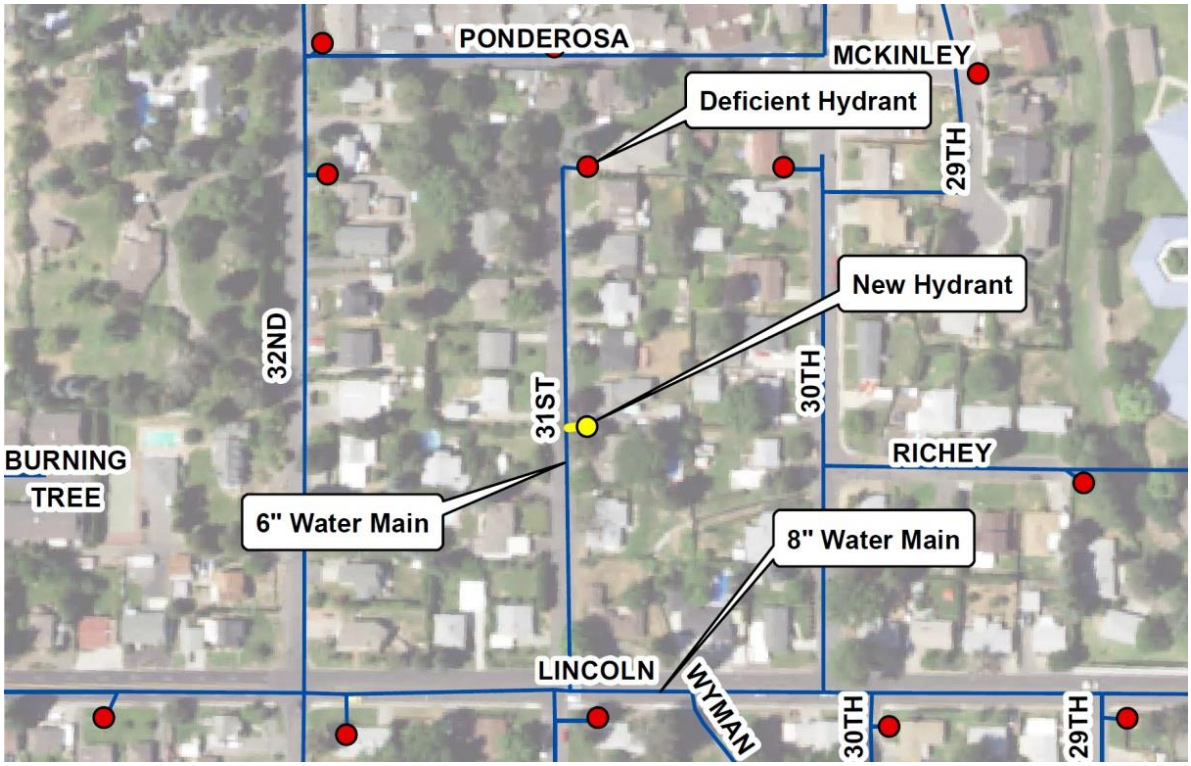
Figure 3-30. North 3rd Avenue Waterline Fire Flow Improvements



North 31st Avenue Hydrant Improvement (D-8)

An existing 6-inch water main is located on North 31st Avenue that dead-ends at the end of the street. A hydrant is located at the end of the water main that meets 88 percent of the fire flow goal. All parcels surrounding the water main are developed single family residential properties making looping of line difficult and the next nearest hydrant is located 690 ft away to the south. To improve available fire flow for North 31st Avenue, the project adds an additional hydrant on North 31st Avenue mid-block. Although this does not increase available fire flow to the hydrant at the end of North 31st Avenue, the new hydrant would be capable of meeting the 1,000 gpm fire flow goal.

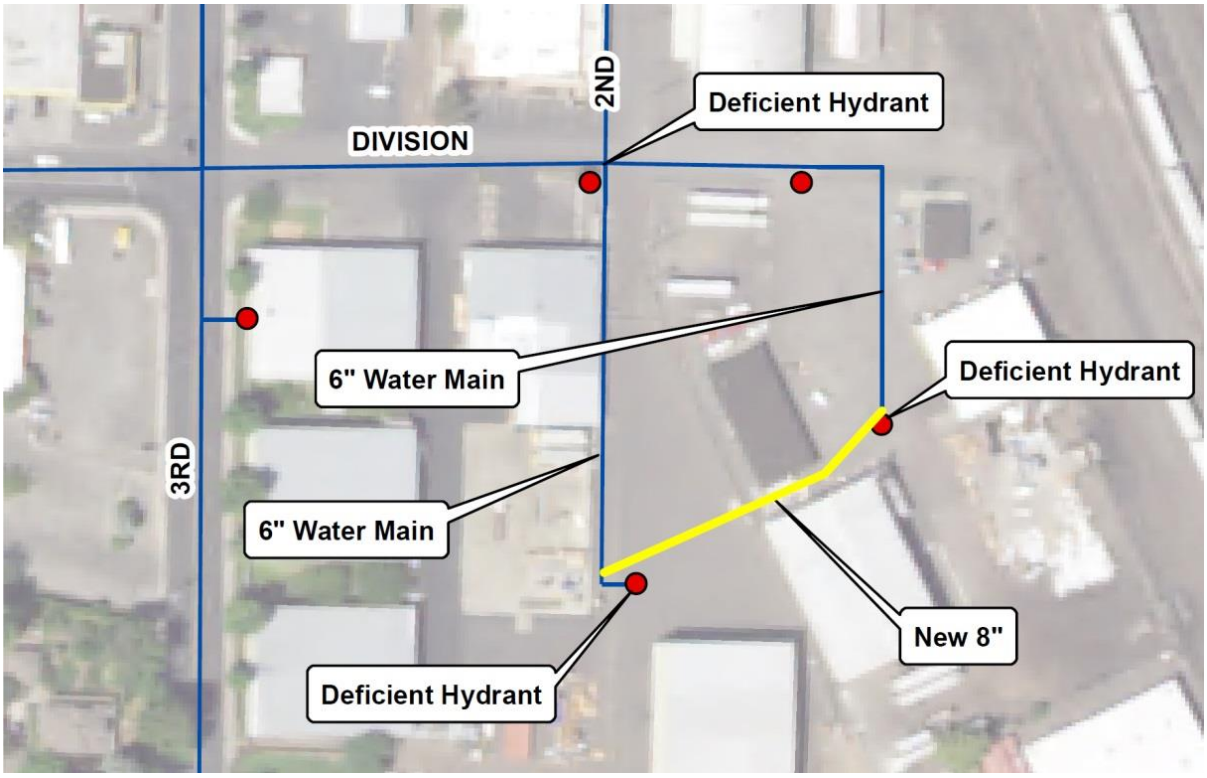
Figure 3-31. North 31st Avenue Hydrant Improvement



South 2nd Avenue and Division Street Waterline Fire Flow Improvements (D-9)

Near the intersection of Division Street and South 2nd Avenue are two dead-end 6-inch mains—each with a hydrant located at the end of the main. Both hydrants do not meet the fire flow goal. The project loops the two mains by installing approximately 250 LF of 8-inch DI pipe between the ends of each dead-end main. Looping the mains significantly increases available fire flow with the western hydrant seeing the available fire flow increase from 88 percent to 174 percent of the fire flow goal and the eastern hydrant seeing the available fire flow increase from 93 percent to 178 percent of the fire flow goal.

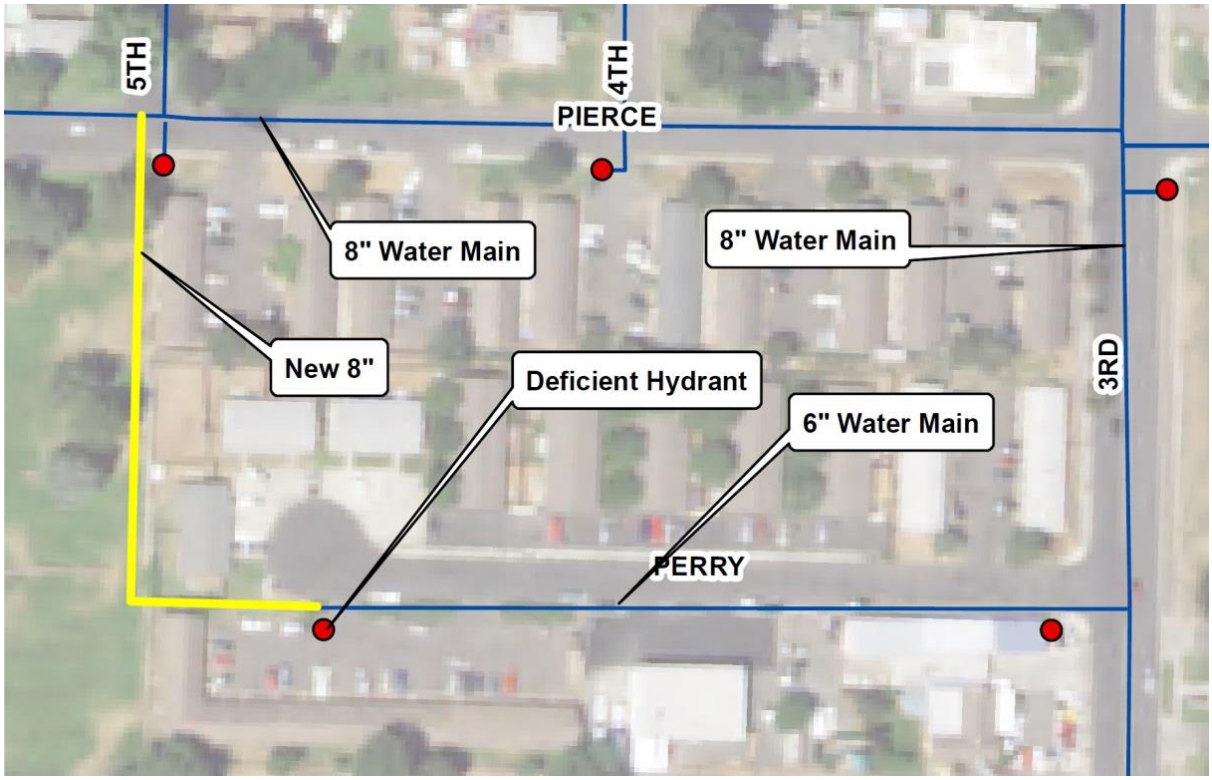
Figure 3-32. South 2nd Avenue and Division Street Waterline Fire Flow Improvements



Perry Street Waterline Fire Flow Improvements (D-10)

An existing 6-inch water main is located on Perry Street that dead-ends at the end of the street. To improve available fire flow, the project loops the water main by using 8-inch DI pipe to extend the existing water main to the west into Gardner Park. The new water main would then go north and connect to the existing 8-inch water main along West Pierce Street. Approximately 460 LF of 8-inch DI pipe would be installed. The project would increase the available fire flow at the end of Perry Street from 92 percent to 275 percent of the fire flow goal.

Figure 3-33. Perry Street Waterline Fire Flow Improvements

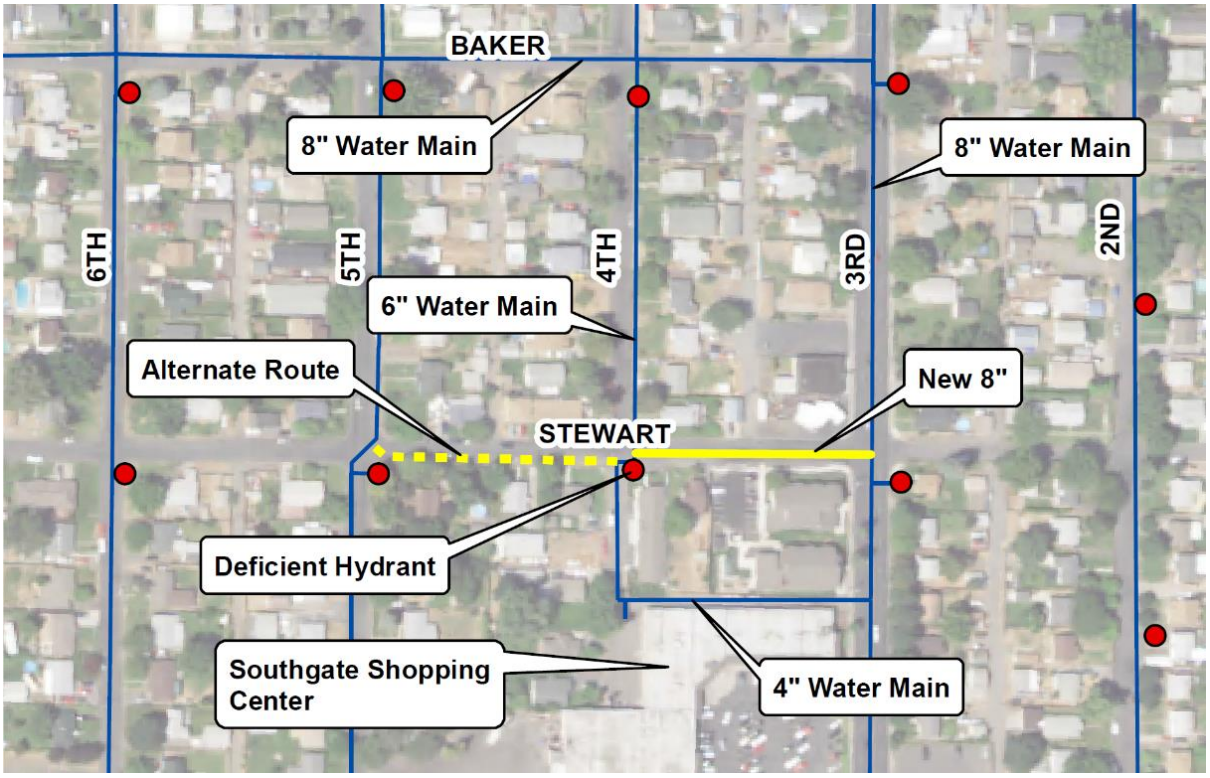


South 4th Avenue Waterline Fire Flow Improvements (D-11)

A hydrant near the intersection of Stewart Street and South 4th Avenue does not meet the fire flow goal. The hydrant is on a 6-inch main along South 4th Avenue that extends approximately 180 ft south of Stewart Street before going east along the north side of the Southgate Shopping Center parking lot where it connects to an 8-inch main on South 3rd Avenue. The east-west portion of the main (approximately 330 LF) is only a 4-inch pipe. To increase available fire flow, the project adds an additional 8-inch pipe on Stewart Street between South 4th Avenue and South 3rd Avenue (approximately 310 LF). The project would increase the available fire flow at the hydrant on Stewart Street from 96 percent of the fire flow goal to 260 percent.

Alternatively, an 8-inch pipe could be added on Stewart Street between South 4th Avenue and South 5th Avenue (approximately 330 LF) which would increase the available fire flow to 200 percent of the fire flow goal.

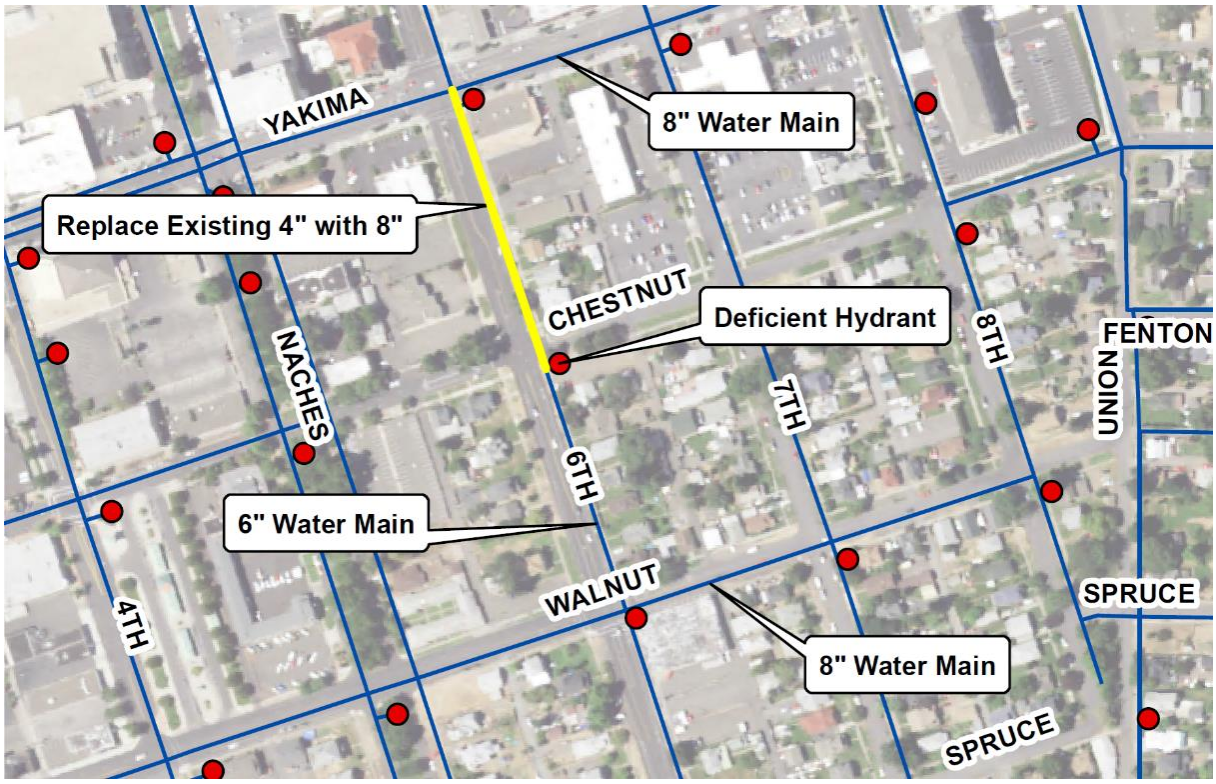
Figure 3-34. South 4th Avenue Waterline Fire Flow Improvements



South 6th Street and East Chestnut Avenue Hydrant Improvement (D-12)

A hydrant near the intersection of South 6th Street and East Chestnut Avenue is below the fire goal. The hydrant is fed by a water main that runs along South 6th Street between East Yakima Avenue and East Walnut Street. Between East Chestnut Avenue and East Walnut Street the water main is 6-inch while between East Yakima Avenue and East Chestnut Avenue the water main is 4-inch. To increase fire flows to the hydrant, the project replaces the 4-inch water line with 8-inch DI pipe (approximately 460 LF). The project would increase available fire flows from 98 percent to 206 percent of the fire flow goal.

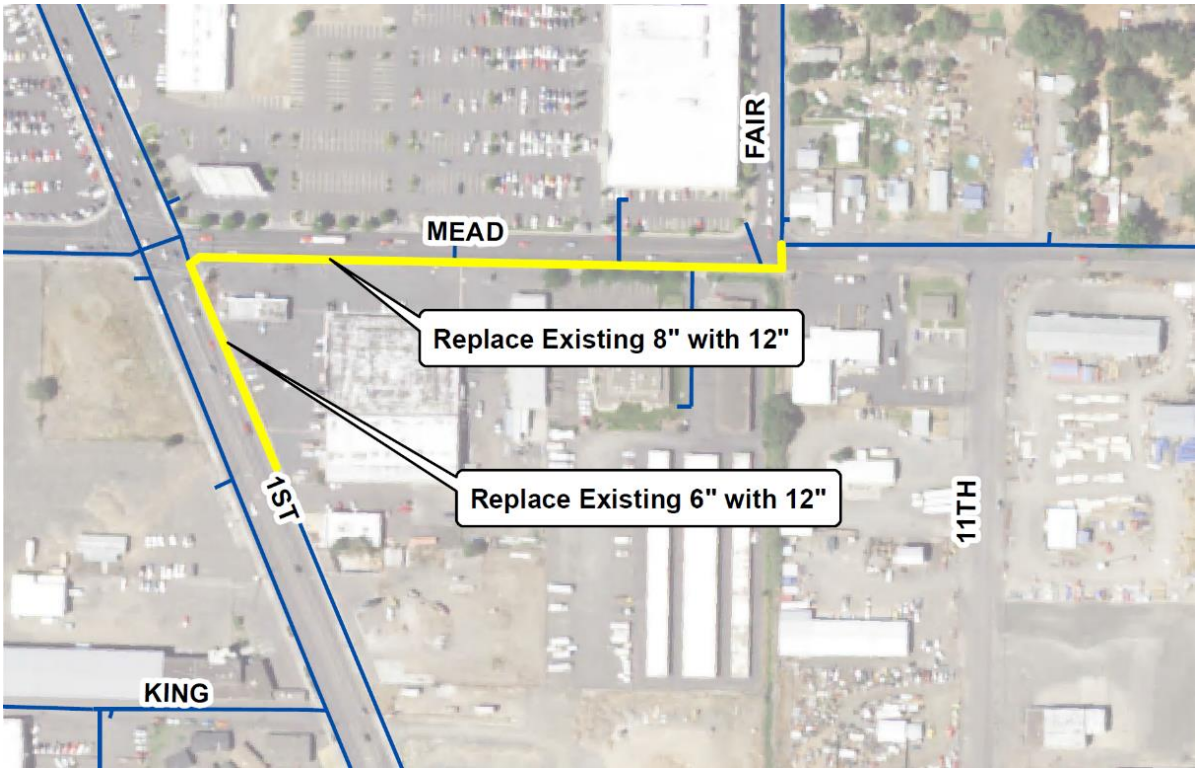
Figure 3-35. South 6th Street and East Chestnut Avenue Hydrant Improvement



East Mead Avenue Water Main Fire Flow Improvements (D-13)

The existing 8-inch main on East Mead Avenue east of South 1st Street is a constraint to conveying higher fire flows to the commercial/industrial area along I-82. Although currently not identified as a deficiency given the current fire flow goals, the City would like to provide greater flows to this area to support future industrial and commercial development in the area. An improvement completed under an earlier CIP should be extended to include a 12-inch main along East Mead Avenue between South 1st Street and the existing 12-inch pipe that extends eastward from South 10th Street. This project would replace the existing 8-inch in Mead from South 1st Street to South 10th Street and replace about 300 ft of existing 6-inch in South 1st Street with a 12-inch main. As an example, at the intersection of East Mead Avenue and Rudkin Road, available fire flows would increase by almost 30 percent increasing from 5,095 gpm to 6,480 gpm (assumes Viola Avenue Freeway Crossing Improvements is also completed). Similar increases in available fire flow would be seen in areas along Rudkin Road and East Mead Avenue.

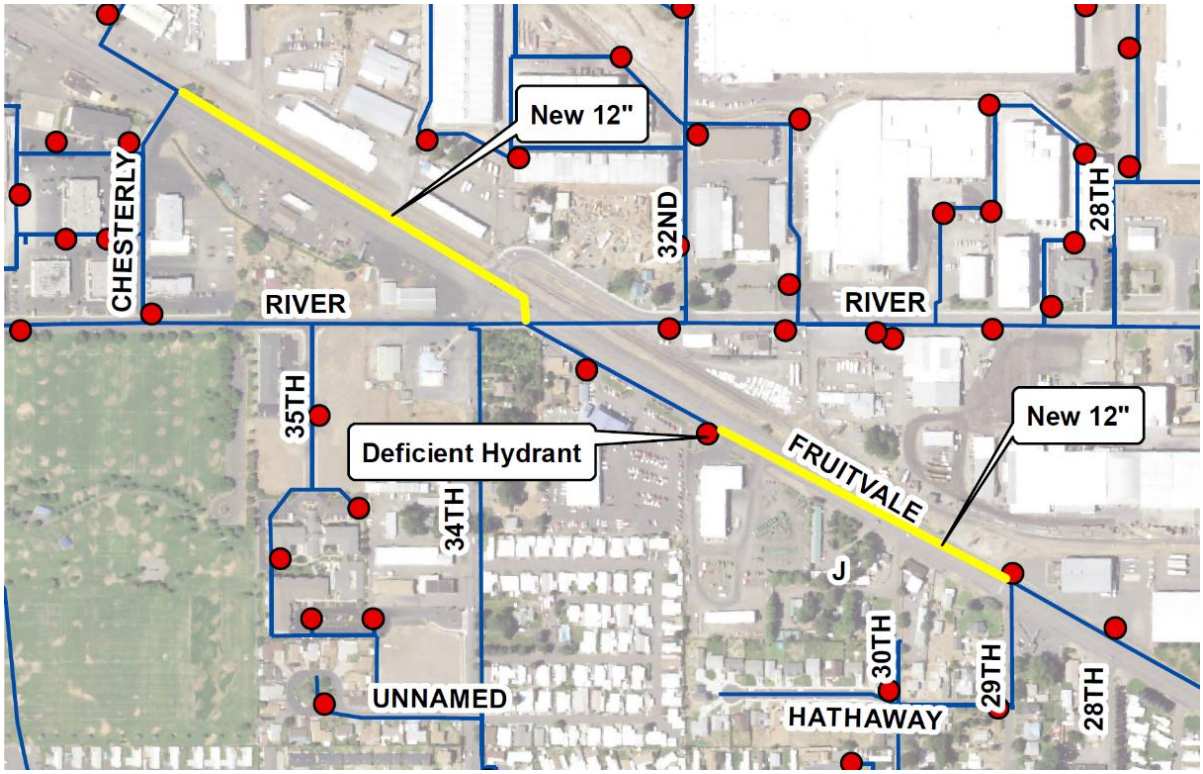
Figure 3-36. East Mead Avenue Water Main Fire Flow Improvements



Fruitvale Boulevard Waterline Improvements (D-14)

This project installs 2,200 ft of 12-inch DI waterline in Fruitvale Boulevard between Chesterly Dr. (private street) and North 29th Avenue, including crossings and hydrants. Currently, there is no waterline in portions of Fruitvale Boulevard between Chesterly Dr. (private road) and North 29th Avenue. This project would install a new 12-inch waterline and would make water service available to customers in this area. The project would also provide looping in the area, improving fire flows and improve water quality by eliminating an existing dead-end waterline.

Figure 3-37. Fruitvale Boulevard Waterline Improvements



Open Gear Valve Replacement Program (D-15)

There are 16-inch and larger open gear gate valves throughout the water system that are 50 to 75 years old and are at the end of their useful life. Some valves are no longer operable and parts are not available for repair and maintenance of the valves. Already partially completed, this project would continue to systematically replace one to two valves each year until all have been replaced.

Two-bolt Joint Waterline Replacement Program

The City of Yakima has existing waterlines with pipe joints joined together with an uncommon two-bolt system, as opposed to the standard rubber gasket. These waterlines are nearing the end of their useful life, and should a pipe joint leak, there is no repair but to cut the joint out and install a new section of waterline. In an emergency, this can be costly and time consuming and result in extended water outages for customers. Once the specific locations of these waterlines are determined, replacement should take place on a systematic basis, based on repair history, as well as the criticality of the waterline.

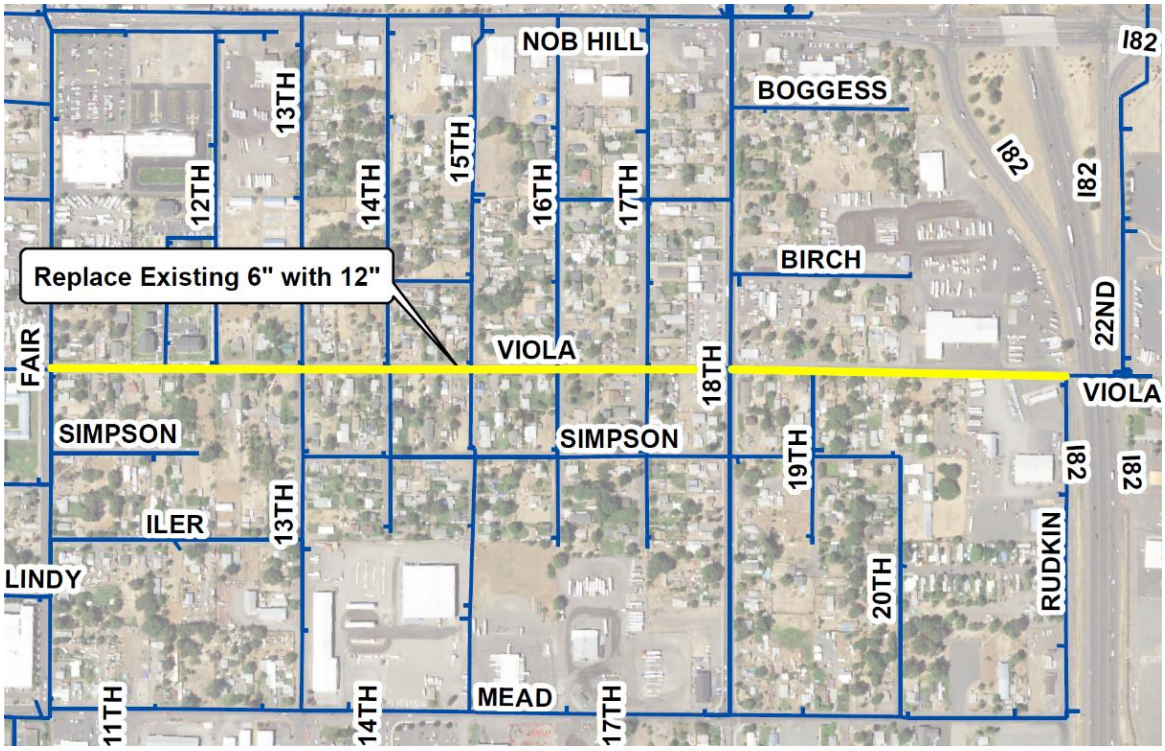
The following projects were identified for the program; however, more projects may be identified in the future as locations of two-bolt systems are determined:

- East Viola Avenue Waterline Improvements (D-16)
- Viola Avenue Freeway Crossing Improvements (D-17)

East Viola Avenue Waterline Improvements (D-16)

This project installs 4,000 of 12-inch DI waterline in East Viola Avenue, crossings, services and hydrants, and it replaces existing water mains in East Viola Avenue between South Fair Avenue and Rudkin Road, replacing the existing 6-inch CI water main. The existing 6-inch CI waterline has pipe joints joined together with an uncommon two-bolt system, as opposed to the standard rubber gasket. This waterline is has neared the end of its useful life, and should a main break occur, there is no repair but to cut the joint out and install a new section of waterline. In an emergency, this can be costly and time consuming and result in extended water outages for customers.

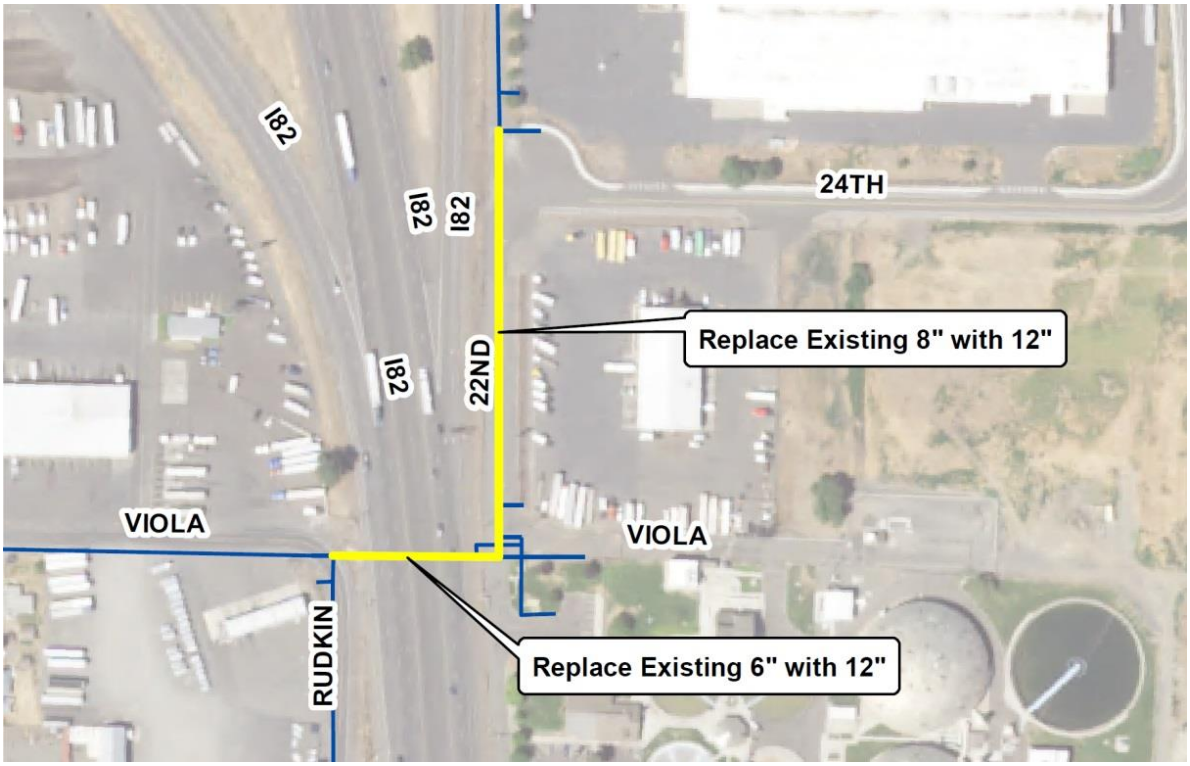
Figure 3-38. East Viola Avenue Waterline Improvements



Viola Avenue Freeway Crossing Improvements (D-17)

Currently, the 6-inch main that crosses under I-82 is a constraint for conveying higher fire flows to the industrial area east of I-82, including the Yakima WWTP and surrounding commercial areas. Although currently not identified as a deficiency given the current fire flow goals, the City would like to provide greater flows to this area to support future industrial and commercial development in the area. Additionally, the existing 6-inch main uses an uncommon two-bolt system, as opposed to the standard rubber gasket. Should a main break occur, there is no repair but to cut the joint out and install a new section of waterline. Given the pipe's age and direct-bury under I-82, the pipe poses a liability. A 12-inch main would be installed which will extend from the intersection of Rudkin Road and Viola Avenue under I-82 and connect to the existing waterlines at South 22nd Street and Viola Avenue. Design and specification have been completed and are ready for construction once funding is available. As an example, at the intersection of East Viola Avenue and South 22nd Street, available fire flow would increase by 90 percent increasing from 3,550 gpm to 6,760 gpm (assumes East Mead Avenue Water Main Improvements is also completed). Similar increases in available fire flow would be seen in the areas on the east side of I-82.

Figure 3-39. Viola Avenue Freeway Crossing Fire Flow Improvements

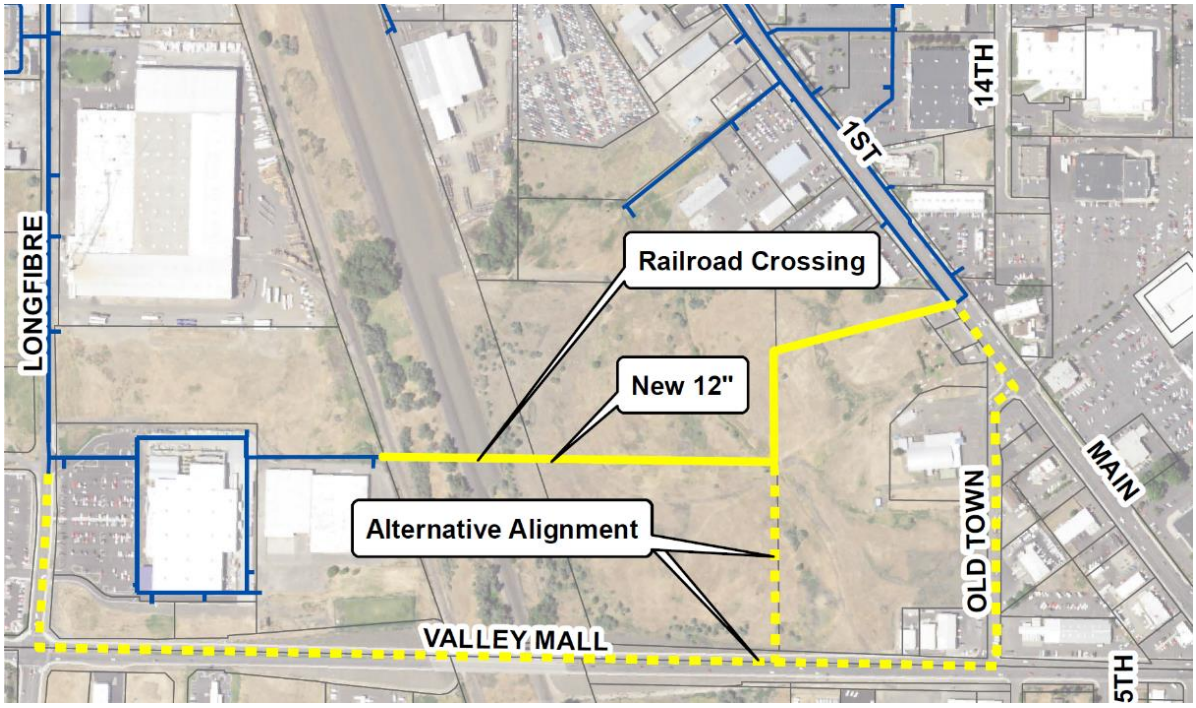


System Looping Projects

Longfibre to South 1st Street Water Main (D-18)

This project will connect the existing 12-inch main in Longfibre Road to an existing 12-inch main in South 1st Street, including crossing the BNSF railroad, to complete a loop which will better serve this area. This will strengthen the distribution system at this location, improving fire flows and providing service to future development in this area. This project could be completed as part of a new development. Approximately 1,350 LF of 12-inch DI pipe would be installed if following the shortest alignment.

Figure 3-40. Longfibre to South 1st Street Water Main



Lead-Oakum Joint Waterline Replacement Program

In the older downtown core area of the City of Yakima, there are existing cast-iron waterlines with pipe joints that are sealed with oakum and lead, as opposed to the standard rubber gasket. These waterlines are nearing the end of their useful life, and should a pipe joint leak, there is no repair but to cut the joint out and install a new section of waterline. In an emergency, this can be costly and time consuming and result in extended water outages for customers. Once the specific locations of these waterlines are determined, replacement should take place on a systematic basis, based on repair history, as well as the criticality of the waterline. As part of these replacements, the city will continue its efforts to remove lead gooseneck connections as well as any other lead appurtenances in the water system as they are discovered.

The following projects are locations currently planned for replacement which includes:

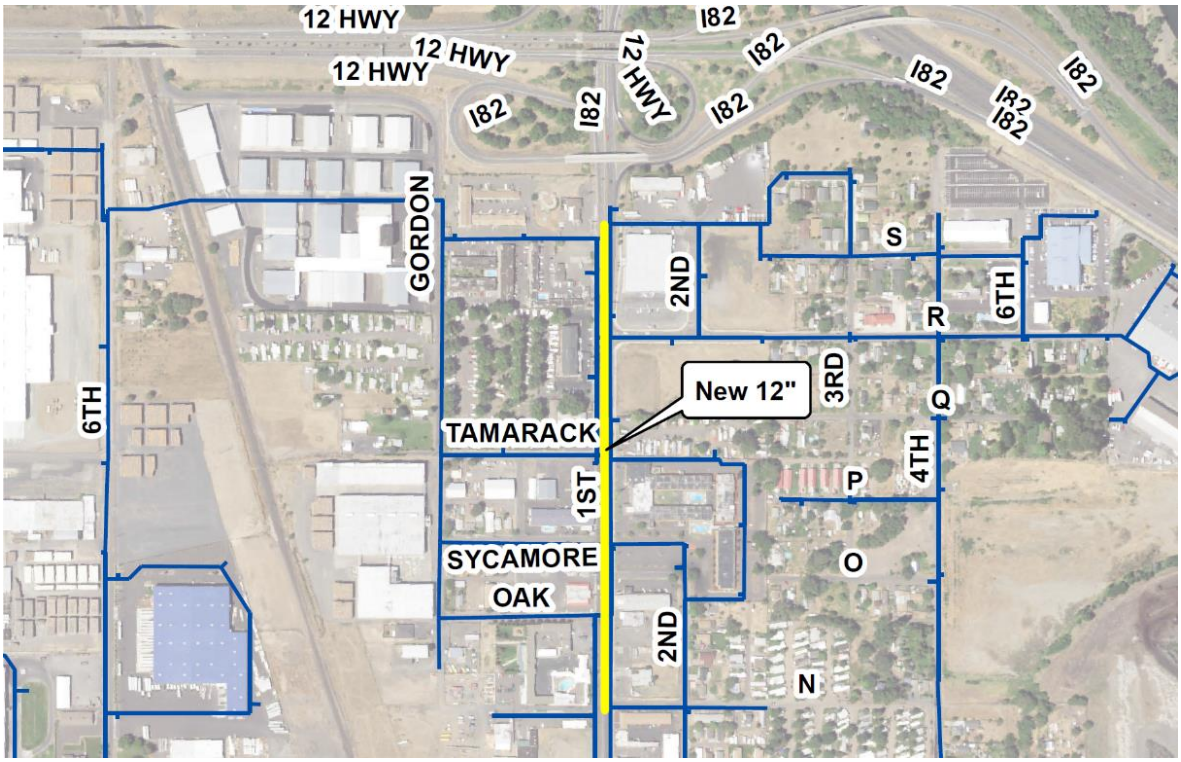
- North 1st Street Waterline Improvements - Phase 1 (D-19)
- North 1st Street Waterline Improvements - Phase 2 (D-20)
- North 1st Street Waterline Improvements - Phase 3 (D-21)

- North Front Street Waterline Improvements (D-22)
- West I Street Waterline Improvements (D-23)
- Yakima Avenue and Other Future, Not Yet Identified Replacements (D-24)

North 1st Street Waterline Improvements – Phase 1 (D-19)

This project installs 2,300 ft of 12-inch DI waterline, crossings, services and hydrants, and it replaces existing water mains in North 1st Street between East N Street north to the I-82 / Highway 12 Interchange. Existing lines are cast iron with lead-oakum joints, 70 - 90 years old and are past their useful life. Main breaks have occurred in the past, indicating the mains' deteriorating condition. Replacement of the lines will also improve system flow and fire flows to the surrounding area. The project will be completed in conjunction with the North 1st Street Corridor Revitalization.

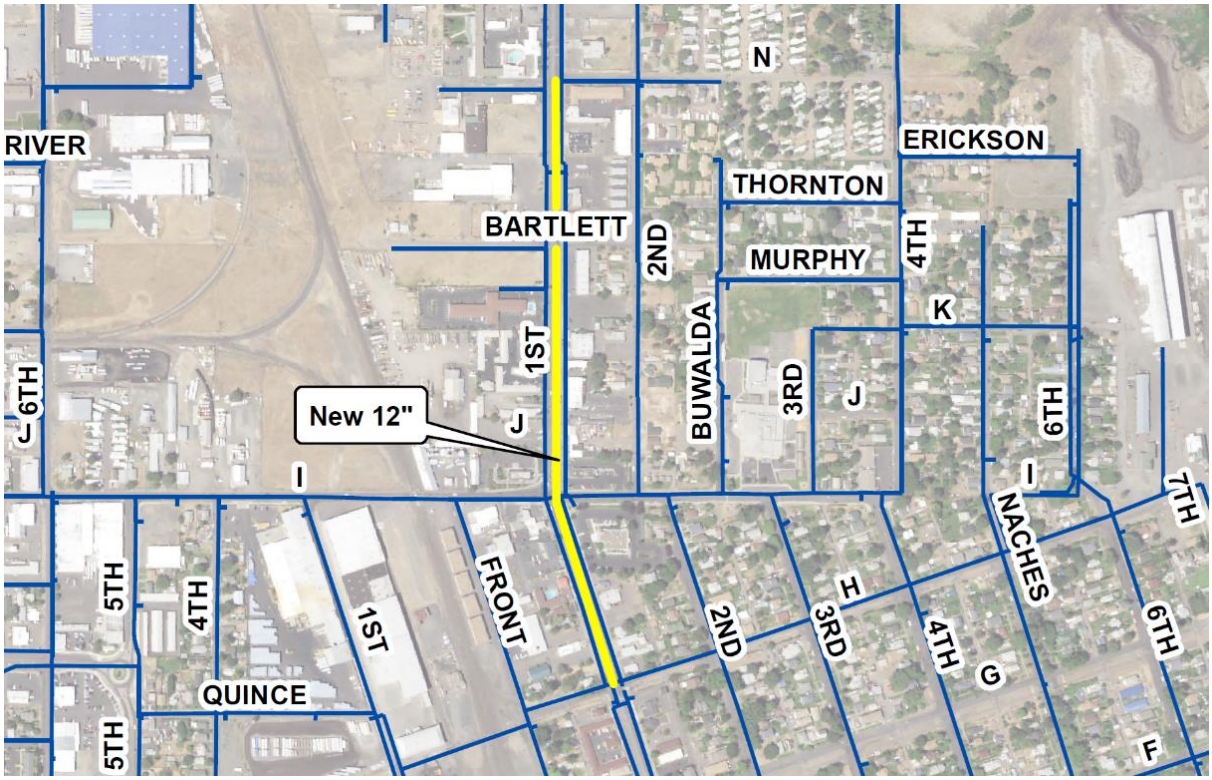
Figure 3-41. North 1st Street Waterline Improvements – Phase 1



North 1st Street Waterline Improvements - Phase 2 (D-20)

This project installs 2,500 ft of 12-inch DI waterline, crossings, services and hydrants, and it replaces existing water mains in North 1st Street between East N Street and East H Street. Existing lines are cast iron with lead-oakum joints, 70 - 90 years old and are past their useful life. Main breaks have occurred in the past, indicating the mains deteriorating condition. Replacement of the lines will also improve system flow and fire flows to the surrounding area. The project will be completed in conjunction with the North 1st Street Corridor Revitalization.

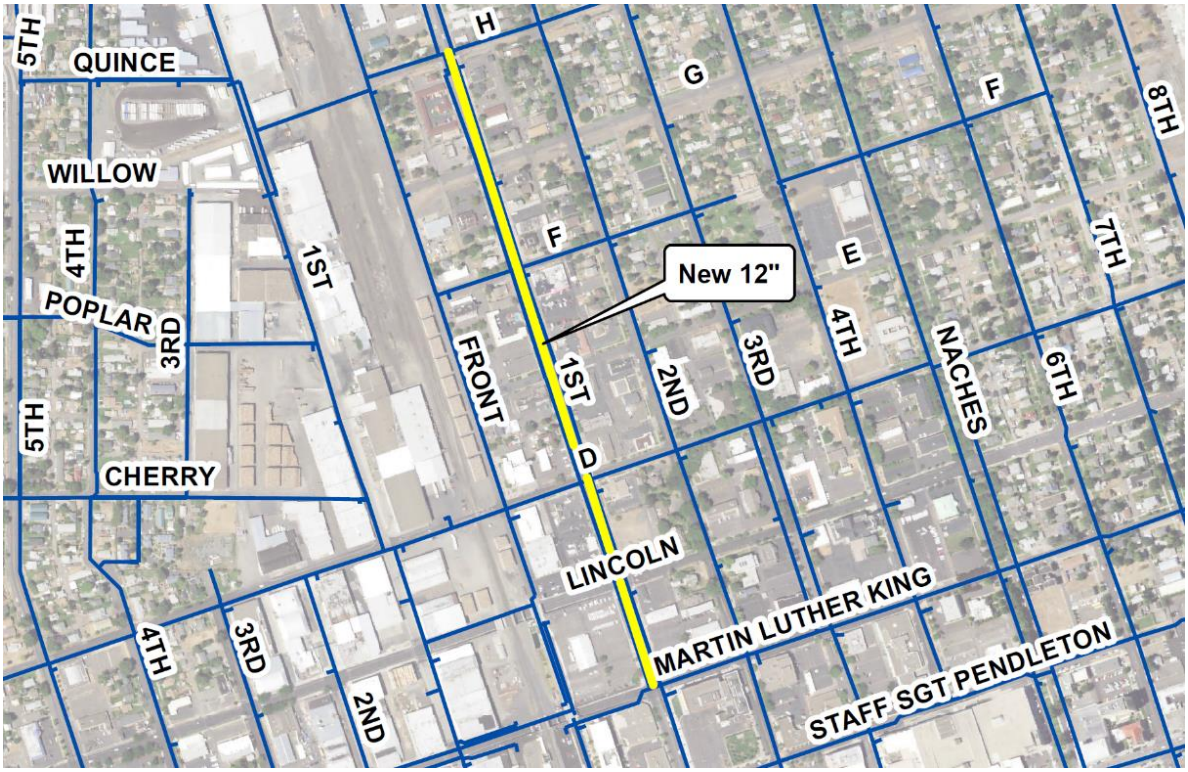
Figure 3-42. North 1st Street Waterline Improvements - Phase 2



North 1st Street Waterline Improvements - Phase 3 (D-21)

This project installs 2,900 ft of 12-inch DI waterline, crossings, services and hydrants, and it replaces existing water mains in North 1st Street between East H Street and Martin Luther King Jr. Boulevard. Existing lines are cast iron with lead-oakum joints, 70 - 90 years old and are past their useful life. Main breaks have occurred in the past, indicating the mains deteriorating condition. Replacement of the lines will also improve system flow and fire flows to the surrounding area. The project will be completed in conjunction with the North 1st Street Corridor Revitalization.

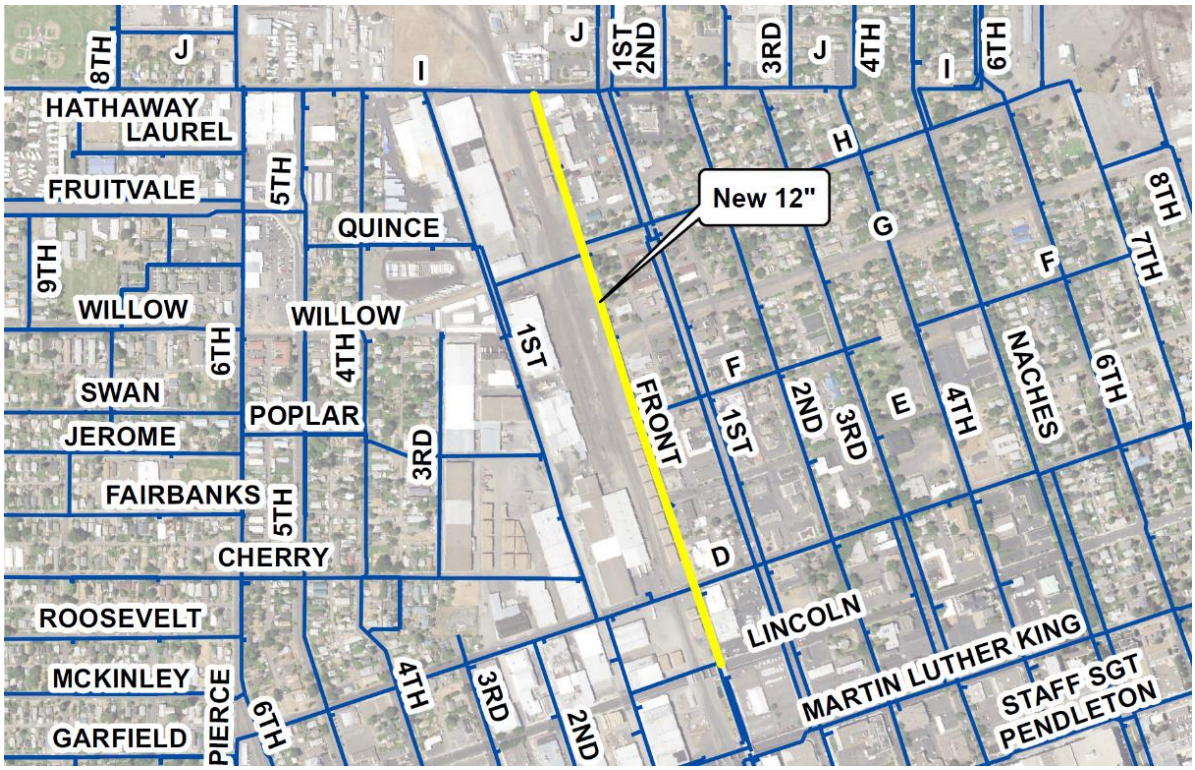
Figure 3-43. North 1st Street Waterline Improvements - Phase 3



North Front Street Waterline Improvements (D-22)

This project installs 3,200 ft of 12-inch DI waterline in North Front Street between East I Street and East Lincoln Avenue, including crossings, services and hydrants. Existing lines are cast iron with lead-oakum joints, 70 - 90 years old and are past their useful life. Main breaks have occurred in the past, indicating the mains deteriorating condition. Replacement of the lines will also improve system flow and fire flows to the surrounding area.

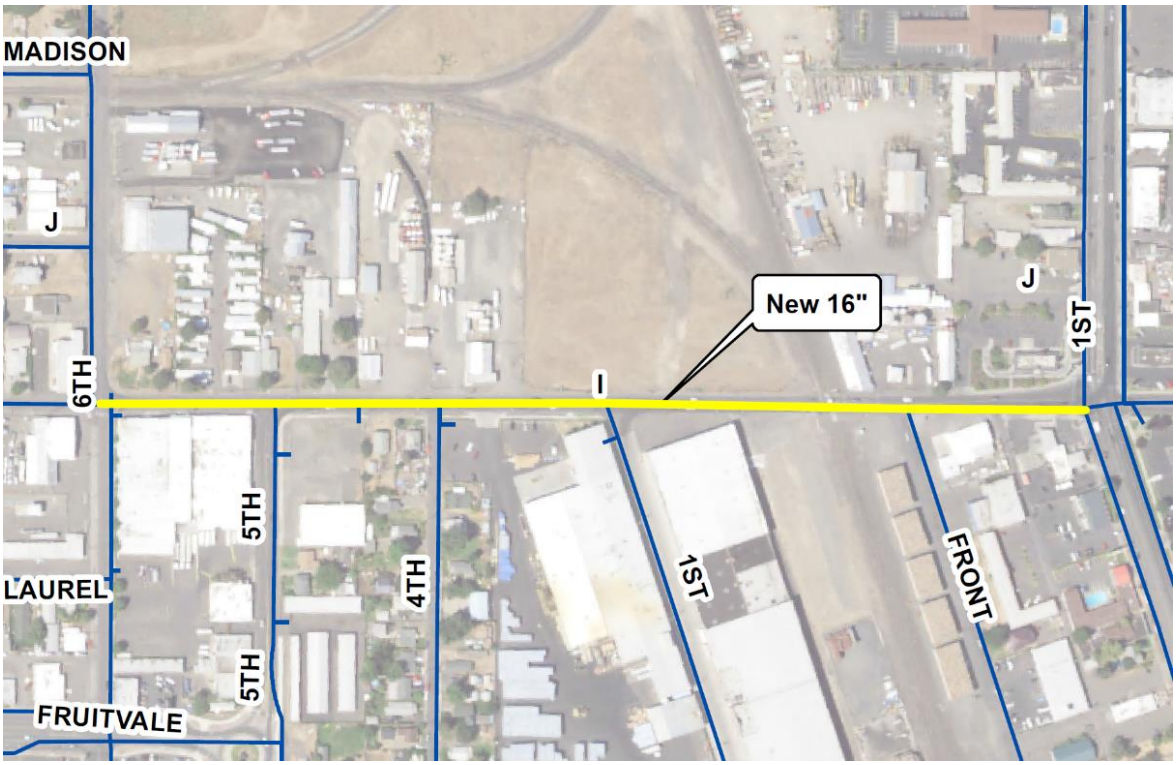
Figure 3-44. North Front Street Waterline Improvements



West I Street Waterline Improvements (D-23)

This project installs 1,600 ft of 16-inch DI and 400 ft 12-inch DI waterline in West I Street between North 6th Avenue and North 1st Street, including crossings, services, valves and hydrants, as well as a bore crossing of the BNSF railroad. The existing 16-inch lead joint CI water main has aged past its useful life and has required periodic repair due to leaks. Replacement of the line will reduce unscheduled repairs, as well as improve system operation.

Figure 3-45. West I Street Waterline Improvements



Yakima Avenue and Other Future, Not Yet Identified Replacements (D-24)

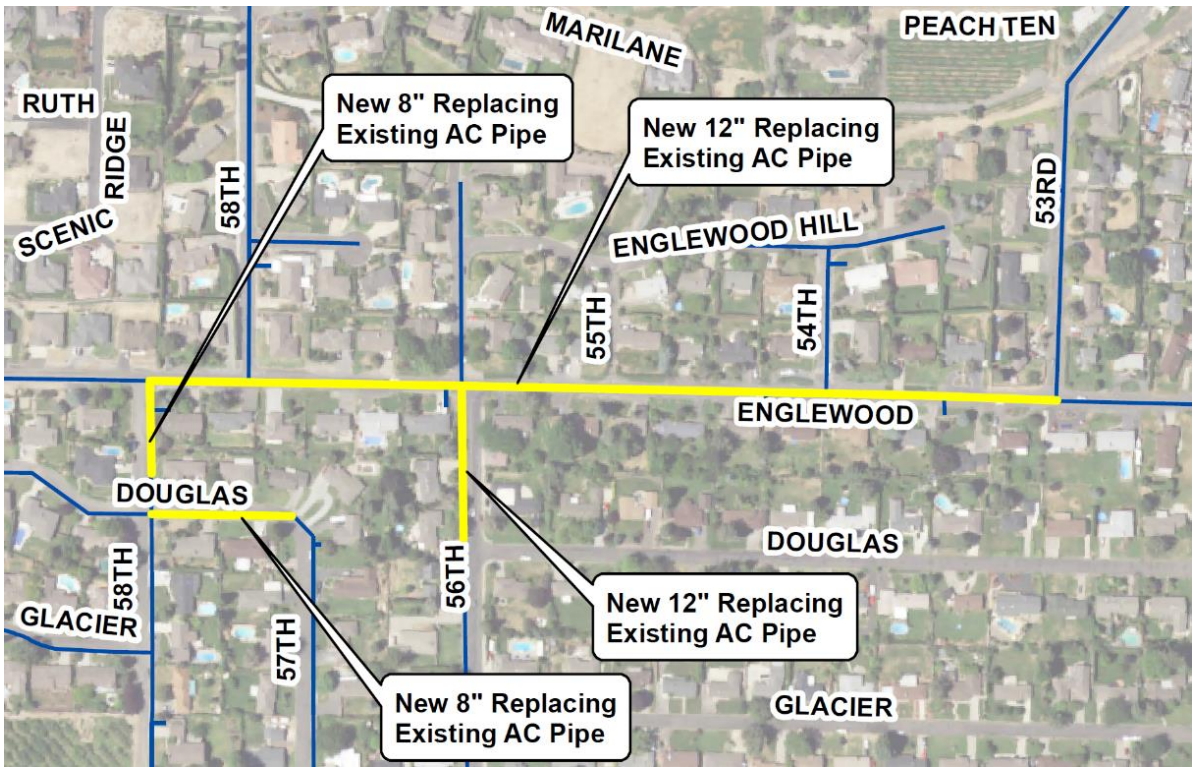
In addition the lead-oakum joint waterline replacement projects listed above, other projects may be identified as specific locations of lead-oakum joint waterlines are determined based on repair history, as well as the criticality of the waterline. One such potential location exists on Yakima Avenue.

Miscellaneous Operation and Maintenance Improvements, Repairs, and Replacements

Englewood Avenue AC Waterline Replacement (D-25)

This project installs 2,150 ft of 12-inch DI waterline in Englewood Avenue between North 53rd Avenue and North 58th Avenue, and in North 56th Avenue between Douglas Drive and Englewood Avenue. It also installs 650 ft of 8-inch DI waterline in North 58th Avenue and Douglas Drive south of Englewood Avenue, including crossings, services, valves and hydrants. The existing 8-inch and 12-inch asbestos cement (AC) water main is fragile and susceptible to damage resulting in major leaks, which have occurred in the past. The main is also difficult to work on given its material type and requires special safety considerations to meet OSHA requirements. Replacement of the line will reduce unscheduled repairs and provide a standard waterline for future connections and long term service.

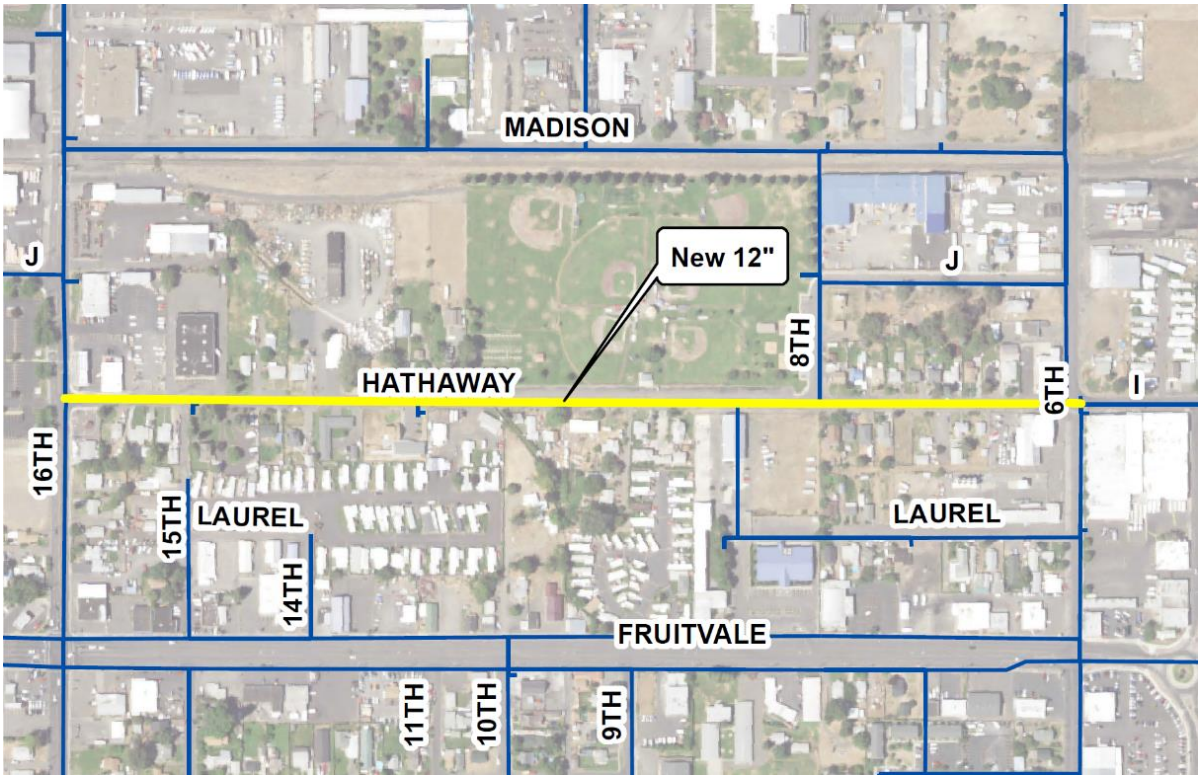
Figure 3-46. Englewood Avenue AC Waterline Replacement



Hathaway Street Waterline Improvements (D-26)

This project installs 2,650 ft of 12-inch DI waterline Hathaway Street between North 6th Avenue and North 16th Street, including crossings, services, valves and hydrants. The existing 16-inch OD Steel water main has deteriorated and required periodic repair due to leaks. Replacement of the line will reduce unscheduled repairs, as well as improve system operation.

Figure 3-47. Hathaway Street Waterline Improvements



Distribution Main Leak Detection (D-27)

In 2008/09, the City of Yakima conducted an extensive leak detection program. The program used extremely sensitive sound amplification instruments and a computer-based leak correlation program to help pinpoint the location of the leaks. Approximately 280 miles of the distribution system were included in the program. In this program, 15 leaks were detected and repaired in water mains, meters, hydrants, service lines, service connections, and valves. Since 2009, over 30 main breaks have occurred and have been repaired. Other leak detection and repair programs had been previously conducted in 1996, 1997, 1999, and 2000.

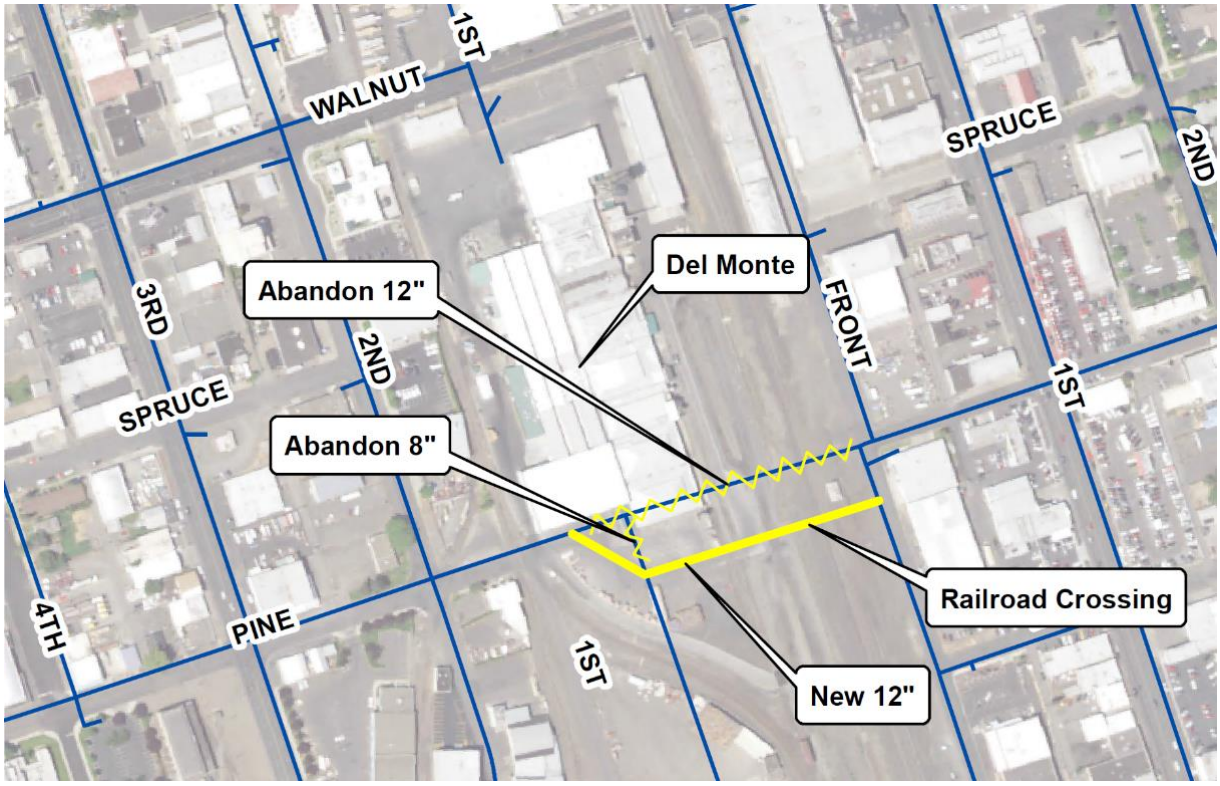
Although the new Advanced Metering Infrastructure (AMI) system is almost fully implemented, which has included replacement of galvanized water services, the distribution system leakage is still estimated at nearly 15 percent. With aging cast iron pipe as a majority of the distribution system pipe material (including lead/oakum joint pipe), it is likely that there are system leaks due to main breaks or failed joints that are currently undetected.

This project would provide a detailed leak detection survey throughout the distribution system on 4-inch to 24-inch diameter pipe, as well as valves, fire hydrants and water services.

Del Monte Site Waterline Replacement (D-28)

Currently, the existing 8-inch CI and 12-inch CI public waterlines located on the Del Monte property at West Walnut Street/West Pine Street/South 1st Avenue are underneath existing buildings. This presents a liability to the City should a water main break occur, and repair and maintenance of these waterlines is not possible. This project would abandon the existing waterlines and install a new 12-inch waterline around the south end of the existing building (West Pine Street), as well as a new BNSF railroad crossing to South Front Street. Project cost may possibly be shared with Del Monte.

Figure 3-48. Del Monte Site Waterline Replacement



Advanced Metering Infrastructure (AMI) Battery Replacement / System Upgrade (D-29)

AMI has improved meter reading accuracy, billing accuracy, identified customer usage patterns, potential customer leaks, and provided improved customer service. Components of the AMI system include water meters, transmitters, data collection units, and software. Over time, components of the system will require upgrade or replacement, including software, hardware, batteries or other associated infrastructure. For example, over 19,000 water meter data transmitters require the use of batteries, which have a life expectancy of approximately 20 years. Replacement of the battery will also include replacement of the transmitter and meter register. This project would provide funding for the on-going planned, or sometimes unexpected, replacements or upgrades. With a 20 year life expectancy on batteries, major replacement work will likely begin around 2030.

Waterline Replacement Program (D-30)

This project replaces aging, undersized waterlines throughout the system. Replacement of the undersized lines will improve overall system performance, improve fire flows, and provide for future development. Replacement will also eliminate aging waterlines, which will require on-going repair. Depending on the area, replacements may also include waterlines identified as part of the Lead Oakum Joint Waterline Replacement program.

In parts of the City, private water mains have been brought into the City's system. This program replaces those mains less than 6-inch (in some cases 1-inch galvanized) and completes loops in the areas where these mains are replaced. This improves domestic flows to current residential customers, provides fire protection in areas where no fire hydrants have previously existed and improves overall system performance and reliability by looping the new mains to existing mains.

As part of these replacements, the city will continue its efforts to remove lead gooseneck connections as well as any other lead appurtenances in the water system as they are discovered.

Water System Expansion

New Waterline Installation in Unserved Areas (D-31)

This project installs all new water facilities – waterlines, water services and fire hydrants – in areas of the City which currently do not have public water facilities. Currently, properties in these areas have individual wells, some of which are shallow and improperly constructed according to current standards. Installation of the new facilities would provide fire protection to these area, provide water service to properties (once appropriate connection fees are paid) and provide for future development within the area. Projects may be coordinated with proposed sanitary sewers projects in the same areas.

Mill Site Redevelopment (D-32)

In conjunction with private developer funding, this project installs waterlines and facilities in the currently underdeveloped area of the old Boise Cascade lumber mill site (west of I-82 and north of North Fair Avenue). The project may replace existing, undersized facilities to provide adequate flows to new development at the site, and it may also replace existing facilities that are in poor condition and are incapable of providing for the future needs of the area. The project may also add new waterlines to the site depending on demands of new development.

3.8 Limiting Factors and Carrying Capacity

A key element of this WSP is the evaluation of the capacities of various water system elements and their abilities to support current and projected future water supply needs. Resulting from these evaluations are "carrying capacities," or the maximum number of equivalent residential units (ERUs) that existing facilities can support. Such analyses aid in identifying capacity deficiencies and provide the foundation for some capital improvement projects.

Table 3-21 summarizes the carrying capacities associated with the City's primary water system components. This summary is formatted consistent with "Worksheet 6-1" of the DOH Water System Design Manual (December 2009). Details regarding source and storage capacity analyses are provided earlier in this section of the WSP. By comparing this carrying capacity with the demand forecast presented in Chapter 2, it can be seen that existing facilities are able to support current demands and needs projected through the 20-year planning horizon.

A carrying capacity analysis has not been conducted for the City's distribution facilities for the following reasons. It is difficult to characterize ERU carrying capacities in terms of piping, etc. Water mains are typically designed to convey fire flows. In the case of the City's system, this means that they are also more than adequate to support the average and maximum day demands imposed by customers. Some deficiencies have been identified throughout the system regarding the capability of certain sections of distribution piping to convey required fire flows at minimum pressures. Such deficiencies, however, are not a function of the amount of current or proposed ERUs, and therefore do not factor into a carrying capacity analysis.

Table 3-21. DOH Water System Design Manual "Worksheet 6-1: ERU Determinations"

Water System Physical Capacity Documentation Based on MDD

Note: *Capacity determinations are only for existing facilities that are operational for the water system.*

Specific Single-Family Residential Connection Criteria:

Average Day Demand (ADD): 233 [1] gpd/ERU

Maximum Day Demand (MDD): 408 [2] gpd/ERU

Water System Service Connections correlated to ERUs			
Service Classification [3]	**Total MDD for the classification, mgd [4]**	**Total # Connections in the classification [5]**	**ERUs [6]**
Single-Family	6.06	14,862	14,862
Multi-Family	3.04	1,622	7,460
Commercial	6.52	2,156	15,978
Industrial	1.51	116	3,711
Interdepartmental	1.25	577	3,073
Total existing ERUs (Residential + Nonresidential + Non-revenue + Other) = 45,112			

Physical Capacity as ERUs	
Water System Component (Facility)	**Calculated Capacity in ERUs for each component**
Source(s)	52,889 [7]
Treatment	52,889 [8]
Capacity Related Storage (ES+SB)	56,027 [9]
Distribution	N/A [10]
Transmission	69,663 [11]
Other (water rights) [12]	Qi basis: 61,813 (low) 143,343 (high)
	Qa basis: 63,840
Water System Physical Capacity (ERUs) = 52,889	
(based on the limiting water system component shown above)	

Notes:
1. See Chapter 2. ERU value is 233 gpd/ERU.
2. See Chapter. ADD:MDD is 1.75. MDD ERU value listed is rounded. Actual value used in the calculations is 407.75.
3. Service classifications adjusted to include non-revenue and unaccounted water.
4. See Chapter 2.
5. Based on City data.
6. See Table 2 18.
7. See Table 3 10.
8. Treatment is provided at a capacity equal to the source capacity.
9. Calculated per DOH Waster System Design Manual Equation 6-8
10. Not calculated for reasons specified in Section 3-8.
11. Calculated by determining the flow rate necessary to produce a friction head loss in the transmission pipe from the WTP equal to the difference in elevation between the WTP outlet and the static high water level of the 1st Level pressure zone.
12. See Chapter 4 for water rights analysis.

4 Conservation and Water Resources

This chapter consists of five main sections:

- Conservation Program Development and Implementation
- Source of Supply Analysis
- Water Right Evaluation
- Water System Reliability Analysis
- Description of existing and proposed interties.

Applicable state laws include RCW 90.03.005, .260(4) and (5), .330(3), .383(3), .386, and .400, RCW 43.20.230, and .235; RCW 43.70.310, RCW 43.27A.090 (6), RCW 70.119A.180, RCW 90.44.110, Chapter 90.46 RCW, RCW 90.54.020 (2) (6), .050 and .180, as well as WAC 246-290-100, 496, 810, 820, 830, and 840, and Chapter 173-590 WAC.

4.1 Conservation Program Development and Implementation

4.1.1 Introduction

Development and implementation of a water use efficiency (WUE) program is required by the DOH for approval of a water system plan. It is also required by the Department of Ecology (Ecology) when applying for new water rights. The applicable conservation program requirements and guidelines are contained in *Water Use Efficiency Guidebook*, Third Edition, May 2016 (DOH 331-375).

The requirements for a conservation program vary based upon water system size and whether or not additional water rights will be needed within twenty years. In all cases, the larger the size of the system, the more detailed and comprehensive the program. Additionally, if water rights are identified as being necessary within twenty years in the system's water demand forecast, the conservation planning must also include WUE measures as part of the supply alternatives evaluation.

A conservation program, as presented in this chapter, is one of the three required elements of a conservation plan. The other two elements, water use data collection and water demand forecasting, are discussed in Chapter 2, *Basic Planning Data and Water Demand Forecasting.*

4.1.2 Water Use Efficiency Requirements and Compliance Summary

In 2003, the Washington State Legislature passed Engrossed Second Substitute House Bill 1338, better known as the Municipal Water Law, to address the increasing demand in the State's water resources. The law established that all municipal water suppliers must use water efficiently in exchange for water right certainty and flexibility to help them meet future demand. The Legislature directed DOH to adopt an enforceable conservation program, which became effective on January 22, 2007. Table 4-1 summarizes the conservation program requirements and the City's compliance status for each requirement.

Table 4-1. Summary of Water Use Efficiency Program Requirements and Compliance Status

Category	WAC[1] Section	Requirement	Yakima in Compliance?
1. Meters	246-290-496	1. Meter all **sources.**	Yes, See Section 4.1.3
		2. Meter all **service connections**.	Yes, See Section 4.1.3
2. Data Collection	246-290-100	1. Provide monthly and annual **production/purchase** numbers for each source.	Yes, See Table 2-4
		2. Provide annual **consumption** by customer class.	Yes, See Table 2-10
		3. Provide "**seasonal variations**" consumption by customer class.	Yes, See Figure 2-2
		4. Provide annual quantity **supplied to other public water systems**.	Yes, See Table 2-6
		5. Evaluate **reclaimed water** opportunities.	Yes, See Section 4.1.6
		6. Consider water use efficiency **rate structure**.	Yes, See Sections 4.1.3 and 4.1.4
3. Distribution System Leakage	246-290-820	1. **Calculate** annual volume and percent using formula defined in the WUE Rule.	Yes, See Table 2-6
		2. **Report** annually: annual leakage volume, annual leakage percent, and, for systems not fully metered, meter installation progress and leak minimization activities.	Yes, See annual WUE Reports
		3. Develop water loss control **action plan** (if leakage is over 10% for 3 year average).	Yes, See Section 4.1.5
4. Goals	246-290-830	1. **Establish** measurable (in terms of water production or usage) conservation goals and re-establish every 10 years. Provide schedule for achieving goals.	Yes, See Section 4.1.4
		2. Use a **public process** to establish the goals.	Yes, See Section 4.1.4
		3. **Report** annually on progress.	Yes, See annual WUE Reports

Table 4-1. Summary of Water Use Efficiency Program Requirements and Compliance Status (Cont'd.)

Category	WAC[1] Section	Requirement	Yakima in Compliance?
5. Conservation Program	246-290-810	1. **Describe existing** conservation program.	Yes, See Section 4.1.3
		2. **Estimate water saved** over last 6 years due to conservation program.	Yes, See Section 4.1.3
		3. Describe conservation **goals**.	Yes, See Section 4.1.4
		4. Implement or evaluate 9 measures (relating to the following sectors: residential, outdoor, and industrial/commercial).	Yes, See Table 4-3
		5. Describe conservation programs for next 10 years including schedule, budget, and funding mechanism.	Yes, See Section 4.1.4
		6. Describe how customers will be **educated** on efficiency practices.	Yes, See Section 4.1.4
		7. Estimate **projected water savings** from selected measures.	Yes, See Section 4.1.4
		8. Describe how efficiency program will be **evaluated** for effectiveness.	Yes, See Section 4.1.4
		9. Estimate **leakage from transmission lines** (if not included in distribution system leakage).	N/A, all leakage is included in the distribution system leakage number.
6. Demand Forecast	246-290-100	1. Provide demand forecast reflecting **no additional conservation**.	Yes, See Table 2-17
		2. Provide demand forecast reflecting **savings from efficiency program**.	N/A, See Section 4.1.4. WUE measures are intended to maintain the already low per capita water use levels. Therefore, no additional savings are expected.
		3. Provide demand forecast reflecting **all "cost effective" evaluated measures,** if not implementing the minimum number of measures.	N/A, the City plans to implement at least 9 measures.
7.Performance Reports	246-290-840	1. **Develop** annual report including: goals and progress towards meeting them, total annual production, annual leakage volume and percent, and, for systems not fully metered, status of meter installation and actions taken to minimize leakage.	Yes, See annual WUE Reports
		2. **Submit annually** to DOH and customers and make available to the public.	

1. Washington Administrative Code.

4.1.3 Historical Conservation Program

Historical Program Measures

DOH requires systems with more than 10,000 service connections (such as the City of Yakima) to implement at least nine WUE measures. These nine WUE measures are in addition to the mandatory supply-side measures required under the WUE Rule. The City's recent conservation program has consisted of WUE measures across multiple customer classes. Specific WUE measure implemented for different customer classes, count as multiple WUE measures. For example, the City has implemented a conservation rate structure for single family, multifamily, and nonresidential customers. Therefore this counts as three WUE measures. A summary of these measures over the last six years is shown in Table 4-2. The details of each measure are discussed below.

Table 4-2. Historical Conservation Program Summary (2010-2015)

Measure	Sectors[1]			Years Implemented					
	SF	MF	NR	2010	2011	2012	2013	2014	2015
Mandatory Measures									
1. Source Meters	n/a			X	X	X	X	X	X
2. Service Meters	X	X	X	X	X	X	X	X	X
3. Meter Calibration	X	X	X	X	X	X	X	X	X
4. System Leak Detection and Repair	n/a			X	X	X	X	X	X
Water Use Efficiency Measures									
5. Conservation Rate Structure	X	X	X	X	X	X	X	X	X
6. Bills Showing Consumption History	X	X	X	X	X	X	X	X	X
7. Educational Bill Inserts	X	X		X	X	X	X	X	X
8. Conservation Outreach	X	X	X	X	X	X	X	X	X
9. Use of Reclaimed Water	n/a			X	X	X	X	X	X

1. SF = single family, MF = multifamily, NR = non-residential.

1. Source Meters

Source meters are a critical conservation tool since accurate water production data is used in developing conservation priorities, goals, and programs. The City has source meters on its Naches River WTP and all of its wells. All of these meters are verified by a third party contractor on a bi-annual basis.

2. Service Meters

Service meters at customer connections are another key component of providing accurate water information for conservation planning. The City has meters on all service connections. Over the past 6 years, the City replaced or upgraded all of the existing meters with advanced metering infrastructure (AMI) (discussed further in Section 4.1.4).

3. Meter Calibration

The City has conducted audits to determine proper meter size and has replaced over 200 meters with smaller meters that improve accuracy for those users. The City has also implemented an intensive meter calibration program for all meters over 1.5 inches. These efforts enable the City to more accurately measure water consumption and provide the basis for detecting leaks and evaluating conservation opportunities.

4. System Leak Detection and Repair

The City has conducted an extensive and ongoing leak detection program. The program has used extremely sensitive sound amplification instruments and a computer-based leak correlation program to help pinpoint the location of leaks. Approximately 220 miles of the distribution system (90 percent of the total system) were included in the program. In this program, 85 leaks were detected and repaired in water mains, meters, hydrants, service lines, service connections, and valves. It should be noted that repair of these leaks did not significantly reduce the observed distribution system leakage (DSL). As such, the City anticipates that DSL is due to inaccuracies in meter reading and the City's billing system. In addition, the City's leak detection program includes conducting leak detection surveys every few years. The City's leak detection efforts are described further in Section 4.1.5.

5. Conservation Rate Structure

In October 2007, the City conducted a Cost of Services and Rate Study which established a transition to a conservation rate structure. In 2009, the City switched from a declining block rate structure to a single block conservation rate structure. This rate structure applies to residential and nonresidential customers. The City completed a rate study in 2012 and an update in July 2013 that analyzed additional conservation rate options. Sewer use charges are linked to water consumption. This is an additional incentive to conserve water because sewer use rates are higher than the water rates per hundred cubic feet.

6. Bills Showing Consumption History

In 2010, the City began including consumption history in utility bills for both residential and industrial/commercial customers. In 2015, the City established an internet portal that customers can access to view their billing records and water use.

7. Educational Bill Inserts

The City distributes bill inserts providing water system users with information on water efficiency measures. The inserts also direct customers to the City's website for additional information on leak detection and additional water efficiency measures.

8. Additional Conservation Outreach

The City has implemented a number of public outreach activities aimed at conveying water conservation messages. These activities include the following:

- **Brochures:** Since 1989, the City has distributed water conservation brochures to educate the public about water conservation, promoting indoor and outdoor conservation practices. These brochures have been distributed by city staff and displayed on the City's website and at the Utility Billing, Public Works, and City Clerk's offices.
- **WaterSense Program:** The City of Yakima joined the WaterSense program in September 2010. WaterSense is an EPA-sponsored partnership program, launched in 2006, that seeks to protect the future of our nation's water supply by promoting water efficiency and enhancing the market for water-efficient products, programs, and

practices. The City has continued to promote this program to help water users identify water-efficient products and programs that meet the WaterSense water efficiency and performance criteria. In addition, the City has adopted the 1993 Uniform Building Codes which mandate low use plumbing fixtures.

- **Water Conservation Website:** The City encourages a conservation ethic through its website which provides customers with indoor and outdoor water conservation guidance and recommendations.
- **Integrated Plan Partnership:** In 2009, the City partnered with the U.S. Bureau of Reclamation, Ecology, and other stakeholders in the Yakima River basin to develop the Yakima Basin Integrated Plan (described in Section 1.4.9). The Integrated Plan provides a comprehensive approach for addressing the basin's water resource problems and ecosystem restoration needs. An element of the Integrated Plan is to enhance municipal water conservation in the basin. As part of this effort, the City has partnered with other municipalities and agencies in the basin to identify best management practices for water conservation and develop basin-wide resources that promote municipal water conservation. For example, in 2015, the City worked with Integrated Plan partners to produce a water conservation brochure that was distributed throughout the basin.
- **Outreach Letters:** In 2015, the City distributed water conservation letters to local government entities, schools, and community groups to help promote efficient water use. This letter encouraged customers to conserve water, especially during periods of drought, and provided recommendations for implementing conservation measures.

9. Use of Reclaimed Water

All water from a potable source used at the wastewater treatment plant (WWTP) is metered. Since the late 1970s, reclaimed water has been used for all wash downs and for irrigation at the WWTP. The WWTP uses 1.0 to 1.3 million gallons (MG) of reclaimed water a day.

Historical Conservation Program Savings

The City's historical conservation program has focused largely on promoting a conservation ethic within the City through the use of price signals and educational outreach. Water savings associated with promoting a conservation ethic can be difficult to quantify. In 2004, the City established a residential water use goal of 74.9 gallons per capita per day (gpcd). Since 2004, per capita water use has gradually declined from an estimated 78.8 gpcd in 2004 to 71.7 gpcd in 2015. These estimates are based on total residential consumption and water service area population in these years. This shows a reduction of approximately 7.1 gpcd over the last 12 years. Since 2009, per capita water use has declined by approximately 3.7 gpcd. The City has been able to achieve this goal despite moderate population growth in the water service area. This reduction in water use is likely partially attributed to the City's conservation program. However, the City recognizes that reductions in water use are also influenced by other factors, such as the proliferation of more efficient appliances and fixtures, drought conditions such as those that affected the region in 2015, and the 2008 economic recession and its lingering social and economic effects.

Between 2004 and 2009, the average annual DSL estimate was 19.5 percent. Between 2010 and 2015, the average annual DSL estimate was 10.8 percent. This suggests a reduction in DSL of approximately 8.7 percent over the last 12 years. This reduction in DSL has likely contributed to the reduction in per capita water use. However, it should be noted that DSL estimates between 2004 and 2015 have been highly variable, ranging from 31.7 percent in 2008 to 3.1 percent in 2012. Ongoing leak detection efforts over the years have failed to identify any significant amounts of actual leakage in the distribution system. Therefore, it is likely that the variability in estimated DSL can be attributed to the City's billing system not recording all water sales. Therefore, efforts to better understand and reduce DSL have focused initially on upgrading the billing system and undertaking a meter replacement

program. The City implemented a new utility billing system in 2016, making it possible to better account for water use. The City also completed implementation of its AMI system in 2016. While a portion of this reduction in DSL is likely due to the implementation of WUE leak detection measures, it will be difficult to quantify these reductions until the new billing system and AMI system are fully operational.

The City has also generated potable water savings through the use of reclaimed water at the City's WWTP. The WWTP currently uses approximately 1.0 to 1.3 MG of reclaimed water a day for facility operation and irrigation. By using reclaimed water at the WWTP, the City is able to reduce the demand on the potable water system which would have been used if reclaimed water had not been available.

4.1.4 Conservation Program (2018-2027)

The elements included in the conservation program include the following:

- Conservation Program Goals and Objectives
- Evaluation of WUE measures
- Selection of WUE measures for implementation

These elements are outlined in the following subsections.

Water Use Efficiency Program Goals and Objectives

The regulation (WAC 246-290-830) requires the governing body of the municipal water system (the Yakima City Council in this case) to establish WUE goals through a public process. The WUE goals were re-evaluated as part of this 2017 Water System Plan update and will be discussed in a public hearing as part of the City Council meeting adopting this plan. A copy of the Council Action Minutes from that meeting and a signed copy of the resolution adopting the Water Use Efficiency Goals are included in Appendix B. The hearing allowed for public input on the proposed goals. The WUE goals established through this process are as follows:

1. Reduce DSL to 10 percent or less by January 1, 2019
2. Maintain a residential water use goal of 74.9 gpcd

In addition to these goals, the City has established four main objectives for its conservation program:

1. Minimize impact of conservation program on domestic water rates
2. Encourage conservation ethic through increased customer awareness
3. Reduce commercial and industrial water consumption
4. Comply with DOH guidelines and state law

Evaluation of Water Use Efficiency Measures

DOH requires systems with more than 10,000 service connections (such as the City of Yakima) to implement at least nine WUE measures. Specific WUE measure implemented for different customer classes, count as multiple WUE measures. The evaluation and selection of measures relates to the cost-effectiveness of the measures.

During the preparation of the 2004 water system plan update, the City evaluated an initial list of 25 potential conservation measures. The list included measures implemented by other northwest water utilities and the minimum program measures required by DOH. From these 25 measures, the measures that were deemed to be applicable to Yakima were placed on a "short list" for more detailed evaluation. From this list, the City selected those measures to

implement that were cost-effective for their system (see Section 4.1.3 for summary of historical conservation measures).

During this water system plan update, the City considered historical conservation measures and potential new measures that contribute to the conservation goals and objectives. Based on this, the City selected measures for implementation over the next 10-year planning period. Table 4-3 summarizes the measures that the City selected for 2018 through 2027. The following subsections provide a description of each measure.

Table 4-3. Selected Water Use Efficiency Measures for 2018-2027

Measure	Sectors[1]		
	SF	MF	NR
1. Advanced Metering Infrastructure	X	X	X
2. Conservation Rate Structure	X	X	X
3. Bills Showing Consumption History	X	X	X
4. Educational Bill Inserts	X	X	
5. Conservation Outreach	X	X	X
6. Use of Reclaimed Water	Not broken out by sector.		
7. Low-Water Demonstration Gardens	Not broken out by sector.		
8. Irrigation Efficiency Demonstration	Not broken out by sector.		

1. SF = single family, MF = multifamily, NR = non-residential.

Measures Selected for the 2018-2027 Conservation Program

1. Advanced Metering Infrastructure

In 2016, the City finished implementing an AMI system. This involved replacing and upgrading all existing water meters. Components of the AMI system include new water meters, radio transmitters for existing water meters, structures for data collection units, and AMI software. The AMI system will allow for real-time monitoring and geocoding of consumption data. The system will allow the City to evaluate water use, consumption, and DSL, as needed. The system will also improve the City's ability to evaluate the effectiveness of WUE measures, educate customers about leak detection, and support future water system planning.

2. Conservation Rates

The City plans to continue with the existing single block conservation rate structure. In 2017, the City plans to conduct another Cost of Service and Rate Study. This study will consider additional conservation rate options.

3. Water Bills Showing Consumption History

The City plans to continue to provide customers with water bills that show consumptive history. This measure allows customers to compare the percentage increase or decrease in water use over the same period from the previous year.

4. Educational Bill Inserts

The City plans to continue customer leak detection education using billing inserts. Bill inserts direct customers to the City's website for additional information on leak detection and other water efficiency measures, such as EPA's WaterSense program and Pacific Power and Cascade Natural Gas incentive programs for water efficient fixtures and appliances.

5. Additional Conservation Outreach

The City plans to continue public outreach activities aimed at conveying water conservation messages. These activities include the following:

- **Brochures:** The City plans to continue distributing water conservation brochures to educate the public about water conservation and promote indoor and outdoor conservation practices.
- **WaterSense Program**: The City plans to continue to promote WaterSense to help water users identify water-efficient products and programs.
- **Water Conservation Website:** The City plans to continue encouraging a conservation ethic through its website which provides customers with indoor and outdoor water conservation guidance and recommendations.
- **Integrated Plan Partnership:** As part of the Integrated Plan, the City plans to continue its partnership with other municipalities and agencies in the basin to develop basin-wide municipal conservation resources, advance components of a municipal conservation program, and conduct outreach to water users and elected officials. This will contribute to promoting a conservation ethic within the basin and the City.

6. Use of Reclaimed Water at the Wastewater Treatment Plant

The City plans to continue using 1.0 to 1.3 MG of reclaimed water a day at the WWTP. (See Section 4.1.6 for a discussion of other water reuse options evaluated.)

7. Low-Water Demonstration Gardens

In 2016, the City received a grant from Ecology and other contributors to design and install low-water demonstration gardens. In 2017, the City plans to complete installation of demonstration gardens at the Yakima Public Works office and a downtown site on Yakima Avenue. Each site will include signage to educate the public about low-water landscapes. Photos and information about the gardens will also be posted on the City's website for water users to view.

8. Irrigation Efficiency Demonstration Projects

As described above, the City plans to install demonstration gardens at the Yakima Public Works office and a downtown site on Yakima Avenue. These demonstration gardens will use efficient irrigation system technologies, such as wireless irrigation control systems. Each site will include signage to educate the public about efficient irrigation practices. Photos and information about irrigation efficiency will also be posted on the City's website for water users to reference.

Additional Measures Considered But Not Selected for the 2018-2027 Conservation Program

In addition to the measures selected, the City considered other potential conservation measures. However, due to financial considerations, the City decided not to implement these measures at this time. The following subsections summarize the additional measures that the City considered.

Retrofit Kits and Residential Water Audits

The City considered including retrofit kits, toilet flappers (devices that regulate the amount of time for filling the toilet bowl), and residential water audits in their conservation program for 2018 to 2027. However, the City determined that these measures produce limited water-saving benefits and are expensive to implement. For example, toilet flappers often require installation by utility personnel since those mailed to customer are frequently not installed. Similarly, residential water audits involve hiring a utility representative. Audits typically take approximately one hour and must be applied to many customers. In addition to consultation and installation, the cost of the audit also includes scheduling, follow-up, and the conservation devices. Due to labor costs, the City determined that these measures were not cost-effective at this time.

Commercial/Industrial Audits

Like the residential audits, commercial/industrial can be time-consuming and expensive for the City to conduct. Despite being unable to implement these measures at this time, the City still plans to support reductions in commercial and industrial consumption where possible.

Estimated Conservation Program Savings

Savings from Water Use Efficiency Measures

The City's future conservation program will continue to focus largely on promoting a conservation ethic within the City through the use of price signals and educational outreach. Water savings associated with promoting a conservation ethic are difficult to quantify. Therefore, the savings from educational measures were not quantified as part of this Water System Plan update. The following summarize the expected savings from each WUE measure.

1. **Advanced metering infrastructure:** The City would use AMI data to inform customers of potential leaks. The savings from improved customer leak detection is unknown at this time. The City will be able to quantify these savings after several years of collecting AMI data.
2. **Conservation rates:** The City plans to maintain the existing conservation rate structure. This is expected to sustain existing water use levels.
3. **Water bills showing consumption history:** Water savings are expected as part of promoting a conservation ethic.
4. **Educational bill inserts:** Water savings are expected as part of promoting a conservation ethic.
5. **Additional conservation outreach:** Water savings are expected as part of promoting a conservation ethic.
6. **Use of reclaimed water at the WWTP:** The City plans to maintain the level of reclaimed water use at the WWTP (1.0 to 1.3 MG per day). Over the next ten year planning period, this measure will save approximately 3,650 to 4,745 MG of potable water.

7. **Low-water demonstration gardens:** Water savings are expected as part of promoting a conservation ethic
8. **Irrigation efficiency demonstration projects:** Water savings are expected as part of promoting a conservation ethic

Although it is difficult to quantify the water savings expected from individual WUE measures, the City expects that these measures will help to sustain the water savings achieved through the City's historic conservation program (described in Section 4.1.3). Therefore, the City plans to maintain a residential water use goal of 74.9 gpcd. The 2015 per capita usage was estimated to be 71.7 gpcd (see Table 2-10). The 5 year average (2011 to 2015) per capita usage was estimated to be 70.0 gpcd. This is already a low per capita water use level. The City recognizes that low water usage in recent years may be a short-term response to recent drought and the lingering effects of economic recession. Therefore, it is possible that this low level of water usage does not reflect long-term water use trends. As such, the City anticipates that additional reduction in water use would be difficult to obtain and are likely not financially feasible. This is especially true since the City has a separate irrigation supply, so opportunities to reduce outdoor potable water uses are limited. As such, the WUE measures selected for 2018 through 2027 are intended to maintain the existing per capita water use level. Therefore, no additional water savings are expected from these WUE measures over the next 10-year planning period.

Savings from Improved Leak Detection

The City plans to reduce DSL to 10 percent or less. Based on ongoing leak detection efforts, the City speculates that high DSL estimates are attributed to the City's billing system not recording all water sales. As such, it is likely that actual DSL is already under 10 percent. Efforts to better understand and reduce the DSL have therefore focused on upgrading the billing system and implementing AMI. The City completed implementation of the new billing system and AMI system in 2016. Moving forward, this will allow the City to more accurately estimate DSL and better evaluate the effectiveness of the conservation program. Note that the expected savings from improved leak detection are separate from the savings generated by the WUE measures. Because DSL accounts for a portion of the per capita water use estimate, the new billing and AMI systems will allow the City to determine the accuracy of the current per capita water use estimate and evaluate the effectiveness of WUE measures to determine if a new per capita goal is appropriate. The City will reassess the per capita water use goal after gathering several years of AMI data.

4.1.5 Water Loss Control Action Plan

The City of Yakima established a WUE goal to reduce DSL to less than 10 percent by January 1, 2019. The estimated DSL for 2015 was 14.5 percent (see Table 2-6). The estimated three-year average (2013-2015) DSL was 12.7 percent. This is slightly above the WUE Rule requirement (DSL at 10 percent or less). The City has implemented the following actions to achieve the DSL goal:

- Implementation of a new billing system (put on line in 2016).
- Implementation of an AMI system (fully complete in 2016).
- A new source meter on each of the seasonal wells.
- Ongoing transmission main and distribution system leak detection monitoring and repair.

The City has not detected any significant amount of leakage in either the transmission main or the distribution system. The City anticipates that the apparent DSL is due to the City's billing system not recording all water sales. Implementation of the AMI system and a new utility billing system in 2016 is expected to resolve this issue. The new AMI system will allow real-time water meter reads to be transmitted to the utility billing system, eliminating the need

for manual meter reading. This is expected to improve meter reading and billing accuracy, and enhance identification of customer usage patterns and potential leaks. The city also has a program to calibrate source meters every two years as needed, and to calibrate service meters over 1.5 inches as recommended in the maintenance manuals provided by meter vendors.

4.1.6 Water Reuse

An inventory of the potential sources and uses for reclaimed water is required under WAC 246-290-100 to be included in the conservation plan. Reclaimed water is commonly used for landscape irrigation, agricultural irrigation, or industrial processes. The feasibility of using reclaimed water as a water supply depends upon the quality and quantity of the reclaimed water, the requirements of the intended application site, the economics of treating, supplying, and distributing the reclaimed water, and public acceptance.

A discussion of the regulations governing the use of reclaimed water and the potential sources and uses is presented in the following subsection. The use of reclaimed water was not included in the current conservation plan except for its continued use at the WWTP.

Regulations

In 1996, Chapter 90.46 RCW was enacted by the legislature to address reclaimed water use. In passing this legislation, the legislature has encouraged the development of wastewater reclamation and reuse facilities and the use of reclaimed water for domestic, agricultural, industrial, recreational, and fish and wildlife habitat including wetlands. The legislature directed DOH and Ecology to coordinate efforts towards developing an efficient and streamlined process for creating and implementing processes for the use of reclaimed water.

The legislature declared that the people of the state have a primary interest in the development of facilities to provide reclaimed water to replace potable water in non-potable applications, to supplement existing surface and groundwater supplies, and to assist in meeting future water requirements of the state. The legislature also declared that the use of reclaimed water is not inconsistent with the policy of anti-degradation of state waters as provided under Chapter 90.48 RCW and Chapter 90.54 RCW. Reclaimed water facilities are water pollution control facilities as defined in Chapter 70.146 RCW and are eligible for financial assistance as provided in that RCW.

DOH and Ecology issued final water reclamation and reuse standards in September of 1997 (Publication #97-23). These standards, as directed by the legislature, were the result of a joint effort by Ecology and DOH. While the standards are primarily administered by the DOH for facility plan review, Ecology has state wastewater discharge permitting authority under the provisions of Chapter 90.48 RCW.

The 1997 Reclamation and Reuse Standards establish requirements for wastewater treatment and reuse. A multi-tiered (Class A through D) reclaimed water classification system defines the characteristics of the reclaimed water for each class (defined in Publication #97-23).

Reclamation and reuse regulations specifically identify groundwater recharge as a beneficial use, and reclaimed water can be used to mitigate water rights limitations, should they exist.

Potential Sources

Effluent from wastewater treatment plants is the most common source of reclaimed water for municipal applications; however, other sites may also serve to provide a source of water for reuse, depending on the reliability and treatment requirements of the applied water. The primary source of reclaimed water in the City is the Yakima Regional WWTP, located between Interstate 82 and the Yakima River. The activated sludge plant is operated by the

City and primarily discharges secondary treated effluent into the Yakima River. The WWTP is the most likely source for reclaimed water for additional uses within the City.

Potential Reclaimed Water Users

The feasibility of using reclaimed water depends on the volume and quality of the source, the size and location of suitable application sites and the proximity of the source to the application or use sites. Table 4-4 presents an inventory of potential reclaimed water users located within 2 miles of the WWTP, which was considered to be the most likely source of water. As the distance from the source increases, the economic feasibility of serving reclaimed water typically diminishes unless there is a large, constant user available. Potential users were identified based on maps of the area and a listing of the top 20 water users.

Table 4-4. Potential Reclaimed Water Users within 2 Miles of the WWTP

Application	Number
Golf courses	1
Parks and arboretum	9
Schools	5
Industrial/commercial facilities	4
Nurseries	1
Freeway landscape irrigation	1
Yakima WWTP	1
Misc.-pipeline flushing, street cleaning dust control, etc.	---

There are four industrial/commercial entities with high water use located within a 2-mile radius of the WWTP. Two of these entities are involved with food handling or production. Based on water use patterns, the other two entities appear to predominately consume water for indoor uses, so use of reclaimed water would likely require costly retrofitting of these facilities to install separate reclaimed water plumbing. Based on these considerations, use of reclaimed water at these locations is unlikely at this time.

The remaining reuse applications could potentially use a range of Class A to Class C reclaimed water, depending on the specific water quality requirements of each use as described in the *Water Reclamation and Reuse Standards* (September 1997, Department of Health and Department of Ecology, Publication No. 97-23).

Although use of reclaimed water in Yakima may be technically feasible, some institutional constraints must be considered. The unit cost of potable water is relatively low in Yakima, so the unit cost of reclaimed water may exceed the unit cost of potable water and may be difficult to sell. Although the use of reclaimed water to help meet large-scale agriculture's irrigation needs would likely be acceptable, the quantities of reclaimed water that could be made available may be too small to justify the investment in reclaimed water facilities. The use of reclaimed water to irrigate schools, parks, and other public landscaping may also encounter public skepticism unless it is accompanied by a public education program focused on the safe use of reclaimed water.

In addition, the Bureau of Reclamation monitors return flows on the Yakima River at the Parker gage, downstream from the City of Yakima. Flow levels at the Parker gage contribute to the Bureau of Reclamation's estimate for total water supply available, which is used to establish portioning levels. If the City were to decrease releases from the WWTP, this would

reduce the return flows at the Parker gage. As such, the City would be subject to additional prorationing. Reduction of flows at Parker could also prompt other proratable users to seek remedies from the City.

Based on these considerations, the City does not plan to pursue additional reclaimed water uses, beyond what is currently used at the WWTP, at this time.

4.2 Source of Supply Analysis

4.2.1 General

The purpose of a source of supply analysis is to evaluate opportunities to obtain or optimize the use of existing sources already developed, and evaluate other innovative methods to meet water supply needs. DOH planning guidelines require a source of supply analysis for systems that will be pursuing water rights within 20 years of approval of their WSP as defined by the water demand forecast (see Chapter 2, *Basic Planning Data and Water Demand Forecastin*g). The City does not anticipate the need to pursue additional water rights within 20 years of the completion of this WSP update. For that reason, a formal source of supply analysis is not included here. However, the City has developed an ASR program to better utilize existing water rights, provide additional water supply, and improve water system reliability.

Section 4.3 provides a summary of the City's current water rights status.

4.2.2 Aquifer Storage and Recovery

The City's ASR program involves diverting water from the Naches River during low demand periods (e.g., the winter), treating the water to drinking water standards, delivering water through the City's distribution system to groundwater wells, and injecting (recharging) water through the wells into the aquifer (reservoir). The City would then withdraw the stored water at later times for municipal use. The City's ASR program has been developed in close coordination with Ecology through extensive feasibility studies conducted over the last 16 years. Additional technical information regarding the ASR program can be obtained from the *Ahtanum Valley Aquifer Storage and Recovery (City of Yakima ASR)* report prepared by Golder Associates in 2015 (Appendix P).

The City submitted Reservoir Permit Application R4-3552 to Ecology on April 12, 2002. This permit identifies the Upper Ellensburg aquifer in the Ahtanum-Moxee subbasin as the proposed aquifer storage reservoir for the ASR program. On February 24, 2015, Ecology issued a Temporary Permit for operation of the City's ASR system (2015 Permit). Between March and September of 2015, the City operated the ASR program under the 2015 Permit. Under the 2015 Permit, water may be recharged at the City's Kissel Park and Gardner Park Wells, and stored water may be recovered from any of the City's existing four wells. In March and April of 2015, a total of approximately 41 million gallons (125.1 acre-feet) were recharged over 31 days. Recharge occurred only at the Gardner Park Well, with a maximum recorded instantaneous recharge rate of 1,368 gpm. The City did not use any other wells for recharge and did not discharge to surface waters. During 2015, the wellhead and distribution system performed well and there were no leaks or other problems with the wellhead observed during recharge or storage.

The City did not recover any of the stored water during 2015. All water recharged during 2015 is reserved for future recovery as provided in the 2015 Permit. Of the 125.1 acre-feet recharged in 2015, 100.1 acre-feet would be available for recovery in 2016 (80 percent of the 2015 recharge volume). If the City does not withdraw any stored water in 2016, the recoverable quantity available in 2017 would be 87.6 acre-feet (70 percent of the 2015 recharge volume).

The City conducted monitoring of groundwater-levels in 2015 as part of the 2015 Permit. Water levels in the Kissel Park, Kiwanis Park, and Airport wells increased throughout the recharge period. However, it is unclear how much water level changes may be attributable to recharge versus regional conditions, such as antecedent water level trends (e.g. recovery from pumping) and interference pumping from nearby wells.

The City also conducted monitoring of disinfection byproducts (DBPs) in both source water (i.e., water being recharged into ASR wells) and stored water (i.e., water withdrawn from ASR wells), as required by the 2015 Permit. Water quality results in some instances exceeded the 2015 Permit limits for source water DBPs. However, water quality results were in compliance with drinking water standards in all samples (i.e., in both source water and stored water) at all times. By June 2015, DBPs had dropped to very low levels, indicating that the majority of DBPs introduced during recharge had been removed during normal operation of Gardner Park Well.

The City prepared Standard Operating Procedures (SOPs) for the ASR program (Appendix Q). The SOPs address procedures for initiating recharge, monitoring and maintenance during recharge, terminating recharge, recovery, sampling, and coordination with Ecology. The City provided the SOPs to Ecology for review before beginning recharge in 2016. Chapter 6, *Operation and Maintenance*, provides a summary of the operation and maintenance of the ASR system.

In January 2017, Ecology issued a final Reservoir Permit (R4-34552P) authorizing the City to recharge up to 14,400 acre-feet per year using the Gardner Park, Kissel Park, and proposed Southeast Area wells. The Reservoir Permit also authorizes the City to use all of its wells for recovery of stored water. The City intends to construct dedicated ASR wells that would recharge and withdraw water under the Reservoir Permit. This will improve water system reliability, particularly for times when the City's Naches River surface water supply is temporarily unavailable. The instantaneous quantities associated with these new wells would be additive to the City's existing groundwater rights. The City would track annual quantities of water withdrawn from these new dedicated ASR wells against the recoverable quantities of stored water.

The City would likely take a phased approach to evaluating and implementing potential new ASR wells. In identifying new ASR wells, the City would consider the aquifer characteristics and evaluate the impacts to the distribution system due to conducting recharge from multiple points in the system. The City would also continue monitoring of the ASR program at existing wells, including well efficiency and aquifer response, to help inform decisions regarding the siting of subsequent wells.

4.3 Water Right Evaluation

4.3.1 Permits, Certificates, Claims, and Applications

The City of Yakima holds a number of water rights that supply the City's domestic water and municipal irrigation systems. All of these water rights are described in the following narrative and in Table 4-5, Table 4-6, and Table 4-7. The City holds several other water rights that are not discussed in this plan because they are not part of the City's municipal water distribution systems and are not used for domestic purposes.

The City's domestic water distribution system is primarily supplied by surface water, with diversions occurring at the City's Naches River WTP. The City currently uses its groundwater supply system as a seasonal/emergency backup supply, as defined by DOH. However, the water rights are not limited to standby/reserve status as defined by Ecology. The City also has two interties with the Nob Hill Water Association for emergency supply purposes.

The City also owns a municipal irrigation distribution system. The system is supplied by surface water with diversions occurring at the City's Nelson Bridge diversion. By serving

some of the need for irrigation of residential property, the City's operation of the irrigation system lessens the demand on the City's domestic water distribution system. During times of drought, the City also sometimes transfers some of its Nelson Bridge water rights to the Naches River WTP for use in the domestic system. Water rights associated with the municipal irrigation system are therefore described in the following narrative and in , Table 4-6Table 4-7, and .

All of the City's surface water rights are currently under the jurisdiction of the Yakima County Superior Court as part of the surface water rights adjudication (*Ecology v. Acquavella, et al*., Yakima County Superior Court, Cause No. 77-2-01484-5). On November 21, 2002, the Court issued a Conditional Final Order that approves a settlement of the City's Naches River water rights diverted at the Naches River WTP and at the Nelson Bridge diversion. Future steps will involve implementing the Conditional Final Order, including the Court's issuance of a Final Decree and Ecology's issuance of applicable certificate documents after issuance of the Final Decree. The surface water right parameters discussed in this Water System Plan are as set forth in the Conditional Final Order and underlying 2003 settlement. Groundwater right parameters are as provided in the underlying permits, certificates, and change authorizations.

Surface Water Rights Summary

1. Claim # 120529 (10 cfs)

Source Type:	Surface water (Naches River).
Source Location:	Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1[2].
Time of Use:	Year round.
Qi:	10 cfs
Qa:	7,260 AF
Priority Date:	June 30, 1902
Provisions or Limiting Conditions:	None

[2] The service area shown in Figure 4-1 is the same as the place of use described in the Conditional Final Order for all of the City's surface water rights.

2. Claim # 064441 (Reclamation Contract Water Right)

Source Type:	Surface water (Naches River).
Source Location:	Naches River Water Treatment Plant: 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East. And Nelson Bridge diversion: 1,790 feet south and 1,600 feet east from the northwest corner of Section 9, being within the SE ¼ NW ¼ of Section 9, Township 13 North, Range 18 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	The beginning of storage control, as determined by the Bureau of Reclamation, through October 15.
Qi:	35.2 cfs (29 cfs at Naches River WTP and 6.2 cfs at Nelson Bridge)
Qa:	4,500 AF (3,583 AF at Naches River WTP and 917 AF at Nelson Bridge) (see provisions below)
Priority Date:	May 10, 1905
Provisions or Limiting Conditions:	• Since 2013, the total quantity of water that may be diverted under this water right is 4,500 AF. Of this total, 3,583 AF may be diverted at the Naches River WTP, and 917 AF may be diverted at Nelson Bridge. The quantity available for diversion at Nelson Bridge was reduced from 1,500 AF in 2013. • The maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract water right diverted at the Naches River WTP is 7,826 AF. • Like other Bureau contract water, this contract right is subject to pro-ration in water short years. The contract states: "In years of shortage, the diversion and delivery of water provided for in this contract shall be reduced on a proration or proportionate basis in accordance with paragraphs 18 and 19 of the judgment of January 31, 1945." • The settlement provides that, "For purposes of determining proration in any water short year, the parties agree that the City's Reclamation contract right . . . shall be prorated based on 6,000 acre-feet subject to and consistent with the terms set forth in the Reclamation Contract No. 14-06-W53, dated December 12, 1952, as amended on December 10, 1965, between the City and the Bureau of Reclamation, except that the actual deliveries shall not exceed the maximum annual quantities stated . . . above."

3. Certificate 938-D (Former Oak Flats), as amended by Yakima County Water Conservancy Board decision No. 11-2000[3]

Source Type:	Surface water (Naches River)
Source Location:	Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Restricted to off-season use (non-storage control period) (see provisions below).
Qi:	3 cfs
Qa:	2,172 AF
Priority Date:	October 1, 1928
Provisions or Limiting Conditions:	Yakima County Conservancy Board decision No. 11-2000 imposed the following conditions: • City required to discontinue use of former infiltration tunnel for water production purposes. • "The flow meter (that records both instantaneous and cumulative production) currently installed at the Rowe Hill [Naches River WTP] surface water diversion shall be maintained in proper operating condition." Ecology's August 14, 2000 approval of Conservancy Board decision No. 11-2000 imposed the following conditions: • "This is a natural flow right. As such, this right shall not obligate the United States Bureau of Reclamation to provide storage flows at any time." • "This right has a priority date of October 1, 1928. As such, it is junior to all prior rights on the Naches River, including the May 10, 1905 Yakima Project right(s) held by the United States Bureau of Reclamation." • "No diversion shall be made pursuant to this right when the Naches/Yakima river system is on storage control." • "Until such time as a superseding certificate issues for this right, each update of the City of Yakima Water Comprehensive Plan shall include a short description of efforts to put the water under this right to full beneficial use."[4]

[3] Because this water right was a groundwater right before the change authorized by Conservancy Board decision No. 11-2000, it is not subject to pending adjudication in *Acquavella,* and so is not included in the City's settlement or Conditional Final Order.

[4] Since 2000, the City has been putting water under this right to beneficial use through diversions at the Naches River WTP. For the years 2000 through 2015, the range of beneficial use has been between 306 AF (2015) and 1,426 AF (2006).

4. Water Right # S4-01141 (A) and (B) (1951 off-season)

a. Superseding Certificate S4-01141C (A)

Source Type:	Surface water (Naches River).
Source Location:	Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Restricted to off-season use (October 16 to the beginning of storage control) (see below).
Qi:	29 cfs
Qa:	4,414 AF (see provisions below)
Priority Date:	January 29, 1951
Provisions or Limiting Conditions:	Superseding certificate contains the following conditions: • "For municipal supply from October 16 to the beginning of Yakima Project storage control, as determined by the US Bureau of Reclamation." • "Screening of the diversion intake shall be maintained in accordance with applicable law of Department of Fisheries and Wildlife." • "No dam shall be constructed in connection with this diversion." • "This right and the portion of the US Bureau of Reclamation Contract No. 14-06-W53 dated December 12, 1952, as amended on December 10, 1965, [Claim # 064441] water right diverted at Naches River Water Treatment Plan [sic] have a combined maximum annual quantity of 7826 acre-feet per year. It is intentional that the combined total is less than the sum of the individual maximum annual quantities."

b. Superseding Permit S4-01141P (B)

Source Type:	Surface water (Naches River).
Source Location:	Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Restricted to off-season use (October 16 to the beginning of storage control) (see provisions below).
Qi:	29 cfs, non-additive to S4-01141C(A) (see provisions below)
Qa:	1,986 AF, additive to S4-01141C(A) (see provisions below)
Priority Date:	January 29, 1951
Provisions or Limiting Conditions:	Superseding permit contains the following conditions: • "For municipal supply from October 16 to the beginning of Yakima Project storage control, as determined by the US Bureau of Reclamation." • "Screening of the diversion intake shall be maintained in accordance with applicable law of Department of Fisheries and Wildlife."

- "No dam shall be constructed in connection with this diversion."
- "This authorization is in addition to the annual quantity under Surface Water Certificate No. S4-01141C(A) or its replacement certificate subsequent to the issuance of the Decree in Ecology v. Acquavella. The right perfected under this permit will be additive to the combined maximum annual quantity of 7826 acre-feet under Certificate No. S4-01141C(A) and the portion of the US Bureau of Reclamation Contract No. 14-06-W53 dated December 12, 1952, as amended on December 10, 1965, [Claim # 064441] water right diverted at Naches River Water treatment Plant. The permitted instantaneous quantity under Surface Water Permit No. S4-01141P(B) diverted at the Naches River Water treatment Plant is not additive to the instantaneous quantity under Surface Water Certificate No. S4-01141C(A)."
- "Full beneficial use shall be within 20 years of issuance of this permit [i.e., by May 4, 2025]. The permittee shall submit status reports to the Department of Ecology, Central Regional Office, Water Resources Program through submittal of the Department of Health required Water System Plans."[5]
- "An approved measuring device shall be installed and maintained for each of the sources identified herein in accordance the rule 'Requirements for Measuring and Reporting Water Use', Chapter 173-173 WAC. Water use data shall be recorded daily with monthly totals and shall be submitted annually to Ecology by (January 31st of each calendar year)."
- "The rule above describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements."
- "At a minimum, the following information shall be included with each submittal of water use data: owner, contact name if different, mailing address, daytime phone number, WRIA, Certificate No., Department of Health WFI water system number and source number, source name (if any), annual quantity used including units of measurement, maximum monthly rate of diversion including units of measurement, and period of use."
- "In the future, Ecology may require additional parameters to be reported or more frequent reporting."
- "Ecology prefers web based data entry, but does accept hard copies. Ecology will provide forms and electronic data entry information."
- "Department of Ecology personnel, upon presentation of proper credentials, shall have access at reasonable times, to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions."

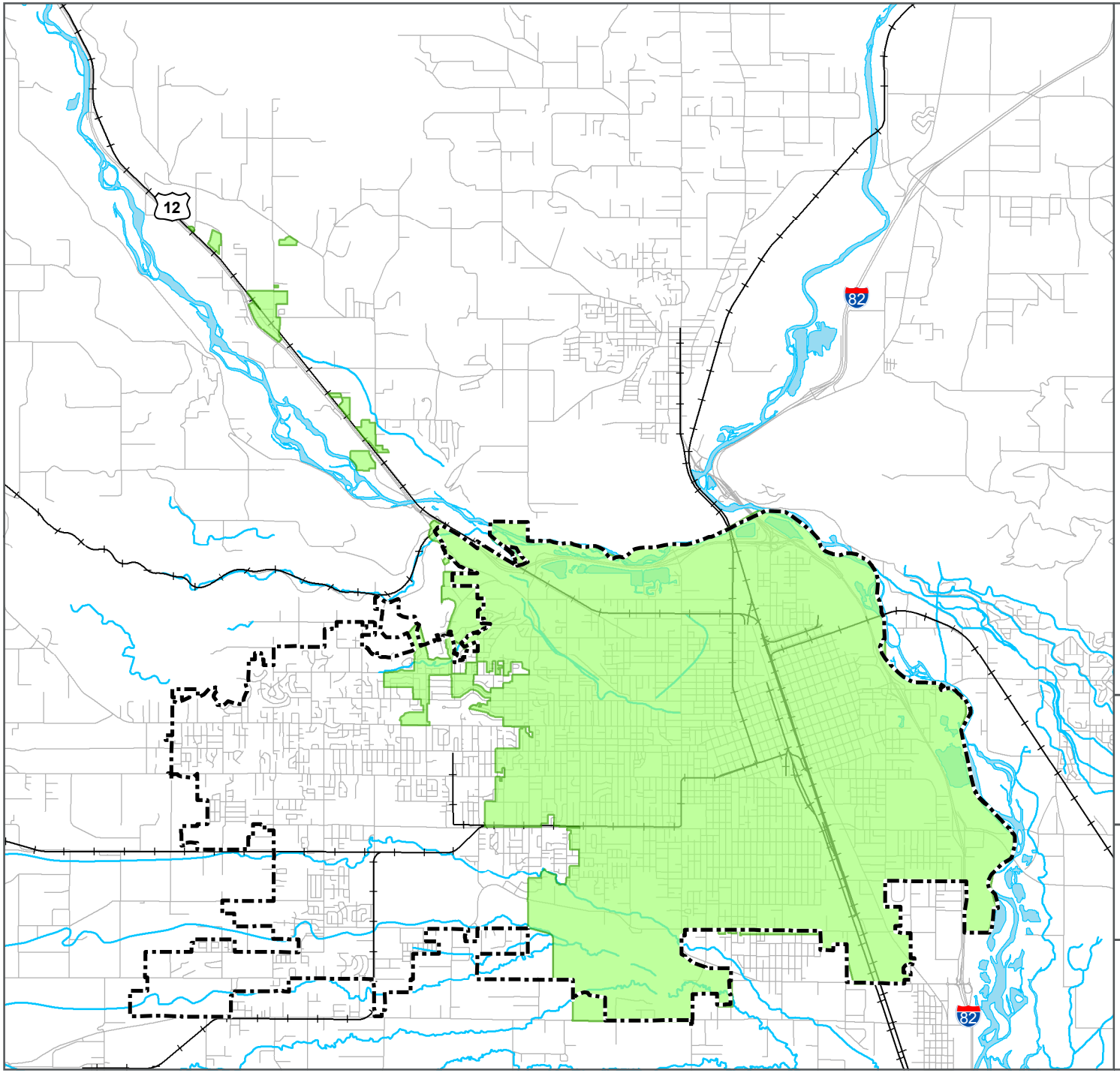
[5] Since issuance of the superseding certificate (S4-01141C(A)) and permit (S4-01141P(B)) in 2005, the City's total beneficial use under these rights has not exceeded the 4,414 AF authorized under the superseding certificate. The City anticipates that, depending on the impact of population growth, conservation programs and other projects, such as ASR, full beneficial use under the permit may occur before May 4, 2025.

5. Claim # 120528 (Former Glaspey)

Source Type:	Surface water (Naches River).
Source Location:	Nelson Bridge diversion: 1,790 feet south and 1,600 feet east from the northwest corner of Section 9, being within the SE ¼ NW ¼ of Section 9, Township 13 North, Range 18 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	April 1 through October 15
Qi:	3 cfs (April 1 – August 31); 2 cfs (September 1-30); 1.5 cfs (October 1-15)
Qa:	945 AF
Priority Date:	April 1, 1869
Provisions or Limiting Conditions:	None

6. Claim # 120528 (Former Old Union)

Source Type:	Surface water (Naches River).
Source Location:	Nelson Bridge diversion: 1,790 feet south and 1,600 feet east from the northwest corner of Section 9, being within the SE1/4 NW1/4 of Section 9, Township 13 North, Range 18 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	April 1 through October 15.
Qi:	17.73 cfs (April 1 – August 31); 11.82 cfs (September 1-30); 8.87 cfs (October 1-15)
Qa:	2,879 AF (see provisions below)
Priority Date:	June 30, 1878
Provisions or Limiting Conditions:	In 2013, the annual quantity available for diversion under this right was reduced to 2,879 acre feet (from 5,585 acre feet).



LEGEND

City Limits Boundary

Place of Use

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

PLACE OF USE

FIGURE 4-1

YAKIMA WATER SYSTEM PLAN

N

0 0.5 1 1.5 2

MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE4-1.MXD - USER: DKUHNS - DATE: 12/12/2016

Groundwater Rights Summary

1. Water Right # 190-A(A)C and (B)P (Former Wright Ave.)

a. Superseding Certificate #190-A(A)C, as amended by Yakima County Water Conservancy Board decision No. 26A-2001

Source Type:	Ground water.
Source Location:	Kissel Park Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. The well, drilled to 1,171 feet, is approximately 300 feet east and 100 feet south of the north west corner of Section 35.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Year round.
Qi:	900 gpm
Qa:	958 AF (see provisions below)
Priority Date:	June 8, 1948
Provisions or Limiting Conditions:	Superseding certificate contains the following conditions: • "Of the 900 gpm and 1448 acre-feet of water authorized, only 900 gpm and 958 acre-feet per year have been perfected by application to beneficial use." • "Based on the preceding, the 490 acre-feet not withdrawn under Ground Water Certificate 190-A is rescinded due to lack of perfection of the water to the authorized beneficial use. Therefore; a superceding Certificate No. 190A(A) shall issue to the City of Yakima in the amount of 900 gpm, 958 acre-feet per year for municipal water supply." Conservancy Board decision No. 26A-2001 contains the following conditions: • City shall discontinue use of former Wright Ave. Well, but may maintain the well for groundwater monitoring purposes. • "The Kissel well will be maintained with an access port in compliance with applicable regulations, and with a flow meter that records both instantaneous and cumulative production from the well." • "Until such time as a superseding certificate issues for this right, each update of the City of Yakima Water Comprehensive Plan shall include a short description of efforts to put the water under this right to full beneficial use at the new point of withdrawal."[6] Ecology approval of Conservancy Board decision No. 26A-2001 contains the following condition: • "A measuring device shall be installed and maintained at the point of withdrawal."

[6] Since 2001, the City has been putting water under this right to beneficial use at the Kissel Park well. For the years 2001 through 2015, the range of beneficial use has been between 0 AF (2014) and 917 AF (2005).

b. Superseding Permit #190-A(B)P, as amended by Yakima County Water Conservancy Board decision No. 26B-2001

Source Type:	Ground water.
Source Location:	Kissel Park Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. The well was drilled to 1,171 feet.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Year round.
Qi:	900 gpm, non-additive to superseding certificate #190-A(A)C
Qa:	490 AF additive to superseding certificate #190-A(A)C (see provisions below)
Priority Date:	June 8, 1948
Provisions or Limiting Conditions:	Superseding permit contains the following conditions: • "A final Certificate of Water Right will reflect the extent of beneficial use within the limitations of the permit." • "A written report describing the water system status (i.e., Water Comprehensive Plan) shall be submitted every 6 years to the Central Regional Office, Department of Ecology Water Resources Program." • "A water conservation plan must be in place and implemented. This plan may include rate structures that are intended to ensure efficient water use is encouraged and additional measures that the City deems appropriate and incorporates into their comprehensive water system plan." • "Metering of water withdrawn from the source well with record keeping and periodic reporting of information to Ecology." Conservancy Board decision No. 26B-2001 contains the following conditions: • City shall discontinue use of former Wright Ave. Well, but may maintain the well for groundwater monitoring purposes. • "Full application of the authorized quantities to beneficial use at the new point of withdrawal (Kissel Well) shall occur by July 1, 2025." • "Until such time as a superseding certificate issues for this right, each update of the City of Yakima Water Comprehensive Plan shall include a short description of efforts to put the water under this right to full beneficial use at the new point of withdrawal."[7] Ecology approval of Conservancy Board decision No. 26B-2001 contains the following condition: • "A measuring device shall be installed and maintained at the point of withdrawal."

[7] As noted above, since issuance of the Conservancy Board decision in 2001, the City's total beneficial use under the former Wright certificate (No. 190-A(A)C) and permit (No. 190-A(B)P) at the Kissel Park Well has not exceeded the 958 AF authorized under the superseding certificate. The City anticipates that, depending on the impact of population growth, conservation programs and other projects, full beneficial use at the Kissel Park Well, under both the certificate and permit, may occur before July 1, 2025.

2. Certificate GWC 2851-A (Former Ranney Well), as amended by Yakima County Water Conservancy Board Decision No. YAKI-05-04

Source Type:	Ground water.
Source Location:	Kissel Park Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. The well was drilled to 1171 feet. and Gardner Park Well: SE ¼ NE ¼ Sec. 36, Township 13 North, Range 18 East.[8]
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1 (see provisions below)
Time of Use:	Year round
Qi:	5,000 gpm, additive to other City rights (see provisions below), of which 2,000 gpm is used at Kissel Park Well, and 3,000 gpm at Gardner Park Well
Qa:	8,000 AF, of which 4,650 AF is additive to other City rights, and 3,350 AF is non-additive alternate source of supply, up to a combined total annual use under all City rights of 29,178 AF (see provisions below)
Priority Date:	August 21, 1956
Provisions or Limiting Conditions:	Conservancy Board decision No. YAKI-05-04 contains the following conditions: • "The amount of water authorized under the right is a maximum limit that shall not be exceeded and the water user shall be entitled only to that amount of water within the specified limit that is beneficially used and required. The total quantity of water withdrawn from all replacement wells under this right shall remain unchanged, and shall not exceed 5,000 gallons per minute or 8,000 acre-feet per year. The rate of withdrawal at any one of the authorized replacement wells shall not exceed 3,000 gallons per minute under existing rights. The right's Qi of 5,000 gpm is additive to the City's other rights. Of the 8,000 AF, 4,650 AF are additive to the other rights held by the City as of the date of this ROE. The remaining 3,350 AF are non-additive to the City's other rights, available as an alternate source of supply to such other rights up to a combined total annual use under all rights of 29,178 AF." • The replacement well was required to meet various construction standards, including installation of access ports, proper well-sealing, and identifying the source aquifer zones, all of which were addressed during installation of the Gardner Park Well. • "An approved measuring device shall be installed and maintained for all replacement points of withdrawal in accordance with Chapter 173-173 WAC ('Requirements for Measuring and Reporting Water Use'). Ch. 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements."

[8] Conservancy Board decision No. YAKI-05-04 authorized replacement wells in three locations, knows as the Elks Well, Gardner Park Well and Southeast Yakima Well areas. The City chose to install the replacement well at Gardner Park Well, and completed installation of the Gardner Park Well in January 2012.

- "Water use data shall be recorded daily. The maximum monthly rate of withdrawal and the monthly total volume shall be recorded by the City and submitted to Ecology."
- "The following information shall be included with each submission of water use data: owner, contact name if different, mailing address, daytime phone number, WRIA, Certificate No., source name, annual quantity used including units, maximum rate of withdrawal including units, period of use, monthly meter readings including units, peak monthly flow including units, purpose of use, well tag number, and period of use. Ecology prefers web-based data entry, but does accept hard copies. Ecology will provide forms and electronic data entry information."
- "Chapter 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements. Installation, operation and maintenance requirements are enclosed as a document entitled 'Water Measurement Device Installation and Operation Requirements'."
- "Department of Ecology personnel, upon presentation of proper credentials, shall have access at reasonable times to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions."
- Construction of the proposed new replacement well(s) was required to begin by September 30, 2009 and be complete by January 1, 2014.[9]
- The Board required the City to report progress in putting water to use at replacement points of withdrawal in all Water System Plan updates. However, Ecology modified the condition to simply require full beneficial use by January 1, 2034 (see Ecology provisions below).
- "Upon final approval of the requested change, the City shall not use and shall decommission the Ranney Well. Decommissioning the Ranney Well shall be complete within two years of approval of this transfer and shall be done in accordance with Chapter 173-160-381 WAC."[10]
- "Upon final approval of the requested change . . . the City shall . . . voluntarily relinquish Kissel Park Well permit No. G4-29864P."[11]

Ecology approval of Conservancy Board decision No. YAKI-05-04 contains the following conditions and modifications:

- "The place of use of this water right is the service area described in the most recent Water System Plan/Small Water System Management Program approved by the Washington State Department of Health, so long as the City of Yakima is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right."
- The authorized change must be completed and water put to full beneficial use by January 1, 2034.

[9] As noted above, the City completed installation of the Gardner Park Well in January 2012.

[10] The City completed decommissioning of the Ranney Well, as required, in July 2008.

[11] The City voluntarily relinquished the former Kissel Park Well permit on November 1, 2006.

- "The rate of withdrawal from the authorized replacement wells at any one of the four specified areas for the authorized points of withdrawal shall not exceed 3,000 gallons per minute under existing rights."
- "By January 1, 2014 the City shall submit a metering plan to ensure that the 5,000 gpm maximum instantaneous withdrawal is not exceeded among the sources authorized herein."[12]

3. Certificate #5318-A (Airport)

Source Type:	Ground water.
Source Location:	Airport Well: NE1/4 NW1/4 SE1/4, Section 35, Township 13 North, Range 18 East. Airport Well, also known as Well #5, is 16 inches in diameter and drilled to a depth of 1,099 feet.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Year round.
Qi:	2,800 gpm
Qa:	3,200 AF, non-additive / alternate source of supply (see provisions below)
Priority Date:	July 24, 1958
Provisions or Limiting Conditions:	Certificate contains the following condition: • "The total yearly withdrawal authorized under this filing shall be considered as a supplemental and/or additional supply. Withdrawal at any given time shall be limited to 3200 acre-feet per year, or that quantity necessary to supplement the available supply to satisfy existing requirements."

4. Certificate #4646-A (Kiwanis Park)

Source Type:	Ground water.
Source Location:	Kiwanis Park Well: SW ¼ NW ¼ of Section 20, Township 13 North, Range 19 East.
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Year round.
Qi:	2,300 gpm
Qa:	3,680 AF, non-additive / alternate source of supply (see provisions below)
Priority Date:	August 4, 1958
Provisions or Limiting Conditions:	Certificate contains the following condition: • "The total yearly withdrawal authorized under this filing shall be considered as a supplemental and/or additional supply. Withdrawal at any given time shall be limited to 3680 acre-feet per year, or that quantity necessary to supplement the available supply to satisfy existing requirements."

[12] The City submitted its metering plan to Ecology on April 20, 2016

5. Permit for Reservoir Application No. R4-34552 (ASR)

Source Type:	Surface water stored in, and subsequently withdrawn from, groundwater.
Source Location (Surface Water):	Naches River Water Treatment Plant – 900 feet north 64° 20' east of the southwest corner of Section 13, being within the SW ¼ SW ¼ of Section 13, Township 14 North, Range 17 East.
Source Location (Groundwater):	Kissel Park Well: NW ¼ NW ¼ NW ¼, Section 35, Township 13 North, Range 18 East. and Gardner Park Well: SE ¼ NE ¼ Section 36, Township 13 North, Range 18 East. and Southeast Area up to two (2) Wells NE1/4 Section 31 Township 13 North Range 19 East
Purpose of Use:	Municipal supply.
Place of Use:	City of Yakima service area as shown on Figure 4-1.
Time of Use:	Year round.
Qi:	Surface water diversions are limited as described above for underlying water rights; Total recharge is limited to 9,000 gpm; Ground water withdrawals are limited as described above for underlying water rights.
Qa:	Surface water diversions are limited as described above for underlying water rights; Total recharge is limited to 14,400 AF per year; Total groundwater withdrawals start at 85 percent of the volume recharged in year one, 80 percent in year two, with 10 percent per year additional reduction for each subsequent year of storage.
Priority Date:	April 12, 2002
Provisions or Limiting Conditions:	Permit contains the following provisions: • The City will submit a Quality Assurance Project Plan as part of the Final Project Monitoring Plan as outlined in the permit. • The City will submit compliance documentation related to management of disinfection byproduct concentrations as outlined in the permit. • The City will complete water quality, operations, and flow and water level monitoring and reporting as outlined in the permit.

Table 4-5. Existing Water Right Status

Permit Certificate or Claim	Name of Right holder or Claimant	Priority Date	Source Name/Number	Primary or Supplemental	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Qi	Qa	Qi	Qa
Permits/Certificates										
1. 938-D (former Oak Flats)	City of Yakima	10/01/1928	Naches River WTP	Primary (winter use only)	3.0 cfs (1,350 gpm)	2,172 AF/YR				
2. S4-01141 (A) Certificate and (B) Permit	City of Yakima	01/29/1951	Naches River WTP	Primary (winter use only)	29 cfs (13,015 gpm)	(A) 4,414 AF/YR[1] (B) 1,986 AF/YR				
3. 190-A (A) Certificate and (B) Permit (former Wright)	City of Yakima	06/08/1948	Kissel Park Well	Primary	900 gpm	(A) 958 AF/YR (B) 490 AF/YR				
4. GWC 2851-A (former Ranney)	City of Yakima	8/21/1956	Kissel Park Well and Gardner Park Well	Primary	5000 gpm (2000 gpm at Kissel Park and 3000 gpm at Gardner Park)	8,000 AF/YR (4,650 AF is additive to other City rights, 3,350 is non-additive / alternate supply)[2]				
5. 5318-A	City of Yakima	07/24/1958	Airport Well	Primary	2800 gpm	3200 AF/YR[3]				
6. 4646-A	City of Yakima	08/04/1958	Kiwanis Park Well	Primary	2300 gpm.	3680 AF/YR[4]				
Claims										
1. 120528 (former Glaspey)	City of Yakima	04/01/1869	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	1.5 – 3.0 cfs (673 – 1,346 gpm)	945 AF/YR				
2. 120528 (former Old Union)	City of Yakima	06/30/1878	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	8.87 – 17.73 cfs (3,981 – 7,957 gpm)	2,879 AF/YR[5]				
3. 120529	City of Yakima	06/30/1902	Naches River WTP	Primary	10 cfs (4,488 gpm)	7,260 AF/YR				
4. 064441 (Reclamation Contract Right)	U.S. Bureau of Reclamation on behalf of City of Yakima	05/10/1905	Naches River WTP and Nelson Bridge Diversion	Primary (~4/1-10/15)	35.2 cfs total (15,798 gpm) 29 cfs at WTP and 6.2 cfs at Nelson Bridge	4,500 AF/YR[6] 3,583 AF/YR at WTP and 917[7] AF/YR at Nelson Bridge				
TOTAL	*********	*******	**********	**********	Low:[8] 17,503 gpm High:[9] 40,589 gpm	29,178 AF[10]	12,798 gpm (MDD)	11,774 AF (actual 2015)	40,589 gpm – 12,798 gpm = 27,791 gpm	29,178 AF - 11,774 AF = 17,404 AF

Table 4-5. Existing Water Right Status (Cont'd.)

Permit Certificate or Claim	Name of Right holder or Claimant	Priority Date	Source Name/Number	Primary or Supplemental	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Qi	Qa	Qi	Qa

Intertie Name/Identifier	Name of Purveyor Providing Water	Existing Limits on Intertie Water Use		Existing Consumption Through Intertie		Current Water Right Status (Excess/Deficiency)	
		Qi	Qa	Qi	Qa	Qi	Qa
1. Nob Hill Water	Nob Hill Water N 56th Ave. & W Lincoln Ave. (Dave England – tel. 509/966-0272)		N/A	N/A	N/A	N/A	N/A
2. Nob Hill Water	Nob Hill Water (32nd Ave. & Ahtanum Rd.)		N/A	N/A	N/A	N/A	N/A
TOTAL	*********	*******	**********	**********	N/A	N/A	N/A

Pending Water Right Application	Name on Permit	Date Submitted	Primary or Supplemental	Pending Water Rights	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested

1. Subject to a combined quantity limitation: 7,826 AF is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract water right diverted at the Naches River WTP. The combined quantity limitation does not apply to Permit S4-01141(B).
2. The 3,350 AF alternate source of supply is available up to a combined total of 29,178 AF under all City rights existing as of June 2006.
3. Annual quantity is non-additive to other City rights, and is available as alternate source of supply.
4. Annual quantity is non-additive to other City rights, and is available as alternate source of supply.
5. Annual quantity was reduced in 2013 (from 5,585 AF).
6. Subject to a combined quantity limitation: 7,826 AF is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River WTP. Combined quantity limitation does not apply to the portion of the Reclamation water right diverted at Nelson Bridge. Annual quantity was reduced in 2013 (from 5,083 AF).
7. Annual quantity was reduced in 2013 (from 1,500 AF).
8. The range of instantaneous quantities (Qi) available is a function of the system elements considered (Naches River WTP, Nelson Bridge, and groundwater wells), and the season (winter vs. summer). The "low" figure shown in the table only reflects water available as primary supply through the City's current domestic water supply system - the Naches River WTP. The figure therefore does not include water available at Nelson Bridge or through the groundwater supply system. Further, the figure only reflects water availability during the summer irrigation season (generally beginning of Bureau of Reclamation storage control through October 15).
9. The "high" Qi includes water available through all City municipal systems: Naches River WTP, Nelson Bridge and groundwater wells. It also reflects water available during the irrigation season (summer). However, it does not include the Qi authorized under permit S4-01141(B) and permit 190-A(B)P, because these instantaneous quantities are non-additive the quantities in the certificates for the respective water rights.
10. Water right change CG4-CWC2581-A@2 (Conservancy Board decision YAKI-05-04) included a provision making the 3,350 AF of non-additive alternate supply available up to a combined total of 29,178 AF under all City rights existing as of June 2006.

Table 4-6. Forecasted Ten Year Water Right Status

Permit Certificate or Claim	Name of Right holder or Claimant	Priority Date	Source Name/Number	Primary or Supplemental	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Qi	Qa	Qi	Qa
Permits/Certificates										
1. 938-D (former Oak Flats)	City of Yakima	10/01/1928	Naches River WTP	Primary (winter use only)	3.0 cfs (1,350 gpm)	2172 AF/YR				
2. S4-01141 (A) Certificate and (B) Permit	City of Yakima	01/29/1951	Naches River WTP	Primary (winter use only)	29 cfs (13,015 gpm)	(A) 4,414 AF/YR[1] (B) 1,986 AF/YR				
3. 190-A (A) Certificate and (B) Permit (former Wright)	City of Yakima	06/08/1948	Kissel Park Well	Primary	900 gpm	(A) 958 AF/YR (B) 490 AF/YR				
4. GWC 2851-A (former Ranney)	City of Yakima	8/21/1956	Kissel Park Well and Gardner Park Well	Primary	5000 gpm (2000 gpm at Kissel Park and 3000 gpm at Gardner Park)	8,000 AF/YR (4,650 AF is additive to other City rights, 3,350 is non-additive / alternate supply)[2]				
5. 5318-A	City of Yakima	07/24/1958	Airport Well	Primary	2800 gpm	3200 AF/YR[3]				
6. 4646-A	City of Yakima	08/04/1958	Kiwanis Park Well	Primary	2300 gpm.	3680 AF/YR[4]				
Claims										
1. 120528 (former Glaspey)	City of Yakima	04/01/1869	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	1.5 – 3.0 cfs (673 – 1,346 gpm)	945 AF/YR				
2. 120528 (former Old Union)	City of Yakima	06/30/1878	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	8.87 – 17.73 cfs (3,981 – 7,957 gpm)	2,879 AF/YR[5]				
3. 120529	City of Yakima	06/30/1902	Naches River WTP	Primary	10 cfs (4,488 gpm)	7,260 AF/YR				
4. 064441 (Reclamation Contract Right)	U.S. Bureau of Reclamation on behalf of City of Yakima	05/10/1905	Naches River WTP and Nelson Bridge Diversion	Primary (~4/1-10/15)	35.2 cfs total (15,798 gpm) 29 cfs at WTP and 6.2 cfs at Nelson Bridge	4,500 AF/YR[6] 3,583 AF/YR at WTP and 917[7] AF/YR at Nelson Bridge				
TOTAL	*********	*******	**********	**********	Low:[8] 17,503 gpm High:[9] 40,589 gpm	29,178 AF[10]	13,328 (projected 2027 MDD)	12,261 AF (projected 2027)	40,589 gpm – 13,328 gpm = 27,261 gpm	29,178 AF - 12,261 AF = 16,917 AF

Table 4-6. Forecasted Ten Year Water Right Status (Cont'd.)

Permit Certificate or Claim	Name of Right holder or Claimant	Priority Date	Source Name/Number	Primary or Supplemental	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Qi	Qa	Qi	Qa
Intertie Name/Identifier		Name of Purveyor Providing Water			Existing Limits on Intertie Water Use		Existing Consumption Through Intertie		Current Water Right Status (Excess/Deficiency)	
					Qi	Qa	Qi	Qa	Qi	Qa
1. Nob Hill Water		Nob Hill Water N 56th Ave. & W Lincoln Ave. (Dave England – tel. 509/966-0272)				N/A	N/A	N/A	N/A	N/A
2. Nob Hill Water		Nob Hill Water (32nd Ave. & Ahtanum Rd.)				N/A	N/A	N/A	N/A	N/A
TOTAL		*********			*******	**********	**********		N/A	N/A
Pending Water Right Application		Name on Permit			Date Submitted	Primary or Supplemental	Pending Water Rights			
							Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested		

1. Subject to a combined quantity limitation: 7,826 AF is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract water right diverted at the Naches River WTP. The combined quantity limitation does not apply to Permit S4-01141(B).
2. The 3,350 AF alternate source of supply is available up to a combined total of 29,178 AF under all City rights existing as of June 2006.
3. Annual quantity is non-additive to other City rights, and is available as alternate source of supply.
4. Annual quantity is non-additive to other City rights, and is available as alternate source of supply.
5. Annual quantity was reduced in 2013 (from 5,585 AF).
6. Subject to a combined quantity limitation: 7,826 AF is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River WTP. Combined quantity limitation does not apply to the portion of the Reclamation water right diverted at Nelson Bridge. Annual quantity was reduced in 2013 (from 5,083 AF).
7. Annual quantity was reduced in 2013 (from 1,500 AF).
8. The range of instantaneous quantities (Qi) available is a function of the system elements considered (Naches River WTP, Nelson Bridge, and groundwater wells), and the season (winter vs. summer). The "low" figure shown in the table only reflects water available as primary supply through the City's current domestic water supply system - the Naches River WTP. The figure therefore does not include water available at Nelson Bridge or through the groundwater supply system. Further, the figure only reflects water availability during the summer irrigation season (generally beginning of Bureau of Reclamation storage control through October 15).
9. The "high" Qi includes water available through all City municipal systems: Naches River WTP, Nelson Bridge and groundwater wells. It also reflects water available during the irrigation season (summer). However, it does not include the Qi authorized under permit S4-01141(B) and permit 190-A(B)P, because these instantaneous quantities are non-additive the quantities in the certificates for the respective water rights.
10. Water right change CG4-CWC2581-A@2 (Conservancy Board decision YAKI-05-04) included a provision making the 3,350 AF of non-additive alternate supply available up to a combined total of 29,178 AF under all City rights existing as of June 2006.

Table 4-7. Forecasted 20-Year Water Right Status

Permit Certificate or Claim	Name of Right holder or Claimant	Priority Date	Source Name/Number	Primary or Supplemental	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Qi	Qa	Qi	Qa
Permits/Certificates										
1. 938-D (former Oak Flats)	City of Yakima	10/01/1928	Naches River WTP	Primary (winter use only)	3.0 cfs (1,350 gpm)	2172 AF/YR				
2. S4-01141 (A) Certificate and (B) Permit	City of Yakima	01/29/1951	Naches River WTP	Primary (winter use only)	29 cfs (13,015 gpm)	(A) 4,414 AF/YR[1] (B) 1,986 AF/YR				
3. 190-A (A) Certificate and (B) Permit (former Wright)	City of Yakima	06/08/1948	Kissel Park Well	Primary	900 gpm	(A) 958 AF/YR (B) 490 AF/YR				
4. GWC 2851-A (former Ranney)	City of Yakima	8/21/1956	Kissel Park Well and Gardner Park Well	Primary	5000 gpm (2000 gpm at Kissel Park and 3000 gpm at Gardner Park)	8,000 AF/YR (4,650 AF is additive to other City rights, 3,350 is non-additive / alternate supply)[2]				
5. 5318-A	City of Yakima	07/24/1958	Airport Well	Primary	2800 gpm	3200 AF/YR[3]				
6. 4646-A	City of Yakima	08/04/1958	Kiwanis Park Well	Primary	2300 gpm.	3680 AF/YR[4]				
Claims										
1. 120528 (former Glaspey)	City of Yakima	04/01/1869	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	1.5 – 3.0 cfs (673 – 1,346 gpm)	945 AF/YR				
2. 120528 (former Old Union)	City of Yakima	06/30/1878	Naches River/ Nelson Bridge Diversion	Primary (4/1 – 10/15)	8.87 – 17.73 cfs (3,981 – 7,957 gpm)	2,879 AF/YR[5]				
3. 120529	City of Yakima	06/30/1902	Naches River WTP	Primary	10 cfs (4,488 gpm)	7,260 AF/YR				
4. 064441 (Reclamation Contract Right)	U.S. Bureau of Reclamation on behalf of City of Yakima	05/10/1905	Naches River WTP and Nelson Bridge Diversion	Primary (~4/1-10/15)	35.2 cfs total (15,798 gpm) 29 cfs at WTP and 6.2 cfs at Nelson Bridge	4,500 AF/YR[6] 3,583 AF/YR at WTP and 917[7] AF/YR at Nelson Bridge				
TOTAL	*********	*******	**********	**********	Low:[8] 17,503 gpm High:[9] 40,589 gpm	29,178 AF[10]	13,707 (projected 2037 MDD)	12,610 AF (projected 2037)	40,589 gpm – 13,707 gpm = 26,882 gpm	29,178 AF - 12,610 AF = 16,568 AF

Table 4-7. Forecasted 20-Year Water Right Status (Cont'd.)

Permit Certificate or Claim	Name of Right holder or Claimant	Priority Date	Source Name/Number	Primary or Supplemental	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)	Existing Water Rights	Existing Consumption	Current Water Right Status (Excess/Deficiency)
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Qi	Qa	Qi	Qa
Intertie Name/Identifier		Name of Purveyor Providing Water			Existing Limits on Intertie Water Use		Existing Consumption Through Intertie		Current Water Right Status (Excess/Deficiency)	
					Qi	Qa	Qi	Qa	Qi	Qa
1. Nob Hill Water		Nob Hill Water N 56th Ave. & W Lincoln Ave. (Dave England – tel. 509/966-0272)				N/A	N/A	N/A	N/A	N/A
2. Nob Hill Water		Nob Hill Water (32nd Ave. & Ahtanum Rd.)				N/A	N/A	N/A	N/A	N/A
TOTAL		*********			*******	**********	**********		N/A	N/A

Pending Water Right Application	Name on Permit	Date Submitted	Primary or Supplemental	Pending Water Rights	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested

1. Subject to a combined quantity limitation: 7,826 AF is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract water right diverted at the Naches River WTP. The combined quantity limitation does not apply to Permit S4-01141(B).
2. The 3,350 AF alternate source of supply is available up to a combined total of 29,178 AF under all City rights existing as of June 2006.
3. Annual quantity is non-additive to other City rights, and is available as alternate source of supply.
4. Annual quantity is non-additive to other City rights, and is available as alternate source of supply.
5. Annual quantity was reduced in 2013 (from 5,585 AF).
6. Subject to a combined quantity limitation: 7,826 AF is the maximum combined annual quantity that may be diverted in any single calendar year under Certificate S4-01141(A) and the portion of the Reclamation contract right diverted at the Naches River WTP. Combined quantity limitation does not apply to the portion of the Reclamation water right diverted at Nelson Bridge. Annual quantity was reduced in 2013 (from 5,083 AF).
7. Annual quantity was reduced in 2013 (from 1,500 AF).
8. The range of instantaneous quantities (Qi) available is a function of the system elements considered (Naches River WTP, Nelson Bridge, and groundwater wells), and the season (winter vs. summer). The "low" figure shown in the table only reflects water available as primary supply through the City's current domestic water supply system - the Naches River WTP. The figure therefore does not include water available at Nelson Bridge or through the groundwater supply system. Further, the figure only reflects water availability during the summer irrigation season (generally beginning of Bureau of Reclamation storage control through October 15).
9. The "high" Qi includes water available through all City municipal systems: Naches River WTP, Nelson Bridge, and groundwater wells. It also reflects water available during the irrigation season (summer). However, it does not include the Qi authorized under permit S4-01141(B) and permit 190-A(B)P, because these instantaneous quantities are non-additive the quantities in the certificates for the respective water rights.
10. Water right change CG4-CWC2581-A@2 (Conservancy Board decision YAKI-05-04) included a provision making the 3,350 AF of non-additive alternate supply available up to a combined total of 29,178 AF under all City rights existing as of June 2006.

4.4 Water System Reliability Analysis

The purpose of the water system reliability analysis is to summarize the steps that can be undertaken to ensure an adequate quantity of water can be provided at all times. When water shortages or interruptions in service occur, public health can be threatened because customers may use other non-potable sources of water inappropriately, or system pressure may be reduced such that basic public health needs are not met or other back flow related problems occur.

4.4.1 Source Reliability

The primary water supply source for the City of Yakima is the Naches River WTP. Potential causes of reduction or interruption of this primary supply source include:

- Spring runoff resulting in flooding and increased turbidities exceeding the process capabilities of the WTP.
- Extended periods of drought resulting in loss of river flow.
- More frequent droughts due to climate change.
- Bureau of Reclamation proration of water storage rights due to limited water availability in the Yakima River basin.
- Failure of 48 inch transmission main transporting water from the WTP to the City's water distribution system.
- Necessary modifications or upgrades to the WTP.
- During winter months, the WTP supply could be temporarily reduced or interrupted due to icing of the intake structure or contact basins.
- Chemical, fuel, or other contaminant spill into the Naches River upstream from the WTP.
- Forest fire in Naches River basin resulting in unacceptable turbidity at the WTP.
- Volcanic eruption in Cascade Range volcanoes, delivering unacceptable quantities of ash to the WTP.
- Incidents resulting in damage to the WTP or other water system infrastructure (See Emergency Operations Guidelines [Appendix R]).

The City has approximately 15.8 MGD available from the existing groundwater well supplies. The wells are categorized as seasonal sources of supply, and are typically only put into service in the event of the types of failures identified above. For example, the WTP was shut down from October to May, 2015 while the recycle lagoons were constructed at the WTP. During this time, the City was able to meet water demands using the City's four wells.

In spring 1974, a failure of the Naches River WTP supply was caused by a break in the 48-inch transmission main. The pipeline floated during flooding conditions and was out of service for approximately 3 months for repairs because a significant length of the pipeline was damaged. The configuration of the 48-inch transmission main has since been altered to ensure that the pipeline is always full, eliminating the potential for flotation during flooding. It is estimated that the extent of any future failure of the 48-inch pipeline would be limited to short lengths and could be repaired within 3 days. However, this type of failure would reduce the available supply to the entire system.

The City anticipates that reduction or interruption in supply due to high turbidity or icing conditions would not last more than 3 days. Other emergency conditions could create longer interruptions of available surface water supply. The City also has two interties with Nob Hill

Water Association. Prolonged supply from these interties cannot be relied upon because Nob Hill may not have excess supply capacity available in the summer months.

Chapter 3, *System Analysis*, summarizes the water quality characteristics of the Naches River and groundwater supplies.

4.4.2 Water Right Adequacy

Existing water rights are expected to be adequate to supply demands over the next 20 years. Section 4.3 provides a detailed discussion of the status of the current water rights. The Bureau of Reclamation can prorate "contract rights" in water short years. Under these conditions the seasonal well supplies are brought on line to make up the difference. The City anticipates that ASR may be used in the future to further augment the well supplies in water short years (see discussion in Sections 4.2.2 and 4.4.4). Specific measures taken in response to water shortages are described in Section 4.4.4.

4.4.3 Facility Reliability

Chapter 3, *System Analysis* provides a discussion of the reliability of water system facilities and includes recommendations for improvements necessary to maintain the reliability and performance of water system facilities.

4.4.4 Water Shortage Response Planning

Short-term reduction or loss of the Naches River WTP supply due to raw water high turbidity, transmission main failure, or icing conditions in the WTP have historically lasted 30 days or less in winter and 3 days or less during summer. The response to short-term disruptions such as these is to activate one or more of the seasonal well supply sources. Depending on the magnitude and duration of the WTP supply disruption, it may be necessary to utilize some of the standby storage capacity and/or activate one of the interties with Nob Hill Water Association. Chapter 3, *System Analysis*, summarizes the storage capacity analysis including stand-by storage and emergency storage requirements.

The purpose of water shortage response planning is to identify measures that can be implemented during water supply reductions or interruptions. These measures could include demand reduction, supply augmentation, or a combination of both.

Problem Assessment

The City's 1902 surface water right of 10 cfs (6.5 MGD) for the Naches River WTP is a senior right. The other rights for the WTP withdrawal are either only available in the winter, or are subject to proration or interruption in years of extreme water shortage. During drought years, the Bureau of Reclamation can prorate the City's contract water rights. The most severe prorationing in recent times occurred in 2001 when the Bureau of Reclamation prorated the City's contract water rights to 29 percent of normal during the summer months. Additional prorationing was activated in 2005 (42 percent) and 2015 (44 percent). It was necessary during these periods to make up the supply shortfall by bringing the seasonal well supply sources on line. By utilizing the seasonal wells it was not necessary to implement demand reductions in these years.

The Bureau of Reclamation and Ecology have conducted hydrologic modeling of climate change in the Yakima River basin as part of the *Yakima River Basin Integrated Water Resource Management Plan*, described in Chapter 1. The Yakima River basin could be adversely affected by climate change in the future. Modeling suggests that droughts will become more frequent in the Yakima River basin in the future, including in the Naches River sub-basin. Climate change may affect the timing and quantity of precipitation, how

precipitation is stored and released from snowpack, and the demand patterns of water users. The Bureau of Reclamation has incorporated three climate change scenarios into their hydrologic model of Yakima River basin: less adverse, adverse, and more adverse. These scenarios were adopted from climate-specific hydrologic modeling conducted by the University of Washington and represent a range of possible future climates.

Under the adverse scenario, the total annual average reservoir inflow would decrease by 11 percent. During the summer, natural runoff and streamflow in the basin would decrease by 50 percent or more. Under these conditions, the Bureau of Reclamation would need to meet water supply demands and instream flow objectives by releasing larger amounts of water from the existing reservoirs. In many years, the reservoirs would not be capable of meeting these demands. Under these conditions, the adverse scenario shows an average reduction in September 30 prorationing levels of 21.5 percent compared to historical prorationing levels (resulting in water diversions under the City's Reclamation Contract Water Right being reduced by approximately 968 acre-feet, in addition to the reductions currently applied during prorationing). Reductions could be less severe or more severe under the other climate scenarios examined. Additional information about Reclamation's modeling of climate change conditions can be found in the February 2016 *Hydrologic Modeling of System Improvements* technical memorandum.

Decreased streamflows could potentially impact the City's senior water rights if flow conditions in the Naches River decline to the point that the City cannot divert its full water right in order to maintain minimum instream flow requirements.

In addition, the City's groundwater rights are junior to Reclamation and other senior surface water right holders. As such, the City's groundwater resources are also subject to curtailment due to the connectivity of surface water and groundwater resources. Decreased natural runoff and streamflows could also reduce aquifer recharge and diminish the physical production from the aquifer over time.

If demands increase or droughts become more frequent, it may become necessary for the City to implement demand reduction measures and/or supply augmentation. The City has identified specific response measures that would be implemented in drought years. These are included in the City's Emergency Operations Guidelines (Appendix R). Some of these measures are also included in the suggested actions outlined in Table 4-8. The City's ASR program would contribute to maintaining aquifer water levels and help the City to augment water supplies if surface water resource decline in the future. However additional measures could also be required.

Options for Demand Reduction in a Water Shortage

In 2005, the City adopted an ordinance (Ord. 2005-16 § 1, 2005) that provided authority for the City to implement restrictions on municipal water use during emergency situations that threaten municipal water supply, such as drought. Under this ordinance, the city manager, upon a finding by the city council that an emergency situation exists which threatens to seriously disrupt or diminish the municipal water supply, may order and enforce restrictions on water use.

Selected demand reduction options would be implemented based on the degree of water shortage that exists. Stages of a water shortage and corresponding demand reduction measures include the following (source: *Preparing Water Shortage Response Plans*, Washington State Department of Health, DOH PUB. #331-301, July 2011):

- **Stage 1: Minor Shortage - Voluntary Measures**
  This is the first step in reducing water consumption during a potential or actual water shortage. An appropriate response at this stage is initiation of a public information program.

- **Stage 2: Moderate Shortage – Mandatory Measures**
  An appropriate response at this stage is to institute mandatory demand reduction measures, enforceable under the authority of special ordinances, or a revised rate schedule.
- **Stage 3: Severe – Rationing Program**
  An appropriate response at this stage is instituting rationing programs through fixed allotments or percentage cutbacks. This response should be initiated only in rare circumstances. It allows the maximum amount of water savings possible in a community without severe hardship. This action would have to be enforceable under the authority of special ordinances.

Demand reduction options that the City could consider at each water shortage stage are summarized in Table 4-8.

Table 4-8. Suggested Public Information Demand Reduction Actions

Stage	Water Shortage Condition	Public Information Actions
Public Information Demand		
1	Minor: Voluntary Measures	• Prepare and distribute water conservation materials (bill insert, etc.). • Prepare and disseminate technical conservation information to specific customer types. • Prepare conservation retrofit kits. • Coordinate media outreach program. • Issue news releases to the media.
2	Moderate: Mandatory Program	• Issue a City Council resolution declaring a drought • Distribute conservation retrofit kits. • Continue public information program.
3	Severe: Rationing Program	• Continue public information program.

Table 4-8. Suggested Public Information Demand Reduction Actions (Cont'd.)

Stage	Water Shortage Condition	Public Information Actions
Government Demand		
1	Minor: Voluntary Measures	• Activate seasonal wells to supplement supplies. • Increase enforcement of hydrant opening. • Increase meter reading efficiency and meter maintenance. • Promote intensive leak detection and repair program. • Draft and adopt ordinances banning water waste. A typical ordinance could require: • No unfixed leaks; • No hosing of paved surfaces; • No fountains except those using re-circulated water; • No water running onto streets; • No watering during the middle of the day; and • No irrigation runoff. • Draft and adopt ordinances allowing a utility to declare a water emergency and requiring: • Fixed consumption allotments or percentage cutbacks (rationing). • All homes and businesses to have retrofitted showers and toilets.
2	Moderate: Mandatory Program	• Reduce water usage for main flushing, street cleaning, public fountains, and park irrigation. • Watering of parks, cemeteries, etc., restricted to nights or designated irrigation days. • Move the Nelson Bridge Diversion portion of the Claim # 064441 (Bureau of Reclamation contract water right) to the WTP.
3	Severe: Rationing Program	• Prohibit public water uses not required for health or safety prohibited unless using tank truck water supplies or reclaimed wastewater • Restrict irrigation of public parks, cemeteries, etc. • Require pool covers for all municipal pools. • Limit main flushing for emergency purposes only. • Reduce system pressure to minimum permissible levels. • Move some portion of Claim # 120528 (Glaspey) and/or Claim # 120528 (Old Union) waster right from Nelson Bridge Diversion to the WTP • Contact Nob Hill Water Association to open intertie to supplement flow.

Table 4-8. Suggested Public Information Demand Reduction Actions (Cont'd.)

Stage	Water Shortage Condition	Public Information Actions
User Restrictions Demand		
1	Minor: Voluntary Measures	• Implement voluntary water use reductions (see Table 4-8, above).
2	Moderate: Mandatory Program	• Implement ordinance banning water waste (see Government actions, above). • Adopt landscape irrigation restrictions incorporating one or more of the following: • Time of day (e.g., 7 p.m. to 7 a.m., etc.) weekly frequency (e.g., odd/even, time per week, etc.) • sprinkle bans (e.g., limit to hand watering) • Golf course irrigation restricted to 6 p.m. to 11 a.m. on designated irrigation days.
3	Severe: Rationing Program	• Implement ordinance allowing utilities to declare a water emergency and to require rationing (see Government actions, above) • Car washing permitted only during specified watering hours of designated irrigation days. • Golf course watering times and weekly watering limits reduced. • Manage water consumption to stay within water allotments. • Permissible watering hours and weekly frequency for landscaping irrigation further reduced.
User Penalties Demand		
1	Minor: Voluntary Measures	• None
2	Moderate: Mandatory Program	• Warning. • House call. • Shut off and reconnection fee.
3	Severe: Rationing Program	• Fines (based on appropriate ordinance).
Pricing Demand		
1	Minor: Voluntary Measures	• None.
2	Moderate: Mandatory Program	• Institute rate changes to encourage conservation. • Impose surcharges.
3	Severe: Rationing Program	• Same as above.

For the City of Yakima surface water supply source, water shortage conditions can be predicted in advance of their occurrence based on precipitation and snowpack data. This data is monitored closely by the Bureau of Reclamation. The City would consult the Bureau of Reclamation personnel in early spring to assess the possibilities for water shortages in the upcoming summer months.

Options for Supply Augmentation in a Water Shortage

Thus far, the City of Yakima has been able to meet current demands even in water short years by supplementing the surface water supply with the seasonal well supply sources. In 2001, 2005, and 2015 it was necessary to rely on the wells for a significant amount of the demand during the summer months. The City could purchase additional surface water rights in the future if a willing seller could be found.

The recovery capacity of the four existing City wells is about 11,000 gpm (15.8 MGD). Since 2000, maximum day demand has ranged from approximately 16 to 24 MGD. Assuming a maximum day demand of 24 MGD, the existing wells have about two-thirds of the capacity required to meet demand in the event of a total shutdown of the Naches River WTP. New wells or other supplies may be advisable to increase system capacity in the event of a long-term shutdown of the WTP.

As described in Section 4.2.2, upon issuance of the final Reservoir Permit, the City intends to construct dedicated ASR wells that would recharge and withdraw water. These ASR wells would contribute to supplementing existing water supplies should future demands or supply conditions require additional supply sources.

4.5 Interties

As discussed in Chapter 1, *System Description*, the City of Yakima has two interties with the Nob Hill Water Association. A summary of the interties, including location, size, hydraulic grade line, and other data, are included in Table 1-5. These interties are for emergency purposes only and are covered in a Memorandum of Understanding between the City and the Association dated September 6, 2000 (Appendix F). These interties are not designed for normal operation of either system and are not considered as a source of supply in the storage and supply analyses presented in Chapter 3, *System Analysis*. No new non-emergency interties are proposed or anticipated during the 20 year planning period.

The City has had preliminary discussions with Yakima County for an emergency intertie between the County's Terrace Heights system and the City system. However, any intertie for these systems would require a bridge crossing of the Yakima River. If a new bridge were to be constructed, provisions would be included in the design to provide the piping necessary to facilitate an intertie.

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5 Source Water Protection

5.1 Source Water Protection Overview

The objective of this chapter is to outline a program to protect, and if possible, improve, source waters used by the City of Yakima water system. Source water protection for Group A systems is required under WAC 246-290-135, -668 and -690.

The appropriate measures to be taken to ensure adequate source water protection depend on whether the source of supply is surface water or ground water. If the utility uses ground water, a wellhead protection program is required. A watershed control program is required for utilities using surface water. The City of Yakima's primary source of supply is surface water which is treated by the Naches River WTP. In addition, the City currently has four groundwater wells which are used as seasonal sources of supply.

5.2 Wellhead Protection Program

The Upper Yakima Valley Regional Wellhead Protection Plan (WHPP) was completed in October 2000 and is updated periodically. The most recent update was submitted in 2015 (Appendix S). The purpose of this plan is to identify potential sources of contamination near the member purveyors' groundwater supplies, implement management strategies to prevent contamination of those supplies, and develop a contingency plan to mitigate contamination in the event that groundwater does become contaminated. In this WHPP, each member community in the Upper Yakima Valley plays a role in protecting the groundwater supplies of the entire area by pooling resources and management efforts to target an audience beyond that which could be reached at a local level.

The member purveyors participating in this WHPP make up the Regional Wellhead Protection Committee (RWPC); members include:

- Yakima County
- City of Yakima
- Town of Naches
- City of Moxee
- Town of Tieton
- City of Union Gap
- City of Selah
- Nob Hill Water Association

The Town of Naches wellhead protection area also lies within the City of Yakima's surface water supply watershed.

Regional management efforts adopted by the eight purveyors forming the RWPC include:

- Development of a Geographical Information System (GIS) database of the wellhead protection areas, potential contamination sources, and water quality data in order to monitor and track sources and potential receptors.
- Development of a planning trigger to distribute wellhead protection notification letters for development changes (i.e. building permits, zoning changes, SEPA) within wellhead protection areas.

- Coordination with Ecology to prioritize their Hazmat Technical Assistance Sweep within wellhead protection areas.
- Coordination with the State Health Department's Sanitary Surveys to ensure up-to-date information is maintained in the regional GIS potential contamination source inventory.
- Coordination with County Health District to identify septic tanks and private wells with Global Positioning System (GPS) units.
- Coordination with the Washington Association of Realtors to adopt a Property Disclosure Addendum that will help to identify private and abandoned well locations during property transfers.
- Designation of the 6-Month wellhead protection area as a critical "Red Zone" by County Emergency Management (LEPC) in order to prioritize wellhead protection during emergencies (i.e. hazardous material spills).
- Public education efforts including literature distribution.
- Coordination with Education Services District (ESD) which provides continuing education to area teachers in order to better integrate wellhead protection and water issues into school curriculum.
- Development of a regional website to increase public awareness on the need to protect groundwater.
- Development of a logo for wellhead protection area signs.
- Development of an interlocal agreement among the eight purveyors to make sure that wellhead protection is given a high priority in the Upper Yakima Valley.

The City of Yakima's water system has wellhead protection areas (WHPAs) for its four drinking water wells (Airport, Kiwanis Park, Kissel Park, and Gardner Park) that were delineated using an analytical method. In the WHPAs, an inventory of existing and potential sources of groundwater contamination was compiled and mapped. The latest inventory was completed in 2015 which included windshield surveys of all well sites and an update of the Potential Wellhead Protection Contaminant Source Inventory Map. Additionally, the City mailed notification letters to businesses located within the wellhead protection areas including any new potential contaminant sources (Appendix S).

5.3 Watershed Control Program

5.3.1 Regulatory Requirements/Program Overview

Watershed control requirements apply to all Group A systems using surface water, (both filtered and unfiltered systems). A watershed control program is an integral part of a purveyor's overall strategy to ensure public health protection. The term "watershed" refers to the hydrologic drainage upstream of a utility's surface water intake. The watershed affects the physical, chemical and microbiological quality of the source.

The watershed for the City of Yakima surface water source does not meet the criteria to remain unfiltered under the Surface Water Treatment Rule, which is detailed in Part 6 of Chapter 246-290 WAC. The surface water supply has been filtered since 1971 when the City completed construction of the Naches River WTP.

A Watershed Control Program is required to include the following elements.

1. Watershed description and inventory, including location, hydrology, land ownership, and activities that could adversely affect drinking water quality.
2. Inventory of all potential surface water contamination sites and activities located within the watershed.
3. Watershed control measures.
4. System operations, including emergency provisions.

These elements for City of Yakima Watershed Control Program are summarized in the following sections.

5.3.2 Watershed Description

Location

The City of Yakima's primary source of water is the Naches River. The Naches River WTP is located approximately 3 miles southeast of the City of Naches, and approximately 4.4 miles downstream of the confluence between the Tieton and Naches Rivers. The Naches River drainage is located on the eastern slope of the Central Washington Cascades in the Wenatchee National Forest. Figure 5-1 shows the location of the watershed and Naches River WTP. The watershed area for the City's surface water supply consists of most of the area comprised by the State of Washington's Water Resources Inventory Area (WRIA) Number 38.

Drainage Area

The watershed drainage area that supplies the WTP is approximately 962 square miles. The Cleman Mountains form the divide between Wenas Creek and the Naches River and provide the northeastern boundary of the triangular-shaped drainage area. The west boundary is the Cascade Range and the southern boundary is formed by the Klickton Divide and Divide Ridge. The Naches River watershed is composed of two major subdrainages: the Tieton River drainage and the Naches River drainage; the divide between the two is Bethel Ridge. The two rivers join at the junction of Highways 410 and 12, and continue southeasterly as the Naches River. The drainage area to the WTP does not include the Cowiche Creek Basin or parts of the Naches River basin that drain to areas downstream of the WTP. The WTP's drainage area is part of the larger Yakima River basin and is approximately 15 percent of the total Yakima River basin drainage area.

Hydrology

The major streams and rivers in the Naches River watershed are shown in Figure 5-1. The average annual precipitation in the Naches River watershed ranges from 47 inches at the headwaters to 8 inches in the lower watershed. A USBR stream gauge is located on the Naches River just downstream of the Wapatox Canal diversion. Table 5-1 summarizes recent data for this gauging station.

Table 5-1. Bureau of Reclamation Stream Flow Data from Naches River Gage near the Town of Naches, WA (2010-2015)

Month	Average (cfs)	Average Low (cfs)	Average High (cfs)
January	1,269	565	2,774
February	1,298	611	2,393
March	1,541	1,032	2,515
April	2,527	1,061	4,608
May	3,402	1,034	5,035
June	3,287	488	5,459
July	1,567	333	3,079
August	753	445	1,118
September	1,865	1,492	2,103
October	783	662	956
November	1,009	557	1,651
December	1,504	609	3,706
Annual	**1,734**	**741**	**2,950**

Geology and Soils

The soils in the upper Naches River watershed are primarily cool, stony, forest soils and dark, stony, rangeland soils varying in depth from very shallow to deep. The mid-watershed consists primarily of dry silty and loamy soils; some areas contain drainage-impeding hardpans. The lower-watershed is primarily dry, coarse, silty soils, some with lime layers at 2 to 4 feet, and dark, stony, rangeland soils, some with hardpan.

Topography

Topographic features of the watershed are shown in Figure 5-2. Elevations in the watershed vary from about 6,800 feet near the western and northern watershed boundaries to about 1,300 feet near the WTP. The Klickton Divide and Divide Ridge form the southern and south-eastern borders. This ridge separates the Tieton River drainage from the Cowiche Creek drainage. The northern border of the watershed is formed by several mountains and ridges including Blowout Mountain, Mt. Clifty, portions of Manastash Ridge (west end), Quartz Mountain, Bald Mountain, and Clemen Mountain. The watershed is primarily forested, but also contains flat valleys lying between steep forested or rock slopes that are used primarily for agricultural purposes or for livestock grazing.

Point of Diversion

The Naches River WTP intake structure is located downstream of the Town of Naches WWTP. In order to minimize the potential contamination of the river from a failure at the Naches WWTP, the City of Yakima and the Town of Naches have established a notification process to respond to a contamination incident.

In addition, City staff has collected and analyzed river water samples and have determined that there is currently no reason for significant concern. City staff has developed emergency

operations guidelines that include procedures for responding to contamination events that might occur upstream of the intake structure (Appendix R).

Wilderness and Protected Multi-Use Natural Areas

The Naches River watershed includes three wilderness areas that are within the Okanogan-Wenatchee National Forest: the Goat Rocks, Norse Peak, and William O. Douglas wilderness areas. Visitor use in these wilderness areas is moderate. Table 5-2 summarizes the wilderness areas within the Naches watershed.

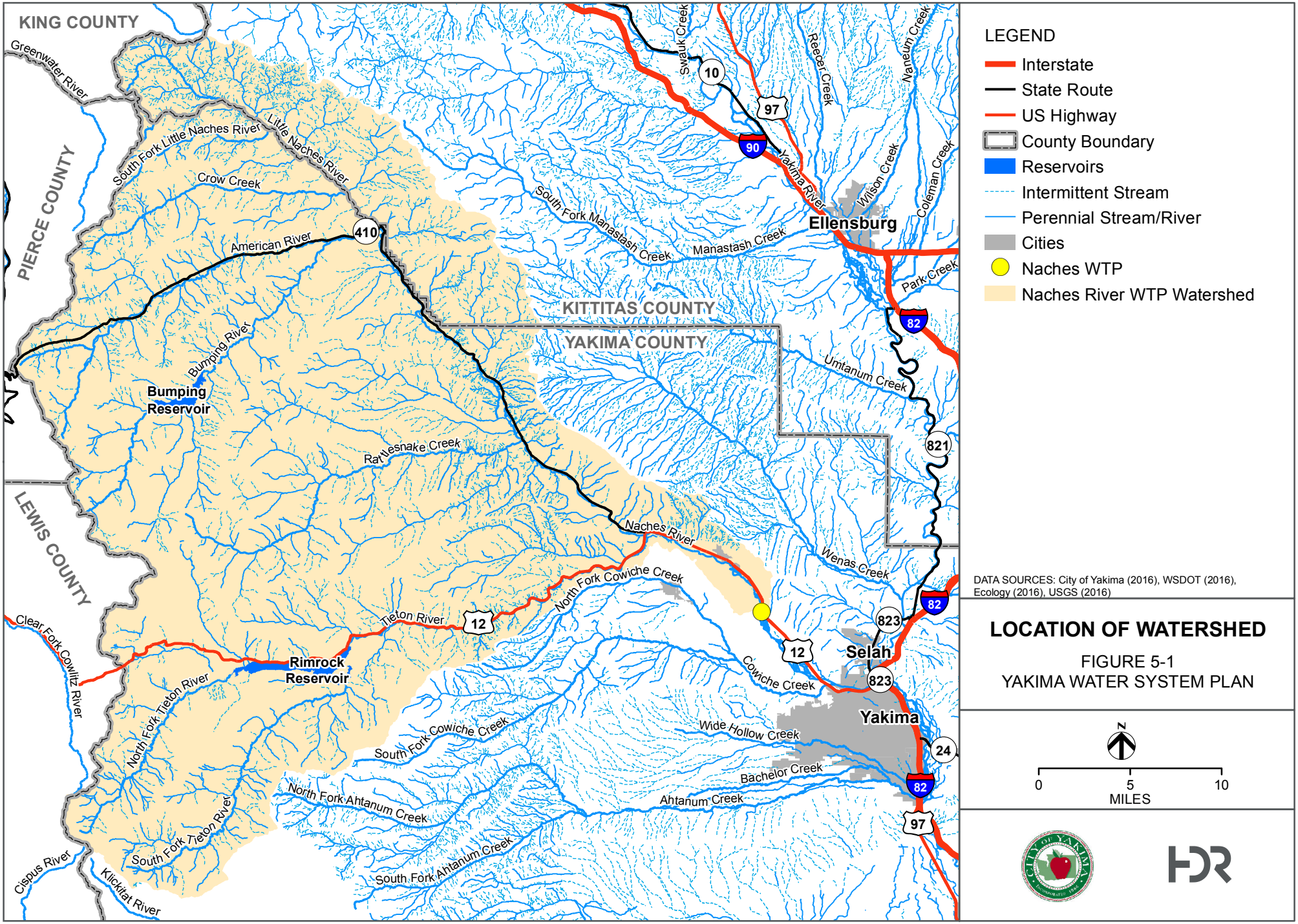
Table 5-2. Naches Watershed Wilderness Areas

Wilderness Area	Area Within Watershed (ac)	Percentage of Watershed (%)
Goat Rocks	36,970	5.2
Norse Peak	36,740	5.2
William O. Douglas	153,220	21.7
Total	**226,930**	**32.1**

The Northwestern Washington *Forest Plan Revision, Review of Potentially Eligible Wild and Scenic Rivers* (June 2011) identifies seven rivers and tributary segments within the Naches River watershed that are eligible to be designated as wild and scenic rivers.

Wildlife

The Naches River watershed supports habitat for a variety of wildlife. The U.S. Forest Service Wenatchee National Forest Plan indicates that threatened and endangered species are present in the Naches River watershed, including bald eagles, grizzly bears, spotted owl, and bull trout. The Forest Service strives to maintain the habitat areas for these and other species.



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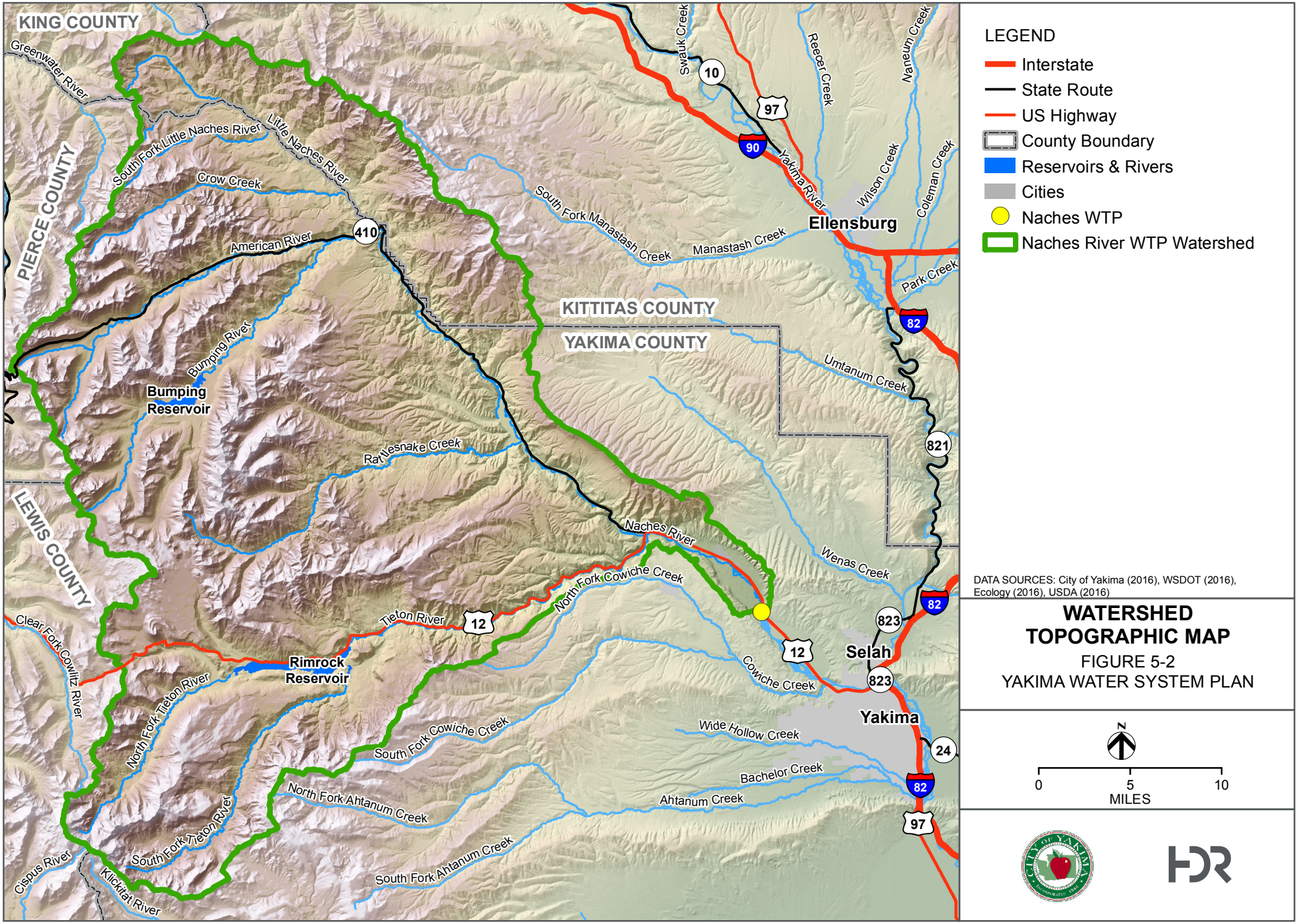

LEGEND

- Interstate
- State Route
- US Highway
- County Boundary
- Reservoirs & Rivers
- Cities
- Naches WTP
- Naches River WTP Watershed

DATA SOURCES: City of Yakima (2016), WSDOT (2016), Ecology (2016), USDA (2016)

WATERSHED TOPOGRAPHIC MAP

FIGURE 5-2
YAKIMA WATER SYSTEM PLAN

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PATH: G:\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE5-2.MXD - USER: DKUHNS - DATE: 8/22/2016

Land Ownership

The majority of the watershed is part of the Wenatchee National Forest administered by the U.S. Forest Service (USFS). Approximately 32 percent of the watershed area is within the Norse Peak, Goat Rocks, and William O. Douglas Wilderness Areas. Portions of the watershed are owned by the State of Washington, while some of the watershed is privately owned. Of the state-owned land in the watershed, roughly 40 percent is managed by DNR, and the other 60 percent is managed by DFW. The majority of the state lands are in the lower Naches area, just upstream from the Town of Naches. Table 5-3 shows the land ownership for the watershed drainage area that supplies the City's WTP. Figure 5-3 provides a geographic representation of land ownership.

Table 5-3. Naches Watershed Land Ownership

Owner	Area (sq. mi.)	Percent of Total Area (%)
U.S. Forest Service	799	83.0
Private Individual or Company	64	6.7
State Dept. of Fish and Wildlife (DFW)	58	6.0
State Dept. of Natural Resources (DNR)	38	3.9
Other[1]	3	0.3
Total	**962**	**100**

1. Other land owners include the Bureau of Land Management, the Bureau of Indian Affairs, the National Parks Service, and the Bureau of Reclamation.

5.3.3 Potential Naches River Watershed Contamination Sites and Activities

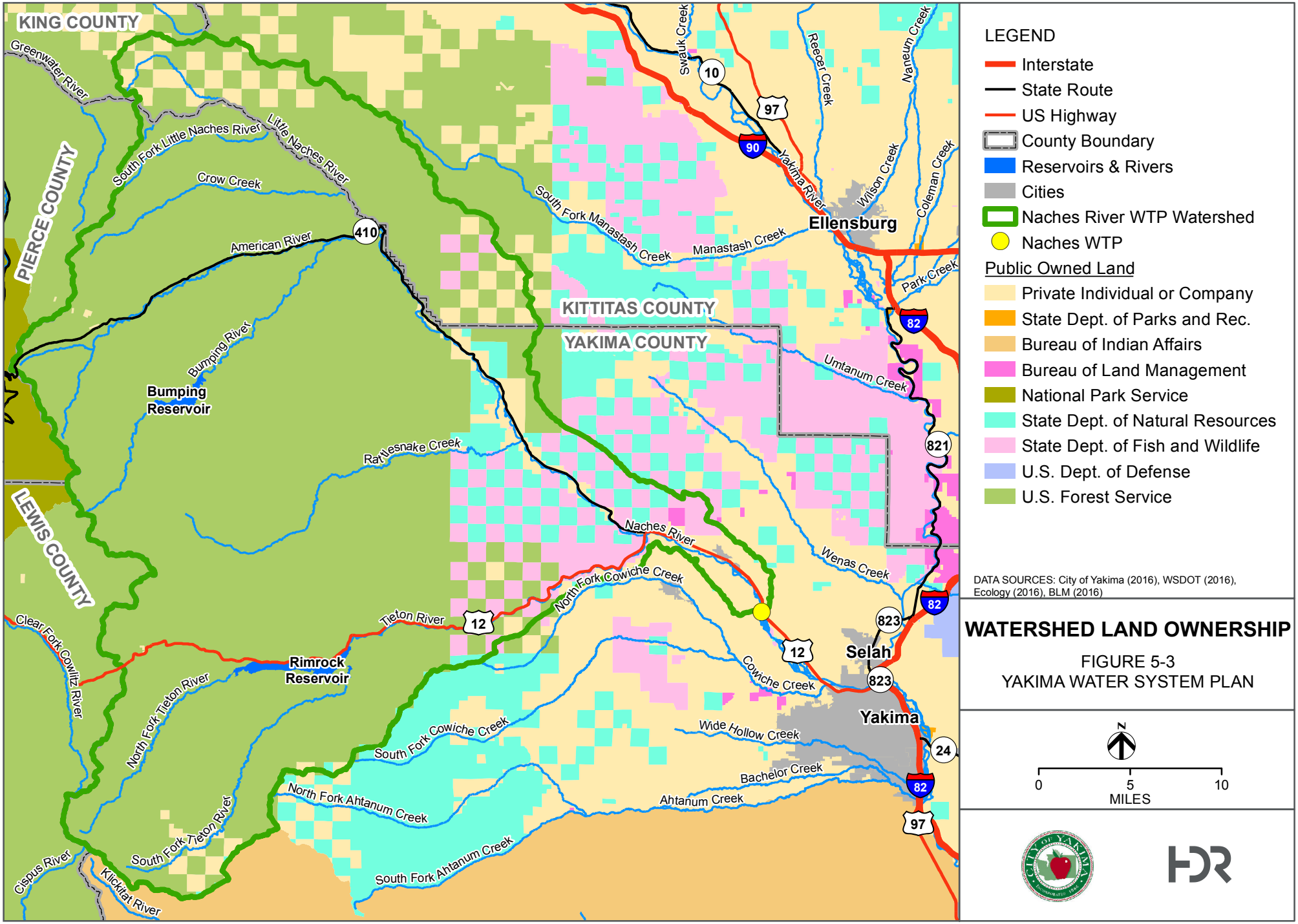
The watershed area is host to a variety of land uses including municipal development at the Town of Naches, several small rural mountain communities, agricultural uses, forestry, and recreation. Table 5-4 summarizes the land uses in the watershed drainage area that supplies the City's WTP. The land use designations are shown geographically on Figure 5-4.

Table 5-4. Naches Watershed Land Uses

Land Use	Area (sq. mi.)	Percent of Total Area (%)
Forestry	898	93.41
Agriculture	44	4.55
Water	9	0.89
Residential	4	0.44
Transportation	3	0.29
Vacant & Undeveloped	2	0.18
Recreation	1	0.10
Other[1]	0.8	0.08
Government	0.6	0.06
Total	**962**	**100**

1. Includes mining, parks, industrial & manufacturing, and commercial land uses.

Although there is a wide range of land uses in the watershed, the intensity of these uses is low. The majority of the watershed is a reserved wilderness area or national forest. However, the development that does exist is concentrated along the state highways, which parallel the two major rivers. Therefore, the potential does exist for contamination of the water supply. The following subsections provide a brief discussion of activities that could adversely affect water quality and relevant Federal, State, or local agency actions to protect water quality.



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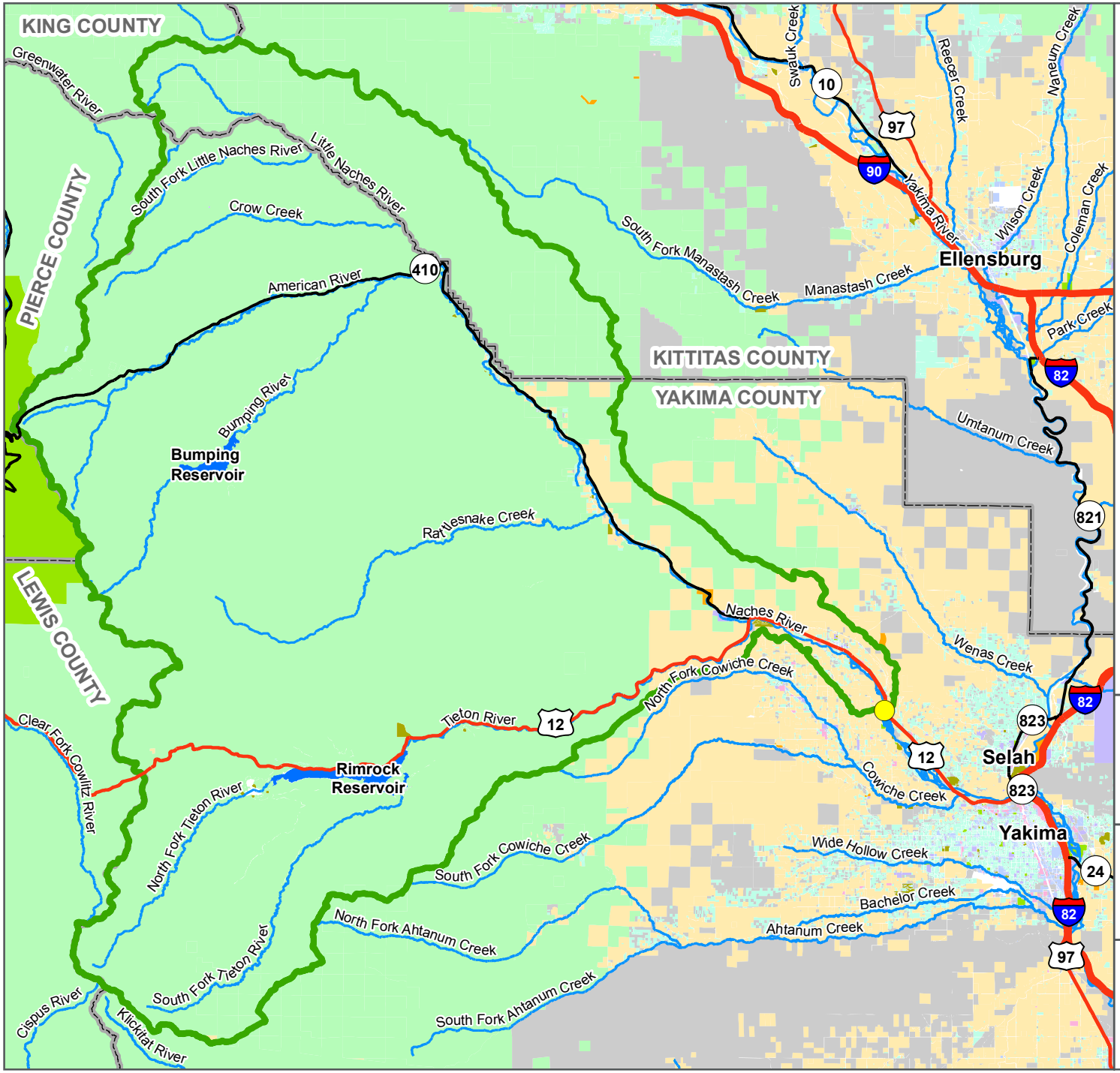

LEGEND

- Interstate
- State Route
- US Highway
- County Boundary
- Reservoirs & Rivers
- Naches River WTP Watershed
- Naches WTP

Land Use

- Agriculture
- Commercial
- Forestry
- Government
- Industrial & Manufacturing
- Mining
- Parks
- Recreation
- Residential
- Vacant & Undeveloped

DATA SOURCES: City of Yakima (2016), WSDOT (2016), Ecology (2016)

WATERSHED LAND USE MAP

FIGURE 5-4
YAKIMA WATER SYSTEM PLAN

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Forest Management

The Forest Service manages approximately 73 percent of the area within the Naches River watershed. This area makes up a portion of the Wenatchee National Forest. Land-uses within the Wenatchee National Forest include recreation, timber production and harvest, and wilderness areas. The Wenatchee National Forest Plan identifies the maintenance of quality water for human use and fish and wildlife needs as a fundamental component of forest management. The Plan recognizes that water originating from the forest must be suitable for domestic use with cost effective treatment processes. As part of the Wenatchee National Forest Plan, the Forest Service has established the goal to meet or exceed standards set forth in the State's Forest Practice Rules (Title 222 WAC) and related regulations. The Forest Practice Rules include restrictions on the application of fertilizers, pesticides, and chemicals on forest lands. Sampling of water quality suggests that the Wenatchee National Forest has historically complied with State water quality standards.

Wildfire

Wildfire is common in the Wenatchee National Forest. The Forest Service implements management practices to reduce the risk of wildfire in the watershed. Management practices include forest thinning, prescribed fires, and public outreach to educate visitors about fire prevention.

In 2013, the U.S. Department of Agriculture and U.S. Department of the Interior established the Western Watershed Enhancement Partnership (WWEP). The WWEP is a federal, local and private partnership that aims to reduce the risks of wildfire to America's water supply in western states. In 2015, under the WWEP, the Forest Service and Bureau of Reclamation began pre-fire forest thinning in areas that drain into Rimrock Reservoir. This will contribute to reduce the risk of wildfire in the watershed that can cause water quality impacts. Future efforts under the WWEP are expected to continue to improve conditions in the watershed.

In 2014, the Yakima Valley Fire Adapted Communities Coalition (YVFACC) was formed, comprised of Federal, State, and local agencies and land managers. Members include the Forest Service, DNR, DFW, and Yakima County, among others. The YVFACC works to increase and sustain wildfire resiliency in the Yakima Valley. The YVFACC was established to network with regional stakeholders to address wildfire issues. In 2015, the YVFACC worked with the Bureau of Land Management and DNR to develop the Yakima County-wide Community Wildfire Protection Plan. The Plan provides a description of wildfire risks and mitigation activities in Yakima County.

Agriculture

As indicated in Figure 5-4, the agricultural land in the watershed is concentrated in the lower Naches River watershed, near the Town of Naches, and along Highway 410 paralleling the Naches River. Agricultural land in the Cowiche Creek sub-watershed drains to the area downstream of Yakima's WTP. The Yakima-Tieton Irrigation Canal parallels the Tieton River from downstream of the Tieton Dam area to near the mouth of the Tieton River and provides irrigation supply to farmers within the Yakima-Tieton Irrigation District.

The Department of Agriculture regulates the application of fertilizer (WAC 16-200) and pesticides (WAC 16-228) on farmlands. Water quality analysis results for the City's raw water supply have to date shown no indication of volatile organics, synthetic organic compounds, or pesticide problems.

Potential contamination from accidental/intentional introduction of agricultural or other hazardous chemicals into the Naches River could occur. However, runoff from the small-scale agricultural activities in the watershed would likely be diluted before reaching the WTP intake and is therefore unlikely to threaten municipal water quality. If a hazardous chemical

spill were to occur, the risk and response to these conditions would be similar to the actions necessary for a transportation chemical spill. The City of Yakima has established emergency response measures to respond if a source water contamination event were to occur. Emergency response measures are included in the City's Emergency Operations Guidelines (Appendix R).

Livestock Grazing

The 2006 Natural Resources Conservation Service Naches Watershed, Rapid Watershed Assessment identifies rangelands within the Naches River watershed on lands managed by DNR. DNR manages public land leases in the Naches River watershed. These public land leases set restrictions on livestock management to minimize impacts to water quality.

Historically, there have not been any water quality issues associated with livestock in the watershed. Livestock grazing in the Naches River watershed is limited such that little or no contaminants are expected in the future due to livestock operations.

Municipal and Industrial Wastewater

The Town of Naches WWTP discharges treated effluent into the Naches River about 3 miles upstream of the City of Yakima WTP. Figure 5-3 shows the location of the Town of Naches with respect to the City of Yakima's WTP. In 2007, the Town of Naches upgraded their WWTP facility to improve the quality of effluent released to the Naches River. The WWTP is a secondary treatment facility operating between a 90 and 95 percent biochemical oxygen demand and total suspended solids removal efficiency.

The City of Yakima has established emergency response measures to respond if a source water contamination event were to occur due to failure of the Naches' WWTP. Emergency response measures are included in the City's Emergency Operations Guidelines (Appendix R). The City maintains emergency contact information with the Town of Naches in the event of a contamination event.

Septic Tanks

The Town of Naches is sewered. Wastewater disposal outside the city limits is by septic tanks and drain fields. In addition, septic systems are probably present in some of the approximately 40 camping areas and resorts that are located in the watershed. The largest concentrations of septic systems are probably in the small communities of Nile, Squaw Rock, Pinecliff, Gold Creek, Silver Beach, and Rimrock. The urban and built-up areas within the Naches River watershed are, therefore, limited and are concentrated in the lower-watershed.

In 2015, Yakima County adopted the *Title 19: Unified Land Development Code*. This code is intended to protect public health and safety by establishing rules for sewer and septic systems. This code also increases Yakima Health District enforcement of satellite sewer systems and individual septic systems, thereby reducing the risk of satellite sewer or septic system failure.

Residential and Commercial Land Uses

The total population in the watershed above the Naches-Tieton confluence is approximately 4,584 persons, according to the 2010 US Census data for Census Tract 30.01. This population number includes some areas that drain downstream of Yakima's WTP. The average population density above the Naches-Tieton confluence is about 4 persons per square mile. An additional 10,238 people live in the area adjacent the lower Naches River drainage between the confluence and Selah (not including Selah) (Census tracts 29 and 30.02). This population number includes the Cowiche Creek sub-watershed area which drains to the area downstream of Yakima's WTP. The equivalent gross population density for this area is about 110 people per square mile. According to the Washington State Office of

Financial Management population estimates for Yakima County, there was little or no growth between 2010 and 2014 in the communities and unincorporated areas above the City's WTP. This growth trend is expected to continue.

Roads and Transportation Corridors

There are two state highways that traverse the watershed from east to west: Highway 12 and Highway 410. Highway 410 parallels the Naches and American Rivers across the entire watershed. Highway 12 parallels the Tieton River to Rimrock Reservoir and continues parallel to Clear Creek until it exits the western boundary of the watershed. There are also numerous Forest Service roads, county roads, and other secondary roads traversing the watershed.

Vehicle use and transportation of oil or other chemicals along these highways could result in an oil or hazardous material spill along the Naches or Tieton Rivers. The City is a partner in the Yakima Area Geographic Response Plan (GRP) which provides a response strategy for protecting sensitive resources in the event of an oil spill. The Yakima Area GRP and City-specific actions are described further in Section 5.3.4.

Recreation

Fishing is a primary form of recreation in the Naches watershed. The American, Bumping, Little Naches, and Tieton Rivers, Rattlesnake Creek, and Bumping and Rimrock Reservoirs all contain various species of trout and salmonids. The lakes also support Kokanee salmon.

Dispersed recreational uses such as backpacking, hiking, hunting, fishing, skiing, snow-mobiling, off-road vehicle travel, camping, rafting, and kayaking are all common in the Yakima River basin. Most of the uses are present to some degree in the Naches River watershed. There are no state or federal parks within the watershed, but there are approximately 40 recreation sites in the watershed, most of which are managed by the Forest Service. The primary water quality concerns associated with recreation are nitrates and bacteriological contamination from improper disposal of human waste. Water quality analysis results for the City's raw water supply show that nitrate and bacteriological levels are well within the treatment plant's operating range for effective removal.

Mining

Small-scale mining is present in the watershed. For example, Copper Mining Co. mines silver, copper, gold, and tungsten south of Bumping and Rimrock Reservoirs. Although lead, zinc, and uranium has been detected, no economic deposits have been discovered. In addition, Horseshoe Bend Quarry is located along Highway 410, adjacent to the Naches River. Runoff from to small-scale mining activities in the watershed would likely be diluted before reaching the WTP intake and is therefore unlikely to threaten municipal water quality.

Landslides

There is a potential for landslides in the Naches River watershed that can increase water turbidity. In October 2009, a landslide occurred near the Community of Nile that submerged approximately a half-mile of State Route 410 and temporarily redirected flows in the Naches River. Although this event resulted in increased turbidity in the Naches River, the City was still able to manage turbidity levels and continue operating the WTP. As part of the Forest Practice Rules (Title 222 WAC), Ecology and DNR have established buffer zones around streams/waterways to protect from landslide and erosion.

Volcanos

There is a potential for volcanic ashfall in the Yakima area. In May 1980, Mount St. Helens erupted resulting in about 3 inches of ash to fall on the Yakima area within the first 24-hours. A total of approximately 5 inches of ash fell on the Yakima area. Following the eruption, the City shut down the WTP for several days until turbidity and pH returned to manageable levels. During the WTP shut down, the City switched to groundwater supplies.

Potential Surface Water Contaminants

Table 5-5 summarizes land uses in the watershed and indicates the possible contaminants from each type of land use. This table was adapted from *Effective Watershed Management for Surface Water Supplies*, American Water Works Association Research Foundation (AWWARF), 1991.

Appendix T includes a list of active Ecology regulated sites/facilities in the Naches River watershed (WRIA 38) that could be potential sources of surface water contamination. This is a consolidated list that includes all active potential contamination sites in WRIA 38 identified under the following Ecology programs:

- Air Quality Program
- Hazardous Waste Program
- Shoreline and Environmental Assessment Program
- Water 2 Resources Program
- Spill Prevention, Preparedness and Response Program
- Toxics Cleanup Program
- Water Quality Program
- Water Resources Program
- Nuclear Waste Program
- Industrial Program
- Environmental Assessment Program

Table 5-5. Land-Use Pollutant Analysis Matrix

Land Use/Contamination Source	Contaminant											
	Turbidity	pH	Nitrogen, Phosphorus	Algae	Viruses, Parasites	Bacteria	THM Precursors	Pesticides	Other SOCs	VOCs	Heavy Metals	Iron, Manganese
Cropland Runoff	X		X	X	X	X	X	X			X	X
Grazing	X		X	X	X	X	X					
Recreation					X	X						
Forest Management	X		X	X		X	X	X				
Roads (surface runoff)	X		X	X			X					
Wastewater Discharge (municipal and industrial)	X	X	X	X	X	X	X	X	X	X	X	X
Septic Tanks		X	X	X	X	X	X	X				
Urbanization	X	X	X	X	X	X	X	X	X	X	X	X
Hazardous Materials/ Chemical Spills (transportation and agricultural users)								X	X	X	X	X
Mining	X	X									X	X

Source: Effective Watershed Management for Surface Water Supplies, AWWARF 1991.

Priority Water Quality Threats

Based on the land uses within the Naches Watershed and the associated potential contaminants, the City considered the water quality threats that pose a plausible risk to the City's surface water supply. The City broke these threats into two tiers. Tier 1 threats are those that pose the greatest risk to water supply, and are therefore a primary priority for City water contamination planning and response. Tier 2 threats are those that pose a lesser risk to water supply, but that the City still considers for water contamination planning and response. Table 5-6 summarizes the Tier 1 and Tier 2 water quality threats to surface water supply in the Naches River watershed.

Table 5-6. Priority Water Quality Threats to Surface Water Supply

Tier 1 Water Quality Threats
Wildfire producing increased water turbidity and pH.
Landslides producing increased water turbidity.
Malfunction of the Town of Naches WWTP resulting in water contamination.
Hazardous material spills from transportation accidents, resulting in water contamination.
Tier 2 Water Quality Threats
Widespread septic tank failure resulting in water contamination.
Road water runoff containing gasoline and other chemicals.
New residential, commercial, or industrial developments
Logging activities causing turbidity.
Large rainstorms causing increased water turbidity.
Agriculture or forest fertilizer and chemical application
Livestock rangeland runoff
Recreation activities (off-road vehicles, boating, campsite waste, etc.)
Yakima-Tieton Irrigation District canal modifications or construction activities.
Volcanic eruption from Cascade Range volcanoes causing high turbidity from ashfall.

5.3.4 City of Yakima Watershed Control Measures

The vast majority of the City of Yakima surface water supply watershed is publicly owned. As pointed out in the Department of Health Sanitary Survey report dated April 22, 2002, the City does not have jurisdiction over activities in the watershed which include; recreation, timber harvesting, vehicle traffic on two major transportation corridors, Town of Naches WWTP operations, and irrigation water storage and delivery systems including Rimrock and Bumping Reservoirs. As stated in the Sanitary Survey report, the City is "doing the best that they can under the current ownership and control." The most effective approach available to the City under these circumstances is to work closely with the other federal, state, and county agencies with jurisdiction over activities in the watershed to make sure that the policies and decisions affecting watershed management and water quality fully consider the potential impacts on the City's water supply. As such, the City established the following Watershed Control Program goals:

1. Where feasible, work to minimize watershed conditions or incidents that compromise water quality for municipal water supply.
2. Where feasible, work with partners in the watershed to receive rapid notifications if a contamination incident occurs, thereby improving the City's ability to response quickly and/or switch to groundwater supplies.

To this end, the City has established City-specific Watershed Control Program strategies for maintaining water quality in the Naches River watershed. For each strategy, the City has identified measures that the City can take to help maintain water quality in the watershed. Where applicable, City measures build on existing watershed protection efforts in the watershed.

Table 5-7. City of Yakima Watershed Control Program Strategies and Measures

Strategy	Measures
1. Establish communication strategies with other entities in the watershed to keep informed about potential threats and provide input to make sure that the policies and decisions affecting watershed management and water quality fully consider the potential impacts on the City's water supply.	1. Attend YVFACC meetings to engage with other stakeholders in the watershed on wildfire management and watershed health topics. Periodically present at YVFACC meetings to educate members about water quality considerations for municipal water supply.
	2. Engage with Yakima County, State agencies, and the Corp of Engineers to receive notices of proposed land use permit applications that might adversely impact the water quality of municipal water supplies. In particular, the City will monitor applications for activities upstream of the WTP that require a Clean Water Act Section 404 Permit, Section 401 Clean Water Certification, and/or a Hydraulic Project Approval.
	3. Communicate with the Town of Naches WWTP operators to ensure contact information and emergency response measures are maintained. This can be scheduled to coincide with the City's WHPP notifications distributed every two years.
	4. Distribute notifications to Yakima County, the Department of Transportation, and land management agencies in the Naches River watershed to educate these entities about the impact that activities in the watershed have on water quality for municipal water supply. This can be scheduled to coincide with the City's WHPP notifications distributed every two years.
2. Maintain emergency water contamination response procedures, including coordination with large land owners in the watershed.	1. Update the Emergency Operations Guidelines (Appendix R) and Operation and Maintenance Manual annually to ensure emergency contacts and other information remains up-to-date. Activate Emergency Operations Guidelines as needed.
	2. Work with Ecology to maintain a Yakima Area Geographic Response Plan and implement spill response actions at vulnerable sites as needed.
	3. Continue to develop ASR and groundwater resources as back-up supplies that can serve as a resource during short-term disruption of the surface water supply.
3. Participate in efforts to protect water quality in the watershed.	1. Collaborate with partners in the watershed on projects that protect water quality in the Naches River watershed (e.g. projects through the Integrated Plan, Washington Resource Conservation & Development Council, or Salmon Recovery Funding Board). For example, the City can provide letters of support for projects in the watershed that have a water quality protection component.
4. Continue to maintain inventory of potential water quality impairments and opportunities to reduce contamination risks.	1. Continue to maintain inventory of entities with potential contaminant sources and regularly engage in outreach to these entities. This can be scheduled to coincide with the City's WHPP inventory update every two years or as part of regular updates to the Emergency Operations Guidelines.
	2. Work with Yakima County to maintain shoreline protections such as aquatic buffers, erosion and sediment control, open space development, stormwater control operation and maintenance, and post construction controls, and enforce restrictions on illicit discharges.

Yakima Area Geographic Response Plan

During the development of this Water System Plan, the Washington State Department of Ecology was in the process of establishing a Geographic Response Plan (GRP) for the Yakima area. GRPs are annexes to the Northwest Area Contingency Plan which guides response to oil spills in Washington, Oregon, and Idaho. Each GRP is prepared for a specific area and includes response strategies tailored to a particular waterway at risk of damage from an oil spill. GRPs help to coordinate response efforts by impacted entities, and Federal and State agencies. They include initial action plans for responders to take in the event of an oil spill, including contacting entities at risk of contamination and deploying oil containment booms.

The City of Yakima is involved in the development of the Yakima Area GRP. The Yakima Area GRP will include 10.5 miles of the Naches River above the confluence with the Yakima River. This GRP does not include the Tieton River since Ecology has determined that there are no significant spill risks along the Tieton River. As part of this effort, the City provided Ecology with information on vulnerable surface water supply facilities, City-specific response measures, and emergency contact information. The City identified the WTP intake structure on the Naches River as the key vulnerable facility, since it is vital for providing potable water supply to City of Yakima citizens. If an oil spill event occurred upstream of the WTP intake structure, then the City would respond by closing the WTP intake head gates and switching to groundwater resources to maintain water supply. If necessary, the City would also assist Ecology in containing any contaminants that reached the intake channel.

Aquifer Storage and Recovery

The City currently uses its groundwater supply system as a backup to supplement surface water supplies when needed. In January 2017, Ecology issued a final Reservoir Permit authorizing the City to conduct ASR activities. The City's ASR program would contribute to augmenting its ground water supply. The City's ASR program would contribute to supplementing existing water supplies and be a valuable resource if a contamination event in the Naches River watershed occurred that required the WTP to be shut down for an extended period. Chapter 4, *Conservation and Water Resources*, describes the use of ASR wells to improve water supply reliability.

Monitoring Water Quality Conditions

The Naches River watershed encompasses a large area and a wide range of land uses and land ownership. Several agencies including the Bureau of Reclamation, the U.S. Geologic Survey, the Forest Service, and Ecology maintain ongoing water quality monitoring programs within the Naches River watershed. The City of Yakima Water/Irrigation Division does not have the staff or the resources to conduct routine monitoring within the watershed.

However, the City monitors raw water quality of the surface water supply and adjusts water system operations accordingly. Understanding conditions in the Naches River is vital to the operation of the WTP. In the spring of 2004, WTP staff installed a new HF scientific turbidimeter at the WTP intake structure to monitor raw water turbidity from the Naches River. The turbidimeter allows WTP operators to identify and respond quickly to changes in turbidity levels of raw water quality.

The City also monitors the Bureau of Reclamation's river operations above the WTP. Understanding flow conditions in the Naches River is important for WTP operation. The City regularly attends the Bureau of Reclamation's monthly planning meetings to discuss river operations below Bumping Lake and Rimrock Reservoirs. The City also monitors the Bureau of Reclamation's daily river operations reports. In addition, the City is on the Bureau of Reclamation's notification list to be informed of changes to river operations.

The City's WTP operation staff also monitors the following weather prediction and forecasts sites to inform decisions about WTP operation.

- The National Oceanic and Atmospheric Administration (NOAA) - Advanced Hydrologic Prediction
- NOAA – National Weather Service for 3 Miles South by Southeast of Naches, WA.
- US Bureau of Reclamation Yakima Project System Status Report

The WTP operators monitor these sites year-round, especially during spring runoff periods and late-fall/early-winter storm periods. In addition to monitoring these websites, the City also subscribes to SunComm (Yakima 911 system) to receive alerts about weather storm warnings. These river condition monitoring activities and general operational observations aid the WTP operators to plan for and respond to rising turbidity levels and potential flood events that could impact water quality at the WTP.

5.3.5 System Operations and Emergency Provisions

In addition to the actions described above, emergency provisions and response measures in the event of contamination event are documented in the City's Emergency Operations Guidelines (Appendix R). Section 3.3 of this Water System Plan summarizes the City's water quality considerations, monitoring program, and compliance with applicable water quality regulations. Table 5-8 provides a list of the City's contacts for emergency response and watershed protection efforts.

Table 5-8. City of Yakima Watershed Protection Plan Partial List of Contacts

Name of Agency	Location/Address	Contact Person	Phone Number
Hazardous Chemical Spills-Transportation System			
Washington Department of Transportation	2809 Rudkin Rd. Union Gap, WA 98903	Various	(509) 577-1600
Washington State Highway Patrol	2715 Rudkin Rd. Union Gap, WA 98903	Various	(509) 575-2320
Agricultural Chemical Contamination			
US Bureau of Reclamation	1917 Marsh Rd. Yakima, WA 98901	Various	(509) 575-5848
Yakima-Tieton Irrigation District	470 Camp Four Rd. Yakima, WA 98908	Rick Dieker, District Manager	(509) 678-4101
US Bureau of Reclamation (operators of the Wapatox Canal)	1917 Marsh Rd. Yakima, WA 98901	Chad Stuart, Field Office Manager	(509) 575-5848
Municipal/Industrial Contamination			
Washington Department of Ecology	15 W. Yakima Ave. Suite 200 Yakima, WA 98902	Various	575-2490
City of Naches (Public Works Foreman)	306 Naches Av Naches, WA 98937	Mike Davis	(509) 653-2881
Yakima County Public Services Dept.	Room 417, Courthouse Yakima, WA 98901	Various	(509) 574-2300
Other State Agencies with Watershed Interests			
Washington Department of Health	16201 E. Indiana Ave. Ste. 1500 Spokane Valley, WA 99216	Andy Cervantes, Regional Engineer	(509) 329-2120
Washington Department of Fish and Wildlife	1701 S 24th AV Yakima, WA 98902-5720	Eric Bartrand, Habitat Biologist	(509) 457-9310
Washington Dept. of Natural Resources	2211 Airport Rd. Ellensburg, WA 98926	Various	(509) 925-8510
Forest Management/Recreation			
USFS-Naches Ranger Station	10237 Highway 12 Naches, WA 98937	District Ranger Various	(509) 653-2205

6 Operation and Maintenance Program

6.1 Water/Irrigation Division Organization

An organizational chart for the City of Yakima Water/Irrigation Division is shown in Figure 6-1 which lists position titles and their associated certifications when required. The responsible positions for key functions are summarized in Figure 6-1.

Figure 6-1. City of Yakima Water/Irrigation Division Organizational Structure

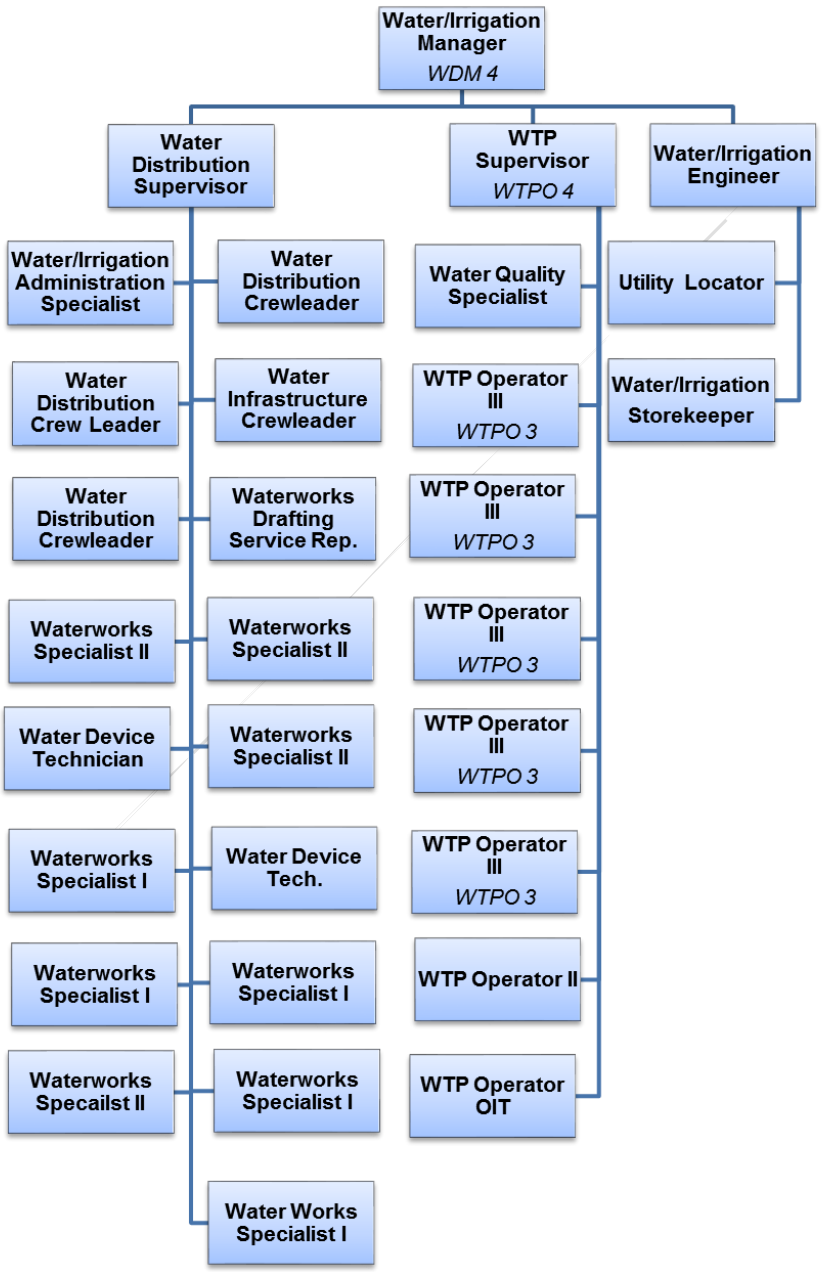

Table 6-1. Responsibility for Key Functions

Key Functions	Responsible Position(s)
Day-to-day Distribution Operations Day-to-day Supply/Treatment Operations	Water/Irrigation Manager Water Distribution Supervisor Water Treatment Plant Supervisor
Preventive Distribution Maintenance Preventive Supply/Treatment Maintenance	Water Distribution Supervisor Water Treatment Plant Supervisor
Field Engineering	Water/Irrigation Engineer
Water Quality Monitoring	Water Treatment Plant Supervisor, Water Quality Specialist
Distribution System Troubleshooting Supply/Treatment System Troubleshooting	Water Distribution Supervisor Water Treatment Plant Supervisor
Distribution Emergency Response Supply/Treatment Emergency Response	Water Distribution Supervisor Water Treatment Plant Supervisor
Cross-Connection Control	Water Distribution Supervisor Water Device Crewleader
Capital Improvements Program Implementation	Water/Irrigation Engineer Water/Irrigation Division Manager
Budget Formulation	Water/Irrigation Division Manager Water/Irrigation Engineer Distribution Supervisor Water Treatment Plant Supervisor
Distribution System Pressure/Flow Complaints Water Quality Complaints	Water Distribution Supervisor Water Quality Specialist
Public and Press Contact	Water/Irrigation Division Manager (primary, all supervisors may have some role) City Communications & Public Affairs Director

6.1.1 Water/Irrigation Division Manager

The Water/Irrigation Division Manager is responsible for overall management of the water utility, preparing and managing the annual budget, managing the water utility staff, responding to customer questions and concerns, and reporting on water system operations to the Public Works Director and City Manager.

6.1.2 Water/Irrigation Engineer

The Water/Irrigation Engineer is responsible for contract administration and field engineering. The Water/Irrigation Engineer also assists with operations, financial matters, and policy development.

6.1.3 Water Treatment Plant Supervisor

The Water Treatment Plant Supervisor is responsible for the overall operation of the WTP, the wells, the reservoirs, and the pump stations, as well as being responsible for the water quality monitoring of the system.

6.1.4 Water Treatment Plant Operator III

Operation and maintenance activities for the WTP, WTP intake structure, wells, reservoirs, and pump stations are performed by Water Treatment Plant Operator III certified operators. This certification level is designated by the State of Washington due to plant size and complexity.

6.1.5 Water Distribution Supervisor

The operation of the distribution system is under the direction of the Water Distribution Supervisor. This position oversees staff who perform installation of new services, fire hydrants, and fire services; preventive maintenance, repairs, and replacement of pipelines, PRVs, and meters; and testing of cross-connection control devices and large valves. Meter reading is performed by utility billing staff and is, therefore, not included within the responsibilities of water distribution staff.

6.1.6 Waterworks Crewleaders and Waterworks Specialist I and II

Eleven positions within the water distribution group are classified as Waterworks Crewleaders or Waterworks Specialists I or II, as follows:

- Waterworks Crewleaders are crew leaders for distribution system operations and maintenance.
- Waterworks Specialists II are primarily equipment operators with general labor duties.
- Waterworks Specialists I are general laborers.

6.1.7 Water Device Technicians

The distribution group includes one Crewleader and two device technicians who are primarily responsible for cross-connection control, installation of the automated meter reading system and repair of large meters.

6.2 Operator Certification

Pursuant to Chapter 246-292 WAC, the City is required to have certified operators. Certified personnel are required for positions that are in direct charge of a public water system or major segments of the system and are responsible for monitoring or improving water quality. DOH requires every community public water system to maintain at least one certified operator on staff at or above the classification level for that community. The City of Yakima water system is classified as Level 4. On-duty operators must maintain a certification level not more than one level lower than the classification of the community water system. The Naches River WTP is classified as Level 4 based on its size and complexity. Therefore, the WTP must retain at least one level 4 operator, and all operators must be certified at level 3 or higher. Positions with operator certifications below level 3 are not considered “operators” for the WTP but are regular supporting staff.

State regulatory language establishes various organizational positions for personnel working for the City Water Division. The following positions are occupied by City personnel:

- Water Distribution Manager (WDM)
- Water Treatment Plant Operator (WTPO)
- Cross Connection Specialist (CCS)
- Backflow Assembly Tester (BAT)

These positions are filled by personnel meeting State mandated requirements.

6.3 System Overview

The major water system components that are operated by the water utility are the Naches River Intake and WTP, four wells (Kiwanis Park, Airport, Kissel Park, and Gardner Park), five storage reservoirs, four pump stations, pressure-reducing valves (PRVs), and distribution system pipelines. The locations of the components of the distribution system are shown in Figures 1-2 and 3-1. Descriptions of these components and how they operate together as part of the system are provided in Chapter 1 and Chapter 3. The nonpotable irrigation system that serves many parts of the City with water for irrigation is not discussed in this plan.

There are two emergency interties between the Nob Hill Water Association and the City of Yakima distribution systems. A description of these interties is provided in Chapter 1.

6.4 Operation and Maintenance of Major System Components

Summary descriptions of major system components and functions and the procedures used to operate the major components of the water supply and treatment system are provided below. For detailed descriptions of the systems and operational procedures refer to the Naches River Water Treatment Plant Operation and Maintenance Manual.

6.4.1 Naches River Water Treatment Plant

Raw Water Intake

Raw water is supplied to the WTP by a raw water pipeline connected to intake facilities adjacent to the Naches River, located approximately 3,500 feet upstream of the WTP facilities. The intake consists of a series of five flat-panel screens designed to achieve fish screening criteria for endangered species protection. The screens are cleaned via air wash supplied to each screen by an air piping manifold with a series of orifices located immediately behind each screen. The screen structure is separated from the river by a concrete wall and an auxiliary intake gate/headwall structure located 1,000 feet upstream of the screens. Water is supplied to the screens through gates in the headwall to allow water from the river to flow into the facilities. Water discharges from the facilities over an Obermeyer weir that functions to maintain the water surface above the top of screens.

The Raw Water Intake Facilities components and function are summarized in Table 6-2.

Table 6-2. Raw Water Intake Facilities Components and Failure Criteria

Components	Components Materials	Function	Failure Criteria[1]	Primary Failure Consequences
Raw Water Pipeline	54-inch RCCP	Convey raw water	Vital	Plant shutdown
Screens (SNU - 201 to 205)	Wedge-wire screen, stainless steel	Prevent fish and debris from entering RW pipeline	Critical	Screening does not meet ESA criteria
Screen Baffles (one per screen)	Stainless steel, adjustable vanes	Equalize flow withdrawal rates across screens	Critical	Variable withdrawal rates across screens
Air Wash Receiver (ARU-210) & Compressor (ACU-210)	2 steel receiver tanks (650 & 400 gal) and components, 1 10-HP, 34.8 scfm, 810 rpm compressor	Generate air for backwashing of screens	Vital	Head across screens may exceed ESA criteria, screen fouling
Obermeyer Weir & Inflation Compressor (ACU-230)	Rubber air bladder, steel weir gate	Maintains water elevation in front of screens Controls flow rate in-front of screens	Critical	Water levels drop in front of screens
Fish Barrier	Steel tubing and frame	Prevent fish from entering forebay in front of screens	Critical	Reduces fish protection
Turbidimeter (AE/AIT-200)	HF Scientific Microtol Turbidimeter	Measures raw water turbidity	Critical	No advance warning of high turbidity events
Differential Bubblers	Tubes with DIP control	Measures water elevation & screen water differential	Critical	Automatic screen cleaning inoperable
Low pressure compressor (ACU-220)	3-HP, 9.4 scfm compressor	Reduce ice formation in front of screens in winter	Critical	Clogging of screen by ice

Notes:
1. Critical = Failure causes problems but plant operation is possible. Vital = Failure requires plant shutdown.

Flash Mix

Proper feed and mixing of chemicals is of fundamental importance for a properly working water treatment facility. The flash mix process imparts energy to the water to ensure complete mixing of chemicals. A pump diffusion type flash mix is utilized at the WTP. A side stream of water is drawn from the raw water pipeline and pumped back into the pipeline in the opposite direction of the main flow, thereby creating a turbulent mixing zone. Chemicals that can be injected at flash mix include the following:

- Primary Coagulant (Aluminium Chlorohydrate (ACH) or Alum);
- Sodium Hypochlorite;

- Coagulant Aid Polymer;
- Caustic Soda.

The Flash Mix components and function are summarized in Table 6-3.

Table 6-3. Flash Mix Components and Failure Criteria

Components	Components Materials	Function	Failure Criteria [1]	Primary Failure Consequences
Raw Water Pipeline	36-inch steel	Conveys raw water	Vital	Plant shutdown
Flash Mix Pump	5 HP	Pumps side stream of water Provides mixing energy	Critical	Use Backup Flash Mix Basin
Nozzle	Non-clog	Creates turbulent mixing zone	Critical	Use Backup Flash Mix Basin

Notes:
1. Critical = Failure causes problems but plant operation is possible. Vital = Failure requires plant shutdown.

Contact and Sedimentation Basins

Two rectangular contact basins are located between the old flash mix basin and the filters. Coagulated water must flow through a contact basin before reaching the filters. Chemicals added in the flash mix basin have additional contact time in the basins before reaching the filters. Basin contact time improves the following processes:

- **Flocculation.** Alum and coagulant aid polymer react with natural suspended solids to create "floc" particles. The "floc" particles settle in the contact basins and are removed in the filters. No mechanical flocculation energy is added in the contact basins.
- **Disinfection.** Prechlorination at the flash mix basin provides additional contact time before the final application of chlorine. Longer chlorine contact time improves disinfection and increases the potential of disinfection byproduct formation.
- **Taste and Odor Reduction.** When powdered activated carbon (PAC) is used, the Contact Basins allow PAC to adsorb taste and odor compounds before reaching the filters, where the PAC is removed. The addition of PAC can affect the disinfection process by adsorbing chlorine.
- **Solids Removal.** The basins remove sand and other heavy particulate matter by gravity settling during episodes of high raw water turbidity. This protects the filters from shortened filter runs that would result from excessive solids loading onto the filters.

The Contact and Sedimentation components and function are summarized in Table 6-4.

Table 6-4. Contact Basin Components and Failure Criteria

Components	Component Materials / Approximate Sizing	Function	Failure Criteria [1]	Primary Failure Consequences
South Contact Basin No. 1 (WTP017)	Concrete basin	Flow conveyance Contact time Solids removal (high turbidity events)	Critical	Use Basin No. 2
North Contact Basin No. 2 (WTP018)	Concrete basin	Flow conveyance Contact time Solids removal (high turbidity events)	Critical	Use Basin No. 1
Basin Inlet Gate (One per Basin)	30-inch (W) x 72-inch (H)	Isolate basin during inspection/ maintenance	Critical	Use other basin
Basin Outlet Gate (One per Basin)	30-inch (W) x 60-inch (H)	Isolate basin during inspection/ maintenance	Critical	Use other basin
Baffles (Inlet and Outlet)	Two rows of 16’ x 8” vertically mounted wood planks (14” spacing)	Sediment deflection	NA	NA
Basin Overflow	36-inch diameter concrete pipe connected to 42-inch diameter pipe	Protects against uncontrolled overflow	Critical	Operate to prevent overflow
Hydrostatic Relief Valve	4-inch diameter valve	Protects basins against groundwater uplift force when basin is empty	Critical	Keep water in basin
Ice Prevention Blower (WTP182)	7.5 HP air blower with 3/4 to 2-inch diameter air distribution pipes	Reduces the formation of ice in the basins	Critical	Manual ice removal
Basin Level Transmitter (WTP059)	Pressure transmitter, air supply, and 1/4-inch diameter bubbler tube	Provides water level to the SCADA system	Critical	Manual flow control
Basin Drain (one per basin)	12-inch diameter mud valve	Drain water from basins Solids removal	Critical	Temporary plug
Filter Influent Conduit	6 foot (W) x 5 foot (H) concrete channel	Convey water from Contact Basins to Filters	Vital	Plant shutdown

Notes:
1. Critical = Failure causes problems but plant operation is possible. Vital = Failure requires plant shutdown. NA = Not applicable as a failure criteria.

Filters

Granular media filtration is a fundamental treatment process used in water treatment plants. The basic mechanisms of particle removal include interception, sedimentation, and diffusion within the granular media.

The WTP filters operate as a contact filtration process. This means that contact basins upstream of the filters provide time for the development of filterable particles following coagulation. There is no flocculation and minimal sedimentation processes upstream of the filters to condition or remove particles.

The WTP has four filters with dual media, consisting of a layer of anthracite coal on top of a layer of silica sand. The media is supported by plastic tri-lateral filter underdrains. The filter media, underdrains, troughs, and surface wash system were replaced in 2005. The filter component and failure criteria are summarized in Table 6-5.

Table 6-5. Filter Component Function and Failure Criteria

Component	Function	Failure Criteria [1]	Primary Failure Consequences
Filter beds (four total)	Includes structure, underdrain, and media	Critical	Failure of one or more filters increases filtration rate through remaining filters, or decreases plant production.
Filter effluent meter	Controls filter effluent valve position for flow	Critical	Operate valve manually
Surface wash meter and backwash supply meter	Control backwash and surface wash valve positions for flow	Critical	Operate valves manually
Filter valves	Control filter operation in backwash and production	Critical	Complete failure of a valve removes that filter from service. Operate valve manually in event of valve actuator failure
Backwash supply pumps (two total)	Refill backwash supply tank	Critical	One pump is required for service, the other is redundant
Backwash storage tank (one total)	Source of backwash water flow and pressure	Vital	Remove from service only for the interval between backwashes without plant shutdown
Filter influent flume / filter effluent conduit / common piping	Convey flow to and from the filters	Vital	Failure requires plant shutdown

Notes:
1. Critical = Failure causes problems but plant operation is possible. Vital = Failure requires plant shutdown. NA = Not applicable as a failure criteria.

Disinfection

The disinfection process kills or inactivates microorganisms, including bacteria, protozoa, and viruses. The WTP utilizes chlorine to disinfect the water. Section 11 of the *Naches River Water Treatment Plant Operation and Maintenance Manual* contains a discussion of the chlorine storage and delivery system. This section focuses on measurement and reporting of disinfection.

Disinfection at the WTP is achieved in two steps, "Sequence 1" and "Sequence 2." Sequence 1 takes place when the water is in the basins or pipelines at the WTP. Sequence 2 takes place in the pipeline between the clearwell and the Gleed Pump Station. The total level of disinfection achieved is the sum of disinfection achieved in Sequence 1 and Sequence 2.

The Surface Water Treatment Rule (SWTR) governs the required removal and inactivation of microbial pathogens. The minimum performance requirements presented below are based upon the classification of the WTP as a direct filtration facility, that is, without conventional flocculation and sedimentation processes for solids removal upstream of the filters.

Giardia cyst removal and inactivation requirement: 3-log (99.9%)

- 2-log (99%) removal via filtration
- 1-log (90%) inactivation via disinfection

Virus removal and inactivation requirement: 4-log (99.99%)

- 3-log (99.9%) removal via filtration
- 1-log (90%) inactivation via disinfection

The requirement for both removal and disinfection of microorganisms provides multiple barriers against contamination of the public water supply.

CT Control Valves

The hydraulic gradient originally was such that the 48 inch pipeline did not become full of water under normal circumstances until somewhere between Eschbach Road and the community of Gleed. In 1998 a set of control valves was installed in the 48 inch main next to the Gleed Pump Station. These valves are automatically monitored and controlled from the WTP so that the pipeline between Gleed and the plant remains full and therefore provides the required CT time. If the CT control valves were to fail, one of the operators would drive to Gleed adjust valves by hand and observe the pressure reading locally to ensure the proper valve settings.

Residuals Handling Facilities

The water treatment process removes particles from the water through some settling in the contact basins and capture in the filter media. The residuals handling facility consists of lagoons with individually actuated inlets, recycle pumps and piping, and filter-to-waste pumps and piping. Pumps are located in the pump control building constructed in 2014, and located west of the filters. Mechanical components of the system include the pumps and valves, while structural components consist of the lagoons and pipe. To aid in settling and drying of solids produced during the backwash process, an anionic polymer is added to the backwash waste stream with the use of a Fluid Dynamics polymer mixing system. A list of specific components and their associated functions is provided in Table 6-6.

Table 6-6. Residuals Handling Facilities Components and Failure Criteria

Components	Component Materials / Sizing	Function	Failure Criteria [1]	Primary Failure Consequence
Lagoon Recycle Pumps	200 - 1600 gpm pump (WTP266)	Recycles clarified water to the water treatment plant process	Critical	Overflow
Filter-to-waste Pumps	Max. 3800 gpm each	Sends Filter-to-waste water to lagoons	Critical	Overflow
Lagoon Level Transmitter	Ultrasonic transmitter (WTP060)	Provides lagoon level signal to SCADA system for control of Lagoon Recycle Pumps	Critical	Manual operation or overflow
4 Lagoons	500,000-gallon, each	Clarifies filter waste washwater; stores and thickens solids	Vital	Backwash not possible
Inlet Pipe	42-inch diameter concrete pipe	Conveys waste streams to lagoon	Vital	Backwash not possible
Recycle piping	16-in – 12-in	Conveys clarified water to the raw water influent	Vital	Backwash not possible
Filter-to-waste Piping	18-in	Conveys Filter-to-waste water to lagoons	Vital	Backwash not possible
Inlet Valves	30-inch sluice gate	Distributes waste stream flow into the lagoons	Critical	Lagoon isolation not possible
Waste Polymer System	5.7 gpd peristaltic pump and 50 gallon polymer mix tank	Addition of anionic polymer to backwash waste stream to aid in settling and drying	Critical	Manual addition of polymer during backwash

Notes:
1. Critical = Failure causes problems but plant operation is possible. Vital = Failure requires plant shutdown.

Chemical Feed Systems

The WTP has seven chemical feed systems that are utilized in the water treatment process, each with specific treatment objectives. Five of the systems feed liquid chemical using peristaltic chemical metering pumps. The on-site sodium hypochlorite generation system uses salt, water, and electricity to generate liquid sodium hypochlorite that is then fed from bulk storage tanks via peristaltic chemical metering pumps. The powdered activated carbon (PAC) feed system uses a dry volumetric feeder.

Five of the chemical feed systems were constructed in 2004 as part of the Chemical and Filter Gallery Upgrade Project, including the primary coagulant, coagulant aid polymer, filter aid polymer, caustic soda, and on-site sodium hypochlorite generation feed systems. The fluoride and PAC systems predate the 2004 improvements. The seven chemical feed systems, associated treatment goals, and failure criteria are outlined in Table 6-7.

Table 6-7. Chemical Systems, Treatment Goals, and Failure Criteria

Chemical	Form	Treatment Goal	Failure Criteria [1]	Primary Failure Consequences
Primary Coagulant (ACH or Alum)	Liquid	Suspended solids removal	Vital	Plant shutdown [2]
Coagulant Aid Polymer	Liquid	Suspended solids removal	Critical	Increased potential for filter breakthrough
Caustic Soda	Liquid	Finished water pH adjustment	Critical	Increased potential for metal corrosion and shut down of fluoride feed
Filter Aid Polymer	Liquid	Floc stabilizer	Vital	Increased potential for filter breakthrough
Fluoride	Liquid	Dental protection	Critical	Decreased level of dental health protection
Sodium Hypochlorite	Liquid Generated On-Site	Disinfection of bacterial/viral/protozoan microbes	Vital	Plant shutdown [2,3]
Powdered Activated Carbon (PAC)	Dry	Taste and odor reduction	Critical	Increased possibility of T&O complaints [4]

Notes:
1. Critical: Failure causes problems but plant operation is possible. Vital: Failure requires plant shutdown.
2. Redundancy in primary coagulant and chlorine systems requires multiple failures before plant shutdown is necessary.
3. See Sodium Hypochlorite subsection for description of emergency feed system.
4. Provided taste and odor compounds are present.

6.4.2 Transmission Mains

Description

The transmission mains are pre-tensioned concrete cylinder pipe and range in size from 54-inch to 30-inch with lengths as follows:

54-inch = 3,500 LF

48-inch = 45,100 LF

30-inch = 3,300 LF

These mains were installed during the period of 1968-1972. Water flows through these pipelines utilizing the force of gravity only. No pumps are required to aid the movement of water. The 54-inch transmission main moves water from the Naches River Raw Water Intake Structure to the WTP.

The 48-inch transmission main moves water from the WTP to the City of Yakima's domestic water distribution system.

The 30-inch transmission main moves water between the equalizing reservoir at 40th Avenue and Englewood (1st Level Reservoir) and the 48-inch transmission main.

Transmission Main Operating Modes and Alternatives

The function of the transmission facilities is to transport large quantities of water from the source to the point of treatment and disinfection (WTP) and from this point to the City's distribution system.

The 48-inch transmission main has outlets installed along its length at intervals of approximately every 1,000 feet. Connections to this main can be accomplished through the use of an existing outlet or by direct tap.

The 48-inch pipeline follows Highway SR-12 from the WTP about 5 miles south to where it crosses the Naches River. In 2011, two 36-inch valves were installed on the transmission pipe, one on each side of the Naches River crossing. At each valve is a 24-inch tee and valve assembly. In the event of the transmission pipe being damaged at the river crossing, the tees and valves allow for the installation of an emergency bypass of the river crossing by utilizing the existing abandoned railroad bridge (now converted to non-motorized, multi-use path) adjacent to the transmission main's alignment.

After the river crossing, the main continues to 40th Avenue where it turns south on 40th Avenue to Powerhouse Road. The main turns and runs along Powerhouse Road to Englewood Avenue at the intersection of Powerhouse Road and Englewood Avenue. At the intersection of 40th Avenue and Englewood Avenue is the 1st Level Reservoir. This reservoir is connected to the 48-inch pipeline via a 30-inch pipeline running along Englewood Avenue. After the Powerhouse Road and Englewood Avenue intersection, the 48-inch main continues east along Englewood Avenue to the intersection of 16th Avenue and Cherry Avenue where the 48-inch pipeline terminates with several distribution pipelines radiating out from this terminus.

Should the transmission facility cease to function between the source and 40th Avenue, then this loss will be treated as a loss of supply. Should the break occur between 40th Avenue and 16th Avenue, then the damaged section will need to be isolated until repairs or replacement can be accomplished.

Detailed procedures and alternatives for handling a transmission line failure are included in the Emergency Operations Guidelines (Appendix R).

6.4.3 Distribution and Storage Systems

The City's distribution system is adjacent to several water systems, but the only interties are with the Nob Hill Water Association. Nob Hill Water interties are located in the 3rd Level pressure zone at the intersection of 56th Avenue and Lincoln Avenue and within the 1st Level pressure zone at South 32nd Ave. and Ahtanum Road.

The distribution pipelines are 4 to 24 inches in diameter. The pipe materials are mainly cast iron, with ductile iron being used since the early 1970's. There are several steel pipelines and many unlined cast iron pipelines remaining in the system.

The City's existing storage capacity is 32 million gallons (MG) distributed among five reservoirs within the three pressure zones. Each pressure zone has an established hydraulic elevation. This elevation is maintained by the distribution reservoir(s) located in each of the pressure zones. Information on the reservoir sizes, materials of construction, and elevations are provided in Chapter 1.

Distribution and Storage Systems Operating Modes and Alternatives

The function of the distribution system is to deliver potable water to the service connections and fire hydrants.

The function of the storage reservoirs is to provide: 1) standby water storage for emergencies and short-term interruptions of source of supply; 2) additional source of water for fire protection purposes; 3) equalizing water for changes in water demands within the system.

Distribution pipelines branch off from the transmission mains, conveying water to the three pressure zones – 1st, 2nd, and 3rd Levels. Gravity alone provides adequate pressure to serve water to the 1st Level zone. Booster pump stations push the water up to the reservoirs in the 2nd and 3rd Level zones, and pressure-reducing valves (PRV's) regulate water flows back from the 3rd to 2nd and 2nd to 1st Level zones when necessary. Normally closed valves and three PRV stations may be operated to move water from the 3rd Level zone to the 2nd Level zone. Conversely, portions of the 3rd Level zone could be served (at lower pressure) from the 2nd Level zone through operation of these normally closed valves and existing check valves.

The 1st Level Reservoir is utilized as an equalizing reservoir for the entire water system. The flow at the WTP is adjusted based upon levels in this reservoir. Any water not consumed by the 1st Level zone through customer demand, or by pumping to the 2nd and 3rd Level zones, is stored here.

Should the distribution system cease to function in specific areas, these areas may be isolated by closing valves to sections as needed based on the distribution grid system in the affected area.

Should the entire distribution system fail to provide its function, then water would necessarily have to be hand carried or transported by vehicles. No fire protection would be available from the system. Fire Department tankers would have to be utilized for fighting fires.

Potable water would need to be made available at distribution points throughout the system. The Yakima Firing Center, the National Guard, and private carriers may be pressed into service in an emergency. Fire stations, City parks, and other City property make good points of distribution of potable water. City residents would be notified of these distribution points and instructed to bring containers to receive their allotment of water.

The source of water for supplying the distribution points could be the Kiwanis Park and Airport artesian wells if flowing. Additionally, potable water could be purchased from any adjacent purveyors that would still have a safe plentiful supply.

Should the storage reservoirs cease to function, the system's ability to meet all demands would become undependable. Some fire fighting capability might be retained, but not to normal standards. The interties with Nob Hill Water Association could be utilized to place their reservoirs into shared operation.

The reservoirs could be isolated and water supply pumped directly into the system from the wells or by the gravity from the WTP. The 48-inch transmission main could act as a reservoir during an emergency. During extended emergencies portable storage reservoirs or temporary reservoirs could be utilized to accomplish the same function as a storage reservoir.

Detailed procedures and alternatives for handling a distribution and storage system failure are included in the Emergency Operations Guidelines (Appendix R).

Distribution and Storage System Routine Operation and Maintenance

Routine operation of the distribution system consists of operating line valves and manually opening and closing interties (when needed). Hydrants are tested annually.

The levels in the five storage reservoirs are controlled by the SCADA system. The levels in the system's reservoirs are continuously monitored by telemetry and recorded on 7-day charts and in the history files of the City's computer system.

6.4.4 Booster Pump Stations

There are four booster pump stations: 3rd Level, 40th Avenue, Gleed, and Stone Church. Information on these pump stations (location, pumps, elevation) are provided in Chapter 1.

Booster Pump Stations Operating Modes and Alternatives

The booster pump stations provide water to the 2nd and 3rd Level zones, as shown in the hydraulic profile. The 40th Avenue and Stone Church pumps are operated in a variety of lead lag positions depending on the demand and the season. The difference in water demands is due to an irrigation demand in the 2nd and 3rd Level zones. These pumps are controlled by the 2nd Level zone's two reservoir levels through the radio telemetry system.

The 3rd Level pumping station is only capable of operating one of the 125 HP pumps at a time. This is due to the size of the electrical service available when the facility was constructed. The two 125 HP pumps are alternated with one placed in a standby role, while the other is being used and with the 40 HP pump placed in the lag position. The smaller 40 HP pump is placed in the lead during low demand times. This station's pumps are controlled by the water levels in the 3rd Level zone’s two reservoirs through the radio telemetry system.

The Gleed pumping station is operated by utilizing the two 5 HP pumps to meet domestic water demands and the 125 HP pump for fire flow demands. This station's pumps are controlled by pressure sensing controls and a hydropneumatic tank.

- At 55 psi the lead pump will start and run until pressure builds to 75 psi.
- Should the pressure continue to drop after the lead pump starts then at 50 psi the backup pump starts. This pump shuts off at 70 psi.
- Should the first two pumps be unable to supply sufficient pressure, at 30 psi the 125 HP pump will start and run until it has run at 90 psi for 12 minutes before shutting off.
- A pressure relief valve is located in the manifold system and allows the bypass of water back into the 48 inch transmission main of any water in excess of 100 psi.

Should the 40th Avenue and Stone Church pump stations cease to function, the stored supply in the 2nd Level Reservoirs may be utilized for a limited time to supply demand. If additional water supply is needed to meet the demands, the Nob Hill Water Association may also be contacted to furnish a source of water through the emergency intertie in the 2nd and 3rd Level zones. Should the 40th Avenue or Stone Church Pump Stations cease to function because of an electrical power outage, a portable electrical generator might be used to restore electrical power to the 40th Avenue Pump Station. Chapter 3 identifies an improvement project to install a new VFD for the largest pump at the station to provide for improved system operation for the 2nd Level zone should the 2nd Level Reservoirs and 40th Avenue Pump Station become isolated from the system due to a main break or other system failure.

Should the 3rd Level Pump Station cease to function, the available supply in the 3rd Level Reservoirs may be utilized for a limited time to supply demand. If additional water supply is needed to meet demands, the Nob Hill Water Association may be contacted to furnish a source of water through the emergency intertie at 56th Avenue and Lincoln Avenue. Should the 3rd Level Pump Station cease to function because of an electrical power outage, the electrical generator should be used to restore electrical power to the site.

Should the Gleed Pump Station cease to function, the customers are without a water supply at adequate pressure (greater than 30 psi). However, as long as the 1st Level Reservoir is capable of maintaining at least a minimum level, there is a positive pressure at Gleed. Currently, there are less than thirty customers served by this pump station and one school (school will be decommissioned in 2017). Storage will need to be installed before more customers can be added to the Gleed system. Water supply for domestic purposes would continue to be available at low pressure (10-15 psi). A local carrier with a food grade tanker may be filled with water and connected to the fire hydrant near the Naches Primary School to supply the Gleed System. The Gleed Fire Department will be notified immediately if the station is to be out of service for any length of time. This rural department has the capability of fighting fires without adequate water supplies available close at hand through use of tanker trucks and can dispatch additional tanker units if necessary.

Detailed procedures and alternatives for handling a booster pump system failure are included in the Emergency Operations Guidelines (Appendix R).

Booster Pump Station Routine Operation and Maintenance

The four pump stations are controlled by the SCADA system, but are visited three times per week to check building temperature and pump operation.

6.4.5 Pressure Reducing Valve (PRV) Stations

The PRV stations are listed in Table 1-3 in Chapter 1, indicating the location, size, pressure settings, the zone that is served and some additional information.

PRV Operating Modes and Alternatives

Control of water flow between the 2nd and 1st Level pressure zones is provided by the PRV's located throughout the distribution system. These control valves are set to open and close at various hydraulic elevations depending on the intended purpose of the valve (continual supply or emergency only).

The normal use of the City's PRV's is to provide additional water flow for emergency purposes. The reduction of pressure in the 1st Level zone under emergency conditions because of a fire flow or other large water demand will cause the hydraulic elevation to decrease. This reduction in hydraulic elevation will cause the normally closed hydraulically actuated valves to open and provide additional flow into the 1st Level zone.

Should the PRV stations cease to function, the valves may be manually operated either open or closed.

The effects of the PRV stations having failed are: 1) Water movement between zones which will result in losses and increases in water pressure in the distribution system, if failure is in the open position. 2) Inadequate water flows during an emergency or other high demand situations, should the valve fail in the closed position.

Detailed procedures and alternatives for handling a PRV failure are included in the Emergency Operations Guidelines (Appendix R).

PRV Routine Maintenance

The PRVs are checked and tested on a quarterly basis.

6.4.6 Wells

The four wells are visited at least twice each day when in operation, but are also monitored by the SCADA System. Operational procedures include checking the chlorination equipment, fluoride equipment (only installed at Gardner Park Well), reading the flowmeter, and checking the building's temperature, motor amperage, well drawdown, and the hour meters on the motors. Currently, the wells are started and stopped locally.

Additional information regarding procedures and alternatives for well operation in the event of a loss of supply or water shortage are included in the Emergency Operations Guidelines (Appendix R).

Two of the wells, Kissel Park and Gardner Park, are used in ASR activities where water is both injected and recovered from the aquifer. Standard operating procedures regarding ASR activities are included in Appendix Q.

6.4.7 Preventive Maintenance Program

Preventive maintenance consists of regularly servicing pumps and motors, exercising valves and hydrants, cleaning reservoirs, and flushing dead-end lines and other pipelines. These activities are performed on a priority basis, with service for pumps, motors, and meters being the highest priority.

The City currently implements the Cayenta maintenance management system. The system includes information about all of the City's facilities and equipment and is used to automate the existing preventive maintenance program.

Cayenta consists of a number of modules that track and control purchasing, budgeting, and maintenance. A complete description of the Cayenta modules and their components is included in Section 6.11 of this Water System Plan Update.

6.4.8 Chemicals, Equipment, and Supplies

The utility maintains an inventory of equipment, such as vehicles, portable pumps, and backhoes, for servicing the water system. The utility also keeps a stock of regularly used supplies and chemicals. In addition to the materials and supplies maintained at the service yard, the utility maintains three completely equipped service trucks with the tools and equipment normally required for system operation and maintenance.

Table 6-8 and Table 6-9 list the equipment and materials, respectively, which are maintained by the utility. Suppliers used by the utility for pipe materials and pump service are shown in Table 6-11.

Table 6-8. Water Division Equipment Listing

Description	Number	Fuel Type	Location
Backhoe/Loaders	3	Diesel	City Shops Complex
Boom Truck	1	Diesel	City Shops Complex
Service Vans	3	Diesel	City Shops Complex
4WD Pickup Truck	2	Gas	Water Treatment Plant
4WD Pickup Truck	3	Gas	City Shops Complex
Valve Trucks	1	Gas	City Shops Complex
Valve/Vacuum Trailers	2	Gas	City Shops Complex
5 Yd. Dump Truck	1	Diesel	City Shops Complex
10 Yd. Dump Truck	2	Diesel	City Shops Complex
Staff Car	1	Gas	City Shops Complex
Air Compressor	2	Diesel	City Shops Complex
Compact Pickup Truck	2	Gas	City Shops Complex

Table 6-9. Materials on Hand

Item	Size and Material Type
Pipe	4-, 6-, 8-, 12-, and 16-inch DI
Service Lines and Fittings	3/4 to 6 inch
Repair Bands	Full circle stainless steel for all above sizes
Couplers	Romac for all above sizes
Valves	3 to 6 inch Gate Valves 6 to 12 inch tapping valves 8 to 16 inch Butterfly Valves
Hydrants	4 to 6 foot bury
Reducers	Miscellaneous for above sizes
Tees	Miscellaneous for above sizes
Treatment Plant Chemicals	Aluminum Chlorohydrate (ACH) Calcium Hypochlorite Sodium Hypochlorite Polymers Activated carbon Caustic Soda Fluoride
Treatment Plant Equipment	Spare PLC Spare PLC cards Spare Telemetry Radio Sump Pumps Surface Wash Nozzles

Table 6-10. Support agencies/organizations for Materials and Services

Organization	Address	Name	Telephone	Available Resources	Required Authorization
TTC Construction	2206 Jerome Ave.	AJ Heckart	509-457-3969 509-945-6749	Debris removal Large excavation equipment	Emergency PO
Picatti Bros.	105 S. 3rd Ave.	N/A	509-248-2540	Motor and pump repair	Emergency PO
Russell Crane Service	505 Locust		509-457-6341	Debris removal	Emergency PO
Ken Leingang Excavating	1117 N. 27th Ave.	Daren Leingang	509-575-5507	Large excavation equipment	Emergency PO
MBI	2016 Fruitvale		509-426-5347	Electrician	Emergency PO
Knobels Electric	801 E Tennant Ln		509-452-9157	Electrician	Emergency PO
H D Fowler	100 River Rd.		509-248-8400	Pipe and appurtenances	Emergency PO
Montgomery Irrigation	1901 S. 13th St.		509-248-9046	Pumps and appurtenances	Emergency PO
Nob Hill Water	6111 Tieton Drive	Zella West or Dave England	509-966-0272	Manpower and equipment	N/A
SECO Rental	515 S. 5th Avenue	N/A	509-248-7900	Pumps and construction equipment	Emergency PO
Washington Department of Fish & Wildlife Screen Shop	3705 W. Washington	Shop Person	509-575-2733	Temporary Fish Screens	Emergency PO
LTI, Inc.	123 Alexander Rd. Sunnyside, WA		800-422-5993	Tank Trucks	Emergency PO

6.5 Water Monitoring and Sampling

Raw water, process water, and finished water are all monitored at the WTP. Data is collected for purposes of historical benchmarking, process control, and regulatory requirements. The primary objective for monitoring is to control processes so a safe finished water is produced. Water quality monitoring is critical to plant operation because water quality characteristics of the Naches River can change rapidly.

The DOH holds regulatory primacy, that is, the right to enforce and monitor compliance of all public water systems in the State. Each month, the State receives water quality data from the WTP and private/state labs contracted by the City of Yakima. Water quality standards enacted by the State are at least as stringent as federal mandated standards.

State and federal regulations provide instructions regarding sample collection and analysis methods. Water quality monitoring and sample collection at the WTP is conducted for process control (Table 6-11) as well as regulatory reporting requirements

(see Chapter 3). All process control parameters are monitored using on-line instruments tied into the SCADA system.

The requirements for development of inorganic monitoring plans are described in WAC 246-290-300 (3f). Organic chemical monitoring plan requirements are described in WAC 246-290-300 (7e). Copies of the current monitoring plans are included in Appendix sections as listed below:

Appendix M	Coliform Monitoring Plan
Appendix J	Inorganic Chemicals Monitoring Plan
Appendix K	Organic Chemicals Monitoring Plan
Appendix L	Stage 2 Disinfectant/Disinfectant By-Products Monitoring Plan
Appendix N	Continuous and Miscellaneous Monitoring Plan

Table 6-11. Automated Water Sampling and Monitoring for the WTP

Process Stream	Sampling Location	Water Quality Parameter	EPA Testing Method	"Standard Methods"[3] Testing Method
Raw water	Raw water pipeline	Turbidity	180.1	2130
Raw water	Raw water pipeline	pH	150.1	4500 - H^+
Filtered water[1]	Filter effluent pipe[4]	Turbidity	180.1	2130
Filtered water[2]	Filter effluent conduit[5]	Turbidity	180.1	2130
Filtered water[1]	Filter effluent pipe[4]	Free Cl_2	330.5	4500 - Cl
Finished water	Filter effluent conduit[5]	Free Cl_2	330.5	4500 - Cl
Finished water	Filter effluent conduit[5]	Fluoride	9214	4500 - F^-
Finished water	Gleed Pump Station	Free Cl_2	330.5	4500 - Cl
Finished water	Gleed Pump Station	pH	150.1	4500 - H^+
Finished water	Gleed Pump Station	Fluoride	9214	4500 - F^-

1. Individual filter effluent
2. Combined filter effluent
3. *Standard Methods for the Examination of Water and Wastewater,* 20th Edition, 1998, Clesceri, L., Greenberg, A., Eaton, A., American Public Health Association.
4. Sample tap located at the coagulation control center.
5. Sample tap located at the water quality lab sink.

The Gleed pump station, downstream of the water treatment plant, contains automated instrumentation to measure pH, temperature, pressure, free chlorine, and fluoride. These data are transmitted to the WTP via telemetry. "CT" calculations for the finished water are made based upon the water quality data collected at Gleed pump station and as described further in Section 9 of the *Naches River Water Treatment Plant Operation and Maintenance Manual* on "Disinfection". There are no service connections between the plant and Gleed pump station. By the time finished water has reached Gleed pump station, chemicals have been thoroughly mixed so that an accurate measurement of residual chlorine and fluoride can be made.

Water quality parameters are submitted to DOH on a monthly basis. Some parameters are measured at the water quality lab inside the WTP, and some are measured at outside

certified labs. Samples are collected from dedicated sample taps at the WTP, the four wells, and additional locations in the distribution system.

Various other process related parameters are included in the monthly reports submitted to DOH in addition to water quality data. Such information is collected daily and includes:

- Plant production volume (gallons);
- Production time (hours);
- Washwater usage (gallons); and
- Usage of Aluminum Chlorohydrate (ACH), alum, sodium hypochlorite, coagulant aid polymer, filter aid polymer, caustic soda, and fluoride (pounds).

The four wells (Airport, Kiwanis Park, Kissel Park, and Gardner Park) report production volume, production time, and chlorine usage; while Gardner Park also reports fluoride use.

State required reports are submitted electronically once a month. Two copies are retained at the WTP; each copy resides on separate computer system. Data on each of the computer systems is backed up once per month. These backups are stored in a separate room from the computers.

6.5.1 Surface Water Treatment Rule Monitoring Requirements

The SWTR requires special monitoring and reporting requirements for filtered surface waters. These requirements are discussed in WAC-246-290-664, -666 and -668. In summary, monitoring and reporting are required for the following:

1. Source coliform monitoring.
2. Source turbidity monitoring.
3. Filtered water turbidity monitoring.
4. Calculation of inactivation ratio (CT monitoring).
5. Disinfectant residual must be monitored at entry to distribution system and at coliform monitoring sites.
6. The following conditions should be reported to DOH before the end of the next business day following the event:
    a. Waterborne disease outbreak
    b. Turbidity of effluent exceeds 1.0 NTU
    c. Residual disinfection concentration falls below 0.2 mg/L at entry to distribution system
    d. Emergency events that could affect water quality, such as spills of hazardous materials in watershed or treatment process failures
7. Report all SWTR monitoring results (items 1 through 5 above) within 10 days of the end of each month. Monthly reporting requirements are described in detail in WAC 246-290-666(3).
8. Watershed control programs must be developed and updated concurrently with the system's water system plan. Requirements for watershed control are detailed in WAC 246-290-668. Chapter 5 includes a contamination assessment and recommendations for a framework to develop and implement a watershed control program for the City's Naches watershed.

6.5.2 Violations Procedures

Follow-up actions for various types of MCL violations are specified in detail in WAC 246-290-320. In general, the following actions must be taken each time a primary standard violation occurs:

1. Notify the DOH in accordance with WAC 246-290-480.
2. Notify the consumers served by the system. Notification requirements for various types of MCL violations are specified in WAC 246-290-330.
3. Determine the cause of contamination.
4. Take any additional actions as directed by DOH.

If a secondary standard is exceeded, notify DOH and take action as directed by DOH.

Follow-up monitoring must be conducted when MCL violations occur. Specific requirements for follow-up monitoring are described in WAC 246-290-320(2) through (9). Bacteriological violations require repeat sampling in accordance with the City's coliform sampling plan (see Appendix M), and WAC 246-290-320(2).

In the case of contamination of the surface supply, the City can shut down the water treatment plant and use groundwater only. The wells are capable of supplying approximately 14 mgd (more than the City's current ADD of 10.5 mgd). The City also has the ability to activate interties with the Nob Hill Water Association. The City's emergency plan (Appendix R) describes procedures for accommodating a WTP shutdown as a result of inadequate finished water quality.

6.5.3 Treatment Optimization Program

In 2006, the City of Yakima Council adopted the Washington State Department of Health Treatment Optimization Standards for drinking water. These standards exceed the regular MCL's and regulations for a drinking water filtration plant. In 2012, the Naches River Water Treatment Plant received the Washington State Treatment Optimization Program (TOP) Bronze Award and in 2014 received the TOP Silver Award.

6.5.4 Coliform Monitoring Plan

The City of Yakima Water Division has developed a Coliform Monitoring Plan in accordance with the requirements of WAC 246-290-300 and the DOH guidelines presented in *Preparation of a Coliform Monitoring Plan*. The Coliform Monitoring Plan is presented in Appendix M.

6.6 Emergency Response Program

The City of Yakima Water/Irrigation Division has developed an Emergency Response Plan for its water treatment plant and distribution facilities. The complete plan is shown in Appendix R. The system is also a part of the Washington Water/Wastewater Agency Response Network (WAWARN), a network of water and wastewater systems that can provide rapid support to other systems during an emergency.

6.6.1 Emergency Call-Up List

After normal working hours, emergencies with the water system are handled through an emergency calling procedure. An updated emergency call-up list is maintained in the City's emergency plan. In the event of an emergency, a report is called in to the

Water/Irrigation Division Operations Center, which is staffed 24 hours a day. The Operations Center directs the call to the appropriate person on call.

In the event of an emergency situation involving the City's water system, the utility might need to inform the public or other services (such as medical services) immediately. Media contact is conducted by emailing bulletins or press releases to the local media representatives on file.

In addition, the following emergency contact numbers are included for reference:

- DOH Regional Engineer: Andres Cervantes 509-329-2120
- DOH Drinking Water Emergency Number (available 24/7): 1-877-481-4901
- DOH Office of Drinking Water Eastern Region (main line): 509-329-2100
- Ecology Spill Response (Washington Emergency Management Division): 1-800-258-8990
- EPA National Response Center: 1-800-424-8802
- Local Health Department (Yakima Health District): 509-575-4040
- Yakima Fire Department (non-emergency number): 509-575-6060

6.6.2 Contingency Operational Plan

Contingency plans must address the possibilities of loss or reduction of water supply, distribution system disruption, loss of telemetry, and power failure.

Sources of Supply

Water service from the major water supply source, the WTP, could be interrupted because of high turbidity runoff conditions, extended drought, contamination in the river, or blocking of the intake structure.

Should the primary water supply source cease to be available, the following alternatives may be utilized to augment or replace the water system supply needs.

- Activation of the City of Yakima's wells.
    - Failure of the water system's main supply to be available may require rationing or restriction of use of the remaining available water supplies.
    - The City of Yakima's groundwater sources have enough capacity to meet the system's average day demand. Restrictions of water use may only be necessary during periods of the year when water usage exceeds the average day demand.
- Activation of the interties with the Nob Hill Water Association.

  - Utilization of the interties with the Nob Hill Water System as a sole source of supply would require rationing. This is because the amount of water available from Nob Hill's water system is limited, especially during the peak use summer months. In addition, the hydraulic capability of the intertie piping and appurtenances is not sufficient to allow flows large enough to meet the City's needs. Ensuring adequate supply to the hospitals on Tieton Drive is of priority; therefore, isolation of parts of the system to direct intertie flows to the hospitals will need to be evaluated to ensure that their supply is adequate.

- Hauling of potable water from other safe sources.
  - Hauling of water would only be implemented in an extreme emergency when complete loss of the primary, secondary, and intertie sources of supplies has occurred.
  - Detailed procedures and alternatives for handling a loss of water supply are included in the Emergency Operations Guidelines (Appendix R).

In the event of high-turbidity conditions or a spill, the public would be notified to curtail water use for the few days necessary to clean up the spill. During drought, an emergency curtailment program would be implemented to limit overall water use to the output of the wells.

If the 48-inch transmission main between Gleed and Yakima is compromised, Gleed would be without water because the water treatment plant and 48-inch transmission main are Gleed's only source of supply and storage. If the WTP is shut down, Gleed does continue to receive water from Yakima through the 48-inch main from gravity flow from the 1st Level Reservoir. In the event that Gleed is unable to obtain water from the transmission main, WTP staff would contract potable tanker trucks to supply water to Gleed through the Gleed pump station.

Distribution system

The distribution system in general has adequate redundant piping to continue to provide service in case of disruption of service as the result of a main break or sabotage. In addition, each of the pressure zones can be served from the adjacent pressure zone in case of emergency by using PRVs, booster pump stations, and the emergency interties with Nob Hill Water Association.

Loss of Telemetry System

Another concern is the potential for loss of the radio-based telemetry system due to equipment failure or power interruption. When the telemetry system is not operational, the booster pump stations and wells can be operated manually and would require that the reservoir levels be monitored visually.

Power Failure

Loss of power has historically not been a serious concern to the water utility because power is nearly always restored within a few hours. The water system has enough reservoir storage to supply demands for the duration of the power outage, and water can be moved from the 3rd Level zone to the rest of the system by gravity. The WTP, Stone Church Pump Station and the 3rd Level Pump Station have standby generators which enables these facilities to remain operation even under extended periods of outage. If a power failure affecting the distribution system is of extended duration, portable generators could be obtained from the Yakima Training Center or Washington State National Guard.

6.7 Safety Procedures

The City of Yakima Water/Irrigation Division practices a safety program to ensure the health and welfare of water system personnel. All appropriate Occupational Safety and Health administration (OSHA) and Washington Industrial Safety and Health Administration (WISHA) regulations are followed during operation of the system. Maintenance and operation personnel are trained in safety practices, including confined space, asbestos handling, first-aid, fall restraint, and chlorine safety training. Specific safety considerations for the City of Yakima water system are provided in the following sections.

6.7.1 Confined Space

Some of the water treatment plant and distribution system valves and other system components are located in vaults or other confined spaces. All water system personnel are trained in confined space safety and the City maintains and operates the required safety equipment (blower, sniffer, tri-pod and harness) necessary to mitigate the dangers associated with confined space.

6.7.2 Asbestos Handling

Water/Irrigation Division personnel have been trained on the proper methods for repair and disposal of AC pipe in compliance with OSHA standards. General procedures for handling of AC pipe include:

- Notification of the local clean air authority in advance of work if possible.
- Use of protective garments.
- Wetting of area to be serviced throughout the maintenance work to minimize dust.
- Cleaning debris off of tools with wet disposable towels.
- Placing of towels, scraps, parts, and garments into disposable bag for transportation to nearest landfill.

It should be noted that the City of Yakima has only a small amount of asbestos-cement pipe left in the system with the ultimate goal of eventually eliminating all remaining pipe made of this material.

6.7.3 Fall Restraint

The City's elevated reservoirs (the two 3rd Level Reservoirs) are equipped with safety-climb structures that mitigate the threat of falling to Water/Irrigation Division personnel. Appropriate harness-type fall gear is used whenever inspecting reservoir roofs and interiors.

6.7.4 Hazardous Chemicals

The water treatment plant currently uses on-site generation of sodium hypochlorite for disinfection while the chlorination systems at the wells use calcium hypochlorite tablet systems. Operating staff have had training on handling of the disinfection chemicals.

A hazardous chemical used at the water treatment plant is fluoride in the form of hydrofluosilicic acid. This highly corrosive and toxic chemical is located is a separate building. The acid is stored in a high density polyethylene tank with secondary containment for the entire tank volume. As in the case of chlorine, the operating staff has

special training and education to mitigate the potential dangers associated with the handling and use of hydrofluosilicic acid.

The Safety Data Sheets (SDS) for these chemical are maintained at the place of use (the WTP and the Water/Irrigation Division Office/Shop facilities).

6.8 Sanitary Survey

As part of the Groundwater Rule, all Group A water systems with groundwater sources are required to complete routine sanitary surveys of the system every three to five years. The survey evaluates the critical elements of the water system and its operation including:

- Planning and management documents.
- Distribution system and status of cross-connection control program.
- Source and sanitary control area.
- Source pumps and pumping facilities.
- Source treatment procedures and equipment.
- Monitoring, reporting, and data verification.
- Finished water storage.
- Operator certification status.

In the State of Washington, sanitary surveys are administered by DOH. The last sanitary survey for the City was conducted in October 2014 with the letter of finding received from DOH in December, 2014. The survey examined the groundwater and surface water sources, and the storage reservoirs. A copy of the latest sanitary survey and its findings is in Appendix U.

The only deficiency found by the survey was at the Kissel Park Well where it was improperly sealed during a well repair project. After the deficiency was identified during the field inspection, the City resolved the issue by properly covering the well during the remainder of the well repair project.

6.9 Cross-Connection Control Program

Section 7.68.070 of the Yakima Municipal Code, titled *Cross connection control,* requires that, no water service shall be installed or continued in use by the purveyor unless the water supply is protected by backflow prevention devices as may be required by this section. The complete text of Chapter 7.68 of the Municipal Code, including Section 7.68.070, is included in this plan as Appendix E. This section of the code, as adopted by Ordinance No. 3078, implements WAC 246-290-490 which establishes cross connection control requirements for all community water systems within the State of Washington.

Section 7.68.070 requires that the policies, procedures, and criteria for determining appropriate levels of protection shall be in accordance with the "Accepted Procedure and Practice in Cross Connection Control Manual--Pacific Northwest Section--American Waterworks Association, Third Edition," or any superseding edition. This manual is incorporated by reference into this water system plan update. A copy of the latest Cross Connection Control Annual Report is included in this plan as Appendix V.

6.10 Customer Complaint Response Program

All water service related complaints are handled through the Water/Irrigation Division office which can be reached at (509) 576-6477. This number is also forwarded to the WTP at night and on weekends to serve as the Night and Weekend Emergency telephone number to report problems and complaints after normal working hours. The nature of the complaint is determined and the appropriate personnel are notified.

- Problems with billing or service shut-off are referred to Customer Service/Utility Billing at (509) 575-6080.
- Problems with distribution leaks, low pressure, flooding, and similar are referred to the Distribution Supervisor, or the stand-by assignee at (509) 728-2356.
- Quality complaints are referred to the Water Quality Specialist at (509) 576-6477, who then investigates the complaint and determines causes and remedies.

The Distribution Supervisor and the Water Quality Specialist are responsible for creating work orders in Cayenta, the City's computerized maintenance management system, and may also employ spreadsheet or database software to record incidents, activities, and costs. In Cayenta, the complaints are assigned a work order number which can then be tracked.

6.11 Recordkeeping and Reporting

The City implements a maintenance management system through the use of the program Cayenta. This program includes information about all of the City's facilities and equipment as well as recordkeeping and reporting.

Cayenta consists of number of modules that track and control purchasing and maintenance.

- Purchasing Module
  - Generates purchase orders
  - Tracks purchases of materials, equipment and services
  - Tracks costs
- Stores Module
  - Generates requisitions for materials, equipment and services
  - Tracks inventory of materials and equipment
  - Issues materials, equipment and services to "Work Orders"
  - Receipts materials, equipment and services from purchase orders
  - Generates requisitions for materials and services based on inventory levels and/or requisitions from "Work Orders"
- Maintenance Module
  - Assigns a unique number to each piece of equipment
  - Generates work orders for all work
  - Generates preventive maintenance work orders based on input schedule
  - Tracks all work

- Tracks all materials, equipment and services used
- Tracks labor hours and costs

- Project Module
  - Tracks special projects including Capital Improvements

In addition to the Cayenta recordkeeping and tracking program, the SCADA system software at the WTP provides for collection and storage of all of the water system process monitoring and control data.

6.12 O & M Manual

As previously noted, a detailed Operation and Maintenance Manual for the Water System components has been prepared. This manual should be referred to for detailed descriptions of all operation and maintenance procedures.

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7 Distribution Facilities Design and Construction Standards

7.1 General

The objective of this chapter is to describe and provide design and construction standards for water system distribution facilities to enable the City of Yakima Water/Irrigation Division to utilize an alternative approval process (discussed in Section 7.2) for Washington State Department of Health (DOH) project approvals. By obtaining advance approval of design and construction standards (i.e., performance standards, sizing criteria, and construction materials and methods) along with an approved water system plan, water purveyors do not need to obtain written DOH approval of individual project reports and construction documents for distribution mains and other miscellaneous distribution-related components (valves, fittings, backflow assemblies, hydrants, etc.). The purveyor must still comply with all applicable sections of the regulations, including project report and construction document requirements listed under WAC 246-290-110 and -120, whether or not documents are submitted individually to DOH for approval.

Distribution-related projects related to distribution reservoirs/storage tanks, booster pump facilities, transmission mains, pipe linings, tank coatings, source of supply, and water quality treatment projects are not eligible under this alternative review process per the design standards developed by the City. Such projects must be submitted to DOH for review and approval prior to construction. Source of supply projects refer to all work involving the development of a new source, redevelopment of an existing source at the wellhead, interties, and/or any project that would result in source capacity changes (i.e., either increased or decreased source production capability). Design and construction standards must be based on DOH design guidance or other documents generally accepted by engineering professionals as containing fundamental criteria for design and construction of water utility projects. The water system standards must be at least as stringent as those discussed in Chapter 246-290 WAC and should not deviate from DOH design guidance unless adequately justified. Justification must include other acceptable industry standards, such as those referenced in WAC 246-290-200.

This chapter addresses the following elements related to water system distribution facilities design and construction:

- Project Review Procedures;
- Policies and Requirements for Outside Parties;
- Design Standards;
- Construction Standards; and
- Construction Certification and Follow-up Procedures.

The information contained here should be useful to a design engineer to prepare detailed construction plans and specifications. Additional guidance is available from DOH on project report and construction document review.

7.2 Project Review Procedures

It is City of Yakima policy that all improvements installed as public facilities or in the public right of way to be shown on engineering design plans, reviewed by the

Engineering Division, and approved by the City Engineer prior to commencing any construction. The engineering design plans must be stamped, signed, and dated by a professional civil engineer licensed in the State of Washington. The plans must include all of the applicable requirements outlined below.

At completion of construction, a set of reproducible record drawings depicting all facilities as constructed shall be submitted to the City Engineer, together with a construction cost summary for all public utilities and a transfer of ownership for all facilities.

The purpose of this procedure is to outline the information that must be shown on all plans in order for the Engineering Division to properly review the design. This shall apply to all projects within the City's jurisdiction including water system extensions and other water system improvement projects.

A detailed outline of the plan submittal requirements is available from the Utilities and Engineering Department upon request. A copy of this document titled "*City of Yakima: Procedures Manual for Construction of Public Improvement Projects Under Private Contracts*", is included in Appendix W.

The City's Engineering Design Requirements also include by reference, DOH's Water System Design Manual (2009, or latest edition).

7.3 Policies and Requirements for Outside Parties

Yakima Municipal Code *Title 12 – Development Standards* establishes requirements and standards for the design and construction of public works improvements by private applicants in conjunction with subdivision or development of real property, and establishes fees for the City Engineer's review of design documents for and inspection of the public works improvements. *Chapter 12.04 Water* addresses the specific requirements applicable to the extension of municipal water service to the development.

Specific requirements of Chapter 12.04 include:

12.04.020 Water line extension required.

Water lines shall be extended to the point where the adjoining property owner's responsibility for further extension begins. This typically requires extension across the street or easement frontage of the developing property. In some cases it will require dedication of an easement and a line extension across the property or extension along two or more sides of the developing property. Extensions will be consistent with and implement the City's adopted water system plan.

12.04.030 Looping required.

All water lines shall be looped. Temporary dead-end water lines may be permitted based upon an agreement between the developer and the City with provisions for timely completion of looping.

12.04.040 Minimum size and material standards.

New water lines in the City of Yakima water system shall be constructed of Class 52 ductile iron and shall be a minimum of eight inches in diameter. Improvements and additions to the Nob Hill Water Company system shall conform to the requirements of Nob Hill Water Association.

In addition, the City has published the following documents, which also apply to developer water service extensions:

- Specifications for Private Construction of Public Water Mains for City of Yakima (2017, or latest edition) (see Appendix X)

- City of Yakima: Procedures Manual for Construction of Public Improvement Projects Under Private Contracts (2013, or latest edition) (see Appendix W)

Both of these documents are available upon request from the City's Engineering Division, and are also included in this plan's appendices.

The above procedures manual also includes the necessary forms and checklist that are to be completed for each project. These include the following:

- Application for Private Development (Owner/Developer)
- Public Improvement Procedure Checklist (Owner/Developer)
- Permit to Construct Public Improvements (City)
- Consultant Retained for Services Letter (Owner/Developer)
- Notice of Substantial Completion (Owner/Developer)
- Correction Notice (City)
- Affidavit of Release of Liens and Claims (Owner/Developer)
- Final Acceptance (City)
- Transfer of Ownership (Owner/Developer)

7.4 Design Standards, Performance Standards, and Sizing Criteria

The criteria and standards are based, in some cases, on regulatory requirements and, in other cases, on the City's policy for service. The two sources for standards are the Insurance Services Office (ISO) and DOH.

7.4.1 Supply

Pump station capacities must be adequate to provide peak-hour demands and fire-flow demands when pumping to a closed system (a pressure zone without storage). For an open system (pressure zone with storage), the capacity of the pump station(s) serving the open system must be adequate to provide the maximum day demand as discussed in Section 3.2.1. All pump stations require a minimum of two pumps for flexible operation. The total capacity of the pumps in a given pump station should generally be 25 to 50 percent greater than the calculated required capacity of the pump station, allowing a pump to be repaired without reducing supply capability.

To increase emergency reliability, at least one pump in each pump station should be equipped with auxiliary power, which would include a diesel generator, a natural gas engine, or an auxiliary hookup so that it can be run from a portable generator to supplement the standard electric motor drive. In this way, some emergency supply capacity is available even if a general power outage occurs. A similar degree of reliability could be provided if the pressure zone is served by a second pump station, provided the second pump station is on a separate power distribution grid.

7.4.2 Storage

The design of storage requirements is discussed in Section 3.2.2

7.4.3 Distribution

The design of distribution requirements (minimum system pressure, minimum pipe size, telemetry, backup power, and valve and hydrant spacing) is discussed in Section 3.2.3. Additional discussion of distribution design standards is provided below:

Velocity

It is the City's policy that pipeline velocities should be maintained at approximately 3 to 5 feet per second for pumped systems for average demand conditions, 7.5 feet per second for peak-hour conditions, and no more than 9 feet per second for fire flow. It can generally be shown that it is more cost-effective (over a facility's service life) to increase the pipeline diameter to maintain 3 to 5 feet per second than to increase the pump horsepower.

Pressure Zone Boundaries

Pressure zone boundaries are based on service elevations and reservoir overflow elevations. Zones are isolated though the closing of valves or pressure reducing valves (PRVs) such that the lower boundary of a zone is along the ground surface contour that results in pressures of no more than 100 pounds per square inch (psi) during static conditions (usually occurring in the early morning hours). The upper boundary of the zone is along the ground surface contour that generally results in static pressures of no less than 40 psi. This low-pressure standard is usually sufficient to ensure that the pressure will not be below 30 psi during peak demand conditions.

Only the minimum number of pressure zones should be created. Wherever pressure zones are created, the system becomes fragmented and the water conveyance capacity can be severely limited by the PRV "bottleneck." Also, it is desirable to limit the number of PRVs because as a mechanical device they require maintenance and are subject to failure. ISO fire-fighting standards consider pipelines much more reliable than PRVs.

The number of PRVs serving any given zone should be sufficient to meet fire-fighting requirements if one is out of service. Therefore, at least two, and ideally three, PRVs should serve each zone.

Waterline Separation

The City has developed separation requirements between waterlines and non-potable pipelines. These requirements are included in Appendix Y.

7.5 Construction Standards, Materials, and Methods

Specifications for the materials and methods of construction of water system extensions are included in the most current edition of the *Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction* as modified by the *Specifications for Private Construction of Public Water Mains for City of Yakima*. Refer to Appendix X for complete information regarding specifications.

The City maintains a number of standard details related to the construction of water distribution system pipes and appurtenances. These details can be found in Appendix Z.

The City also maintains a listed of general construction notes for public waterline construction which can be found in Appendix AA.

7.6 Construction Certification and Follow-up Procedures

The steps that the City's Engineering Division takes to assure that a water system extension project has been constructed in accordance with the applicable standards are described in the above referenced procedures manual found in Appendix W.

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8 Capital Improvement Program

This chapter provides a summary of the City of Yakima's water system Capital Improvement Program (CIP), and presents the costs and schedules for projects planned for implementation in 2017 to 2037.

8.1 Development of CIP

The CIP was prepared by first identifying projects that address water system needs or deficiencies, as documented in earlier chapters of the water system plan. In addition, recurring or annual capital projects related to system maintenance (e.g., water main replacement programs) have also been included in the list of improvements.

A 20-year implementation schedule of the projects was then developed. Generally, projects of higher priority were scheduled for implementation within the 10-year planning horizon (2017-2026). Projects that serve anticipated future needs associated with system growth, or are less critical to system operation, were scheduled for implementation at a time from 2027 to 2037. Detailed scheduling of the higher priority projects was based upon the City's existing implementation timelines for projects that had been identified prior to initiation of this WSP, together with a prioritization process where the City evaluated each project against a set of prioritization criteria.

8.2 Capital Project Costs

Planning-level cost estimates have been developed for the capital projects and programs included in the 20-year CIP. Generally, each project cost includes the following components:

- **Base construction cost**: Includes all labor and material costs needed to construct a project. For distribution system projects, construction costs were estimated using preliminary quantities and unit costs based on the project's planned alignment and scope of work. Unit costs were based on published values from a cost database of average national unit costs, then escalated to 2016 dollars with a location factor applied to adjust for the difference in costs for Yakima compared to the national average[13].
- **Construction contingency**: Takes into account the uncertainties associated with estimating project costs at the planning level. Calculated as 30% of the total of base construction cost.
- **Sales tax**: Calculated as 8.2 percent (the 2016 local tax rate) of the base construction cost.
- **Contractor overhead and profit**: Takes into account the contractor's overhead and profit applied to base construction costs. This ranged from 25 percent to 30 percent of the base construction cost depending on the size of the project. Projects that are planned to be completed by City staff and resources (instead of an outside contractor) do not include overhead and profit.

[13] The RSMeans Heavy Construction Cost Data (2014) cost database is used. Prices adjusted to Yakima using a factor of 99 (national average = 100). 2014 cost data escalated to 2016 dollars using the Engineering News Record (ENR) construction cost index (CCI).

- **Indirect construction costs**: Includes City and consultant design costs, and other related cost items, such as permitting and construction administration. Depending on the size and scope of the project, this ranged from 20 percent to 25 percent of the total of the base construction, construction contingency, sales tax, and contractor overhead and profit. In addition to the percentage, projects requiring temporary and/or permanent easements included an easement acquisition cost based on the area of easement required.

These above elements are totaled to determine the total planning-level cost estimate for a project, as expressed in 2016 dollars.

The above methodology applies to costs developed for improvements first identified through the work completed as part of this water system plan update. Projects identified in past planning efforts which had a cost previously developed had the cost escalated to 2016 dollars using the construction cost index (CCI) published by Engineering News Record (ENR).

8.3 Capital Project Prioritization

8.3.1 Prioritization Criteria and Methodology

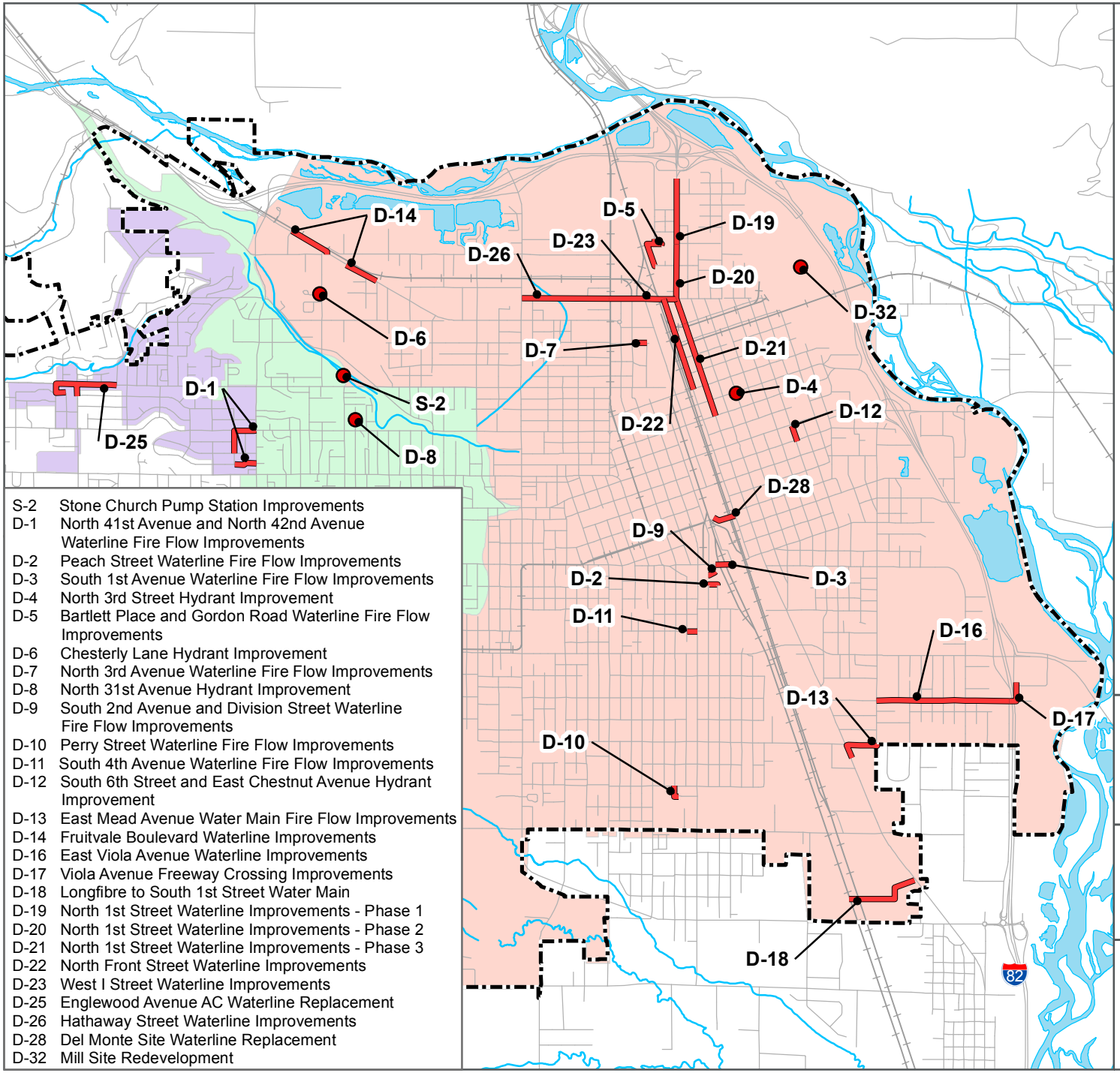
The improvements identified in this Water System Plan Update are categorized into the following functional component categories:

- Water Quality (WQ)
- Water Treatment Plant (WT)
- Source (S)
- Distribution (D)
- Water Planning (WP)

Descriptions of the projects are included in Chapter 3, System Analysis. Figure 8-1 provides the locations for the major planned improvements.

The identified improvement projects have been evaluated and prioritized based on the following criteria to determine the time in the 20-year CIP a project would be implemented:

- **Regulatory Requirement or Binding Commitments**: Does the improvement address a deficiency in meeting mandatory requirements/commitments (fire flow requirements; level of service requirements; Department of Health design criteria, regulations, and standards)? Typically for fire flow improvements, projects addressing a fire flow deficiency that is within 15 percent of the fire flow goal are regarded as having a lower priority.



S-2 Stone Church Pump Station Improvements
D-1 North 41st Avenue and North 42nd Avenue Waterline Fire Flow Improvements
D-2 Peach Street Waterline Fire Flow Improvements
D-3 South 1st Avenue Waterline Fire Flow Improvements
D-4 North 3rd Street Hydrant Improvement
D-5 Bartlett Place and Gordon Road Waterline Fire Flow Improvements
D-6 Chesterly Lane Hydrant Improvement
D-7 North 3rd Avenue Waterline Fire Flow Improvements
D-8 North 31st Avenue Hydrant Improvement
D-9 South 2nd Avenue and Division Street Waterline Fire Flow Improvements
D-10 Perry Street Waterline Fire Flow Improvements
D-11 South 4th Avenue Waterline Fire Flow Improvements
D-12 South 6th Street and East Chestnut Avenue Hydrant Improvement
D-13 East Mead Avenue Water Main Fire Flow Improvements
D-14 Fruitvale Boulevard Waterline Improvements
D-16 East Viola Avenue Waterline Improvements
D-17 Viola Avenue Freeway Crossing Improvements
D-18 Longfibre to South 1st Street Water Main
D-19 North 1st Street Waterline Improvements - Phase 1
D-20 North 1st Street Waterline Improvements - Phase 2
D-21 North 1st Street Waterline Improvements - Phase 3
D-22 North Front Street Waterline Improvements
D-23 West I Street Waterline Improvements
D-25 Englewood Avenue AC Waterline Replacement
D-26 Hathaway Street Waterline Improvements
D-28 Del Monte Site Waterline Replacement
D-32 Mill Site Redevelopment

LEGEND
City Limits Boundary
CIP Projects (point)
CIP Projects
Pressure Zone
1st Level
2nd Level
3rd Level

DATA SOURCES: City of Yakima (2016), WSDOT (2015)

CAPITAL IMPROVEMENT PLAN PROJECT LOCATIONS

FIGURE 8-1

YAKIMA WATER SYSTEM PLAN

N

0 0.5 1 1.5 2
MILES

PATH: \\BEL-SRV03\GISDATA\PROJECTS\WASHINGTON\CITY_OF_YAKIMA_006539\WSP_2017_271665\7.2_WP\MAP_DOCS\WSP\FIGURE8-1.MXD - USER: DKUHNS - DATE: 12/12/2016

- **Water Quality (non-regulatory):** Does the improvement enhance or improve the City's water quality with respect to criteria not mandated under state or federal regulations (such as projects that add looping to dead-end pipes)?
- **Reliability, cost control, and O&M**: Does the improvement reduce future operating costs for the system? Does the improvement reduce operation and maintenance needs, and improve the reliability of the system? Could costs be reduced through project subsidies (partially or completely) by others (such as grants or developer funds)?
- **Future Growth**: Does the project support future growth and development within the system?
- **Costs and ease of implementation**: How easy will it be for the improvement to be accepted, designed, constructed, and financed? What are the capital costs for the project and are they justified given the benefits provided by the improvement?

City Water/Irrigation staff met with the contracted water system planning engineer in a workshop to apply the prioritization criteria to each project and determine project scheduling. The group decided that given the limited number and types of projects identified, a formal scoring matrix was not necessary and that projects would be qualitatively compared to each other while considering the prioritization criteria listed above.

In general, the highest priority projects are scheduled for the first several years of the CIP. A portion of the projects were identified by prior planning efforts which already established a project timeline. In those cases, the previous timelines were maintained. The remainder of the projects that were determined to take place in the 10-year plan were distributed across the 10-year plan to level out capital costs for each year.

8.3.2 Project Prioritization Descriptions

The following provides a brief summary of how the above prioritization criteria apply to each identified project in the CIP:

WQ-1 TOC Monitoring and/or TTHM Treatment

Regulatory Requirement or Binding Commitments: To be determined (TBD)

Water Quality (non-regulatory): TBD

Reliability, cost control, and O&M: TBD

Future Growth: TBD

Costs and ease of implementation: TBD

Summary: As a condition of its ASR permit, the City will complete an engineering technical memorandum that will describe and evaluate a range of treatment and monitoring options. TOC monitoring and/or TTHM treatment will be developed following the completion of the engineering technical memorandum.

WT-1 Rechanneling River Intake

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Project is necessary for the WTP intake off the Naches River to function properly. Without the project, temporary solutions would have to continue to be implemented at an added cost and with the risk of the intake limiting the WTP's capacity.

Future Growth: The project will allow the WTP to maintain its capacity based on its treatment system capabilities (filters) and not be limited by the intake capacity. The WTP operating at its full rated capacity will allow future growth and development.

Costs and ease of implementation: Project will require in-river work adding to the complexity of construction. Project has a high cost compared to other planned projects.

Summary: Project is of a higher priority to maintain the capacity of the WTP intake. Project will be scheduled to occur early in the 10-year CIP.

WT-2 Residual Handling Improvements

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Project may be necessary for the WTP to maintain operations at full capacity.

Future Growth: The project will allow the WTP to maintain its capacity based on its treatment system capabilities (filters and backwash recycle lagoons) and not be limited by the residual handling capacity during higher solids production years. The WTP operating at its full rated capacity will allow future growth and development.

Costs and ease of implementation: TBD

Summary: Project cost and schedule will remain TBD pending further study.

S-1 Additional Source Wells (ASR)

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Project would allow for improved reliability of the water system. If the WTP has to be taken out of service or have its production greatly reduced during peak season demand, the City would be unable to meet demand given the current collection of seasonal wells. The addition of the ASR wells would allow complete redundancy for source capacity if the WTP is taken offline. The project would also allow improved flexibility in the system to handle peak demands. The ASR wells would also provide a regional reliability benefit for water supply from the region's aquifer.

Future Growth: The project will significantly increase the source capacity of the system allowing for future growth beyond the 20-year planning period.

Costs and ease of implementation: Project has the highest cost out of the projects listed in the CIP. Project would require significant planning and design prior to construction.

Summary: To improve the reliability of the water system and to have adequate source capacity if the WTP is taken out of service, this project is considered to have a higher priority. Project will be scheduled to have one well completed early in the 10-year CIP and the other well completed later in the 10-year CIP.

S-2 Stone Church Pump Station Improvements

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Project would improve system redundancy and improved operation of the system in the scenario that the 2nd Level Reservoirs and 40th Avenue Pump station become isolated from the rest of the system.

Future Growth: N/A

Costs and ease of implementation: Project can be readily implemented without major impacts to the surrounding area.

Summary: Due to the benefits for redundancy and operation with relatively small costs, project is scheduled to occur early in the 10-year CIP.

D-1 North 41st Avenue and North 42nd Avenue Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 69% of the fire flow goal to 123% of the fire flow goal.

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project has a higher cost and greater complexity to implement compared to other distribution system improvement projects. Project will also decrease static pressures of impacted areas; however, pressures will remain well above the 30 psi minimum service pressure.

Summary: Due to the large deficiency in fire flow that would be addressed, the project will be scheduled early in the 10-year CIP.

D-2 Peach Street Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 55 percent of the fire flow goal to 106 percent of the fire flow goal.

Water Quality (non-regulatory): Project provides looping of two dead-end mains allowing for potential improvements in water quality.

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project will be relatively easy to implement with City crews able to perform project work.

Summary: Due to the large deficiency in fire flow that would be addressed, low cost, ease of implementation, and potential water quality benefit, the project will be scheduled early in the 10-year CIP.

D-3 South 1st Avenue Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 86 percent of the fire flow goal to 261 percent of the fire flow goal. However, the deficient hydrant is within 15 percent of the fire flow goal, thereby lowering priority of the project.

Water Quality (non-regulatory): Project provides looping of dead-end main allowing for potential improvements in water quality.

Reliability, cost control, and O&M: Project would be financed by a developer.

Future Growth: Project improves flow to an area that could potentially see future growth.

Costs and ease of implementation: Depending on the route selected for looping, project may require crossing of railroad-owned property and the use of trenchless construction methods raising project costs and complexity.

Summary: Project will be given a lower priority and placed within the long-term CIP schedule. Project may be triggered depending on development in the area.

D-4 North 3rd Street Hydrant Improvement

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 61 percent of the fire flow goal to 230 percent of the fire flow goal.

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project will be relatively easy to implement with City crews able to perform project work. Project has a low cost to complete.

Summary: Due to the large deficiency in fire flow that would be addressed, low cost, and ease of implementation, the project will be scheduled early in the 10-year CIP.

D-5 Bartlett Place and Gordon Road Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project improves the available fire flow to an area that is currently fire flow deficient (62 percent to 78 percent of the fire flow goal) to over 138 percent of the fire flow goal.

Water Quality (non-regulatory): Project provides looping of three dead-end mains allowing for potential improvements in water quality.

Reliability, cost control, and O&M: Project would be financed by a developer.

Future Growth: Project improves flow to an area that could potentially see future growth.

Costs and ease of implementation: Project will require multiple easements to be acquired.

Summary: Project will be placed in the long-term CIP with project triggered by development in the area and funded by the developer.

D-6 Chesterly Lane Hydrant Improvement

Regulatory Requirement or Binding Commitments: Project provides a new hydrant near the deficient hydrant with available fire flows meeting the fire flow goal. New hydrant is in an area where spacing of hydrants does not meet City standards.

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project will be relatively easy to implement with City crews able to perform project work. Project has a low cost to complete.

Summary: Due to the low cost, and ease of implementation, the project will be scheduled early in the 10-year CIP.

D-7 North 3rd Avenue Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 85 percent of the fire flow goal to 228 percent of the fire flow goal.

Water Quality (non-regulatory): Project provides looping of a dead-end main allowing for potential improvements in water quality.

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project will be relatively easy to implement with City crews able to perform project work.

Summary: Although available fire flow is within 15 percent of the fire flow goal, due to the relatively low cost, ease of implementation, and potential water quality benefit, the project will be scheduled early in the 10-year CIP.

D-8 North 31st Avenue Hydrant Improvement

Regulatory Requirement or Binding Commitments: Project provides a new hydrant near the deficient hydrant with an available fire flow meeting the fire flow goal. New hydrant is also in an area where spacing of hydrants does not meet City standards.

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project will be relatively easy to implement with City crews able to perform project work. Project has a low cost to complete.

Summary: Due to the low cost, and ease of implementation, the project will be scheduled early in the 10-year CIP.

D-9 South 2nd Avenue and Division Street Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project improves the available fire flow to an area that is currently fire flow deficient (88 percent to 93 percent of the fire flow goal) to over 173 percent of the fire flow goal.

Water Quality (non-regulatory): Project provides looping of two dead-end mains allowing for potential improvements in water quality.

Reliability, cost control, and O&M: Project would be financed by a developer.

Future Growth: N/A

Costs and ease of implementation: Project will require easements to be acquired.

Summary: Due to available fire flow being within 15 percent of the fire flow goal and project alignment located outside of existing right-of-ways or easements, project will be placed in the long-term CIP with project triggered by development in the area and funded by the developer.

D-10 Perry Street Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 92 percent of the fire flow goal to 175 percent of the fire flow goal.

Water Quality (non-regulatory): Project provides looping of dead-end main allowing for potential improvements in water quality.

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project would require construction in a tight space between multi-family residential buildings and a new easement. However, project could be completed by City crews.

Summary: Due to available fire flow being within 15 percent of the fire flow goal and limited construction space, project will be given a lower priority and placed in the long-term CIP.

D-11 South 4th Avenue Waterline Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 96 percent of the fire flow goal to 258 percent of the fire flow goal.

Water Quality (non-regulatory): N/A.

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project will be relatively easy to implement with City crews able to perform project work.

Summary: Although the project has a relatively low cost and ease of implementation, since the available fire flow is within 4 percent of the fire flow goal, project will be given a lower priority and placed in the long-term CIP.

D-12 South 6th Street and East Chestnut Avenue Hydrant Improvement

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 98 percent of the fire flow goal to 206 percent of the fire flow goal.

Water Quality (non-regulatory): N/A.

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: Project would be relatively easy to construct, spanning only one block length.

Summary: Although the project has a lower cost and ease of implementation, since the available fire flow is within 2 percent of the fire flow goal, project will be given a lower priority and placed in the long-term CIP.

D-13 East Mead Avenue Water Main Fire Flow Improvements

Regulatory Requirement or Binding Commitments: Project would improve fire flows to the commercial and industrial area along I-82.

Water Quality (non-regulatory): N/A.

Reliability, cost control, and O&M: Improvement area is a bottleneck in the system. Existing piping is either 6-inch or 8-inch with 12-inch piping used adjacent to the project.

Future Growth: Project would support higher demands along I-82.

Costs and ease of implementation: Project would require construction in high traffic areas.

Summary: To remove the bottleneck in the system and improve flows for future development, the project will be placed within the 10-year CIP.

D-14 Fruitvale Boulevard Waterline Improvements

Regulatory Requirement or Binding Commitments: Project significantly improves the available fire flow to an area that is currently fire flow deficient, from 48 percent of the fire flow goal to 262 percent of the fire flow goal.

Water Quality (non-regulatory): Project provides looping of a dead-end main allowing for potential improvements in water quality.

Reliability, cost control, and O&M: Project would be financed by a developer.

Future Growth: Project would support future growth in the area and allow service connections to areas currently not served by the water system.

Costs and ease of implementation: Project would require construction in high traffic areas.

Summary: Project will be placed in the long-term CIP and will be triggered by future development in the area. At time of construction, hydrant met the necessary fire flow demands. However, as further development occurs per the projected land use and the required fire flow increases, fire flow deficiency and looping will be addressed at that time.

D-15 Open Gear Valve Replacement Program

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: As older open gear valves reach the end of their useful life, they need to be replaced to maintain functionality of the system.

Future Growth: N/A

Costs and ease of implementation: As replacements become necessary, projects can typically be carried out by City crews.

Summary: Project will be placed as an annually recurring program throughout the 20-year CIP to address valve replacements as they become necessary.

Two-bolt Joint Waterline Replacement Program Projects (D-16 East Viola Avenue Waterline Improvements and D-17 Viola Avenue Freeway Crossing Improvements)

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): During replacement, any lead gooseneck connections and lead appurtenances would be removed, if they exist.

Reliability, cost control, and O&M: Older two-bolt joint pipes pose a significant maintenance issue (see program and improvement description in Chapter 3). Replacement improves O&M by significantly decreasing the O&M risk. Project will reduce the likelihood of unscheduled repairs.

Future Growth: N/A

Costs and ease of implementation: Projects have higher costs due to the length of replacement required.

Summary: Due to the significant maintenance issues surrounding the use of two-bolt joint waterlines, these projects will be given a higher priority and will be scheduled for completion early in the 10-year CIP.

D-18 Longfibre to South 1st Street Water Main

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): Project provides looping of two dead-end sections of the water system allowing for potential improvements in water quality.

Reliability, cost control, and O&M: Project would be financed by a developer.

Future Growth: Project would improve flows to project vicinity as well as provide water to areas currently not serviced by the water system allowing for future growth.

Costs and ease of implementation: Project has a high cost due to the length of pipe involved and crossing of railroad-owned property requiring the use of trenchless construction methods.

Summary: Project will be placed in the long-term CIP and will be triggered by future development in the area.

Lead-Oakum Joint Waterline Replacement Program (D-19, D-20, D-21 North 1st Street Waterline Improvements; D-22 North Front Street Waterline Improvements; D-23 West I Street Waterline Improvements; D-24 Yakima Avenue and Other Future, not yet identified replacements)

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): During replacement, any lead gooseneck connections and lead appurtenances would be removed, if they exist.

Reliability, cost control, and O&M: Older cast-iron, lead-oakum joint pipes pose a significant maintenance issue (see program and improvement description in Chapter 3). Replacement improves O&M by significantly decreasing the O&M risk. Projects will reduce the likelihood of unscheduled repairs.

Future Growth: N/A

Costs and ease of implementation: Projects have higher costs due to the length of replacement required.

Summary: Due to the significant maintenance issues surrounding the continued use of these pipes, these projects will be given a higher priority with identified projects scheduled for completion within the 10-year CIP. An annually recurring cost will also be included throughout the 20-year CIP to address not yet identified lead-oakum joint waterline replacements.

D-25 Englewood Avenue AC Waterline Replacement

Regulatory Requirement or Binding Commitments: Removal of AC pipe will eliminate the need for the City to continue its asbestos monitoring plan.

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Existing AC piping is fragile and susceptible to damage. If damage does occur, special safety considerations must be implemented for removal and disposal. Project will reduce the likelihood of unscheduled repairs.

Future Growth: N/A

Costs and ease of implementation: Project has a higher cost due to the length of replacement required.

Summary: Due to the potential maintenance difficulties that would be eliminated by replacing the existing AC pipe, and removing the necessity of continuing asbestos monitoring, the project will be given a higher priority and be scheduled for completion within the 10-year CIP.

D-26 Hathaway Street Waterline Improvements

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: The existing steel pipe has deteriorated and requires periodic repairs due to leaks. Replacement would reduce the number of unscheduled repairs.

Future Growth: N/A

Costs and ease of implementation: Project has a higher cost due to the length of replacement required.

Summary: Due to the frequent maintenance issues surrounding the continued use of the pipe, the project will be given a higher priority and be scheduled for completion near the start of the 10-year CIP.

D-27 Distribution Main Leak Detection

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Program will assist the City in reducing its distribution system losses, allowing the system to operate more efficiently and at a lower cost.

Future Growth: N/A

Costs and ease of implementation: Project has a relatively low cost to implement and would not pose any significant impacts to the areas where work is being conducted.

Summary: Due to the relative ease to complete the program and the benefits for lowering distribution system losses, the leak detection program will be scheduled early in the 10-year CIP.

D-28 Del Monte Site Waterline Replacement

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Costs for the project could be shared with Del Monte. Due to the location of piping underneath existing buildings, repair and maintenance of piping is currently not possible. Project allows for future maintenance of piping.

Future Growth: N/A

Costs and ease of implementation: Project has a higher cost due to the crossing of railroad-owned property requiring the use of trenchless construction methods.

Summary: Due to the high cost of the project and the project not being immediately needed to satisfy a demand gap, the project will be given a lower priority and placed in the long-term CIP.

D-29 Advanced Metering Infrastructure (AMI) Battery Replacement / System Upgrade

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: Program will be required as installed AMI ages.

Future Growth: N/A

Costs and ease of implementation: Program cost is currently unknown and will be dependent on the technologies available at the time of replacement.

Summary: Project is currently not necessary. However, as the AMI ages the program will need to begin being implemented. Program will be placed in the long-term CIP with costs to be determined.

D-30 Waterline Replacement Program

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): During replacement, any lead gooseneck connections and lead appurtenances would be removed, if they exist.

Reliability, cost control, and O&M: Replacement would reduce the number of unscheduled repairs and improve system performance.

Future Growth: Upsizing of undersized and/or aging piping as part of the program will allow for future growth and development.

Costs and ease of implementation: Cost and ease of implementation will be dependent on individual projects completed as part of the program.

Summary: Due to the decrease in maintenance issues surrounding the continued use of pipes applicable to this program, the program will be given a higher priority with an annually recurring cost included throughout the 20-year CIP.

D-31 New Waterline Installation in Unserved Areas Program

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: N/A

Future Growth: Program allows for the growth of the water system in areas currently not served.

Costs and ease of implementation: Cost and ease of implementation will be dependent on individual projects completed as part of the program.

Summary: Due to the necessity to support growth and development across the City, the program will be given a higher priority with an annually recurring cost included throughout the 20-year CIP.

D-32 Mill Site Redevelopment

Regulatory Requirement or Binding Commitments: N/A

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: N/A

Future Growth: Project would allow for the redevelopment of the former Boise Cascade Mill Site.

Costs and ease of implementation: Cost and ease of implementation will be dependent on the development to occur at the site. Costs would be financed by the developer.

Summary: Program will be placed in the long-term CIP with costs to be determined and the project triggered by development in the area.

WP-1 Water System Plan Update

Regulatory Requirement or Binding Commitments: Completion of a water system plan update is a regulatory requirement.

Water Quality (non-regulatory): N/A

Reliability, cost control, and O&M: N/A

Future Growth: N/A

Costs and ease of implementation: N/A

Summary: To meet regulatory requirements, completion of the next water system plan update will be scheduled to occur in 2027.

8.4 CIP Annual Costs to 2037

Figure 8-2 - presents the City's schedule of CIP projects planned for implementation between 2017 and 2037.

In total, the City's 10-year CIP (2017-2026) in 2016 dollars includes approximately $28.9 million in improvements. The long-term CIP (2027-2037) includes approximately $15.3 million in additional improvements. Figure 8-2 illustrates the annual total CIP improvement cost across the planning period.

Figure 8-2. Annual CIP Costs 2017 - 2037

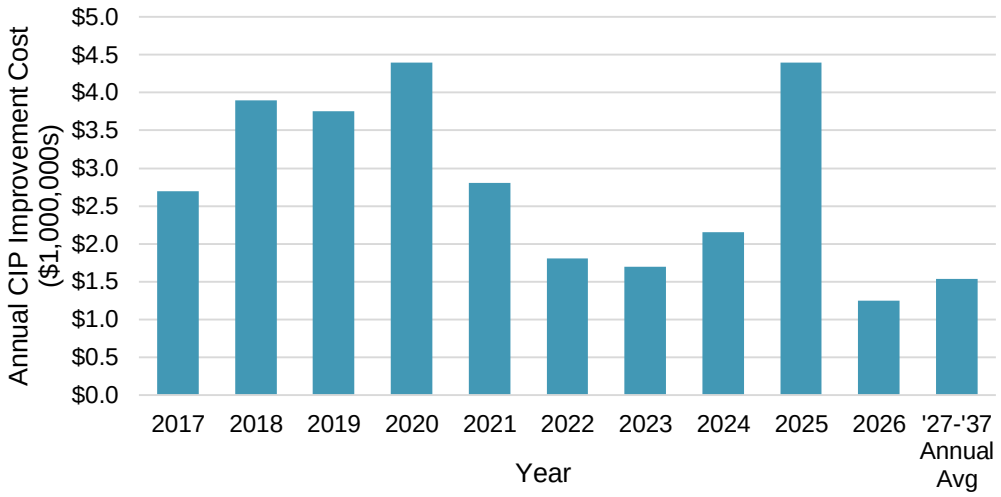


Table 8-1. Capital Improvement Program (2017-2037)

						Schedule and Cost of Improvements ($1,000's 2016 Dollars) [1]												
Capital Improvement Project / Program Name	**ID**	**Purpose of Project [2]**	**Funding Source [3]**	**Project Construction By**	**Base Project Cost (2016 Dollars)[4]**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**10-Year CIP Total**	**Long-Term (2027-2037)**	**20-Year CIP Total**
Water Quality Improvements																		
TOC Monitoring and or TTHM Treatment (TBD)	WQ-1	Improve	TBD	Contractor	TBD											TBD	TBD	TBD
Water Treatment Plant Improvements																		
Rechanneling River Intake	WT-1	O&M	OI	Contractor	$750,000	$750										$750		$750
Residual Handling Improvements	WT-2	O&M		Contractor	TBD											TBD	TBD	TBD
Source Improvements																		
Additional Source Wells (ASR)	S-1	Improve	OI	Contractor	$4,500,000		$450	$900	$3,150			$450	$900	$3,150		$9,000		$9,000
Stone Church Pump Station Improvements	S-2	Improve	OI	Contractor	$80,000		$80									$80		$80
Distribution Improvements																		
Fire Flow Improvements																		
North 41st Avenue and North 42nd Avenue Waterline	D-1	Deficiency	OI	Contractor	$741,000			$741								$741		$741
Peach Street Waterline Fire Flow Improvements	D-2	Deficiency	OI	City	$53,000	$53										$53		$53
South 1st Avenue Waterline Fire Flow Improvements	D-3	Deficiency	Dev	Contractor	$393,000											$0	$393	$393
North 3rd Street Hydrant Improvement	D-4	Deficiency	OI	City	$33,000	$33										$33		$33
Bartlett Place and Gordon Road Waterline Fire Flow Improvements	D-5	Deficiency	Dev	Contractor	$293,000											$0	$293	$293
Chesterly Lane Hydrant Improvement	D-6	Deficiency	OI	City	$31,000	$31										$31		$31
North 3rd Avenue Waterline Fire Flow Improvements	D-7	Deficiency	OI	City	$89,000	$89										$89		$89
North 31st Avenue Hydrant Improvement	D-8	Deficiency	OI	City	$17,000	$17										$17		$17
South 2nd Avenue and Division Street Waterline Fire Flow Improvements	D-9	Deficiency	Dev	Contractor	$88,000											$0	$88	$88
Perry Street Waterline Fire Flow Improvements	D-10	Deficiency	OI	City	$85,000											$0	$85	$85
South 4th Avenue Waterline Fire Flow Improvements	D-11	Deficiency	OI	City	$84,000											$0	$84	$84
South 6th Street and East Chestnut Avenue Hydrant Improvement	D-12	Deficiency	OI	Contractor	$149,000											$0	$149	$149
East Mead Avenue Water Main Fire Flow Improvements	D-13	Deficiency	OI	Contractor	$253,000					$253						$253		$253
Fruitvale Boulevard Waterline Improvements	D-14	Improve	Dev	Contractor	$445,000											$0	$445	$445
Open Gear Valve Replacement Program	D-15	O&M	OI	City	$25,000	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$250	$250	$500
Two-bolt Joint Waterline Replacement Program																		

Table 8-1. Capital Improvement Program (2017-2037) (Cont'd.)

Capital Improvement Project / Program Name	ID	Purpose of Project [2]	Funding Source [3]	Project Construction By	Base Project Cost (2016 Dollars)[4]	Schedule and Cost of Improvements ($1,000's 2016 Dollars) [1]												
						2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	10-Year CIP Total	Long-Term (2027-2037)	20-Year CIP Total
East Viola Avenue Waterline Improvements	D-16	Improve	OI	Contractor	$809,000			$809								$809		$809
Viola Avenue Freeway Crossing Improvements	D-17	Improve	OI	Contractor	$419,000	$419										$419		$419
System Looping Projects																		
Longfibre to South 1st Street Water Main	D-18	Improve	Dev	Contractor	$615,000											$0	$615	$615
Lead-Oakum Joint Waterline Replacement Program																		
North 1st Street Waterline Improvements - Phase 1	D-19	O&M	OI	Contractor	$450,000		$450									$450		$450
North 1st Street Waterline Improvements - Phase 2	D-20	O&M	OI	Contractor	$495,000		$495									$495		$495
North 1st Street Waterline Improvements - Phase 3	D-21	O&M	OI	Contractor	$587,000		$587									$587		$587
North Front Street Waterline Improvements	D-22	O&M	OI	Contractor	$776,000					$776						$776		$776
West I Street Waterline Improvements	D-23	O&M	OI	Contractor	$525,000					$525						$525		$525
Yakima Avenue and Other Future, Not Yet Identified Replacements	D-24	O&M	OI	TBD	$900,000	$900	$900	$900	$900	$900	$900	$900	$900	$900	$900	$9,000	$9,000	$18,000
Miscellaneous Operation and Maintenance Improvements, Repairs, and Replacements																		
Englewood Avenue AC Waterline Replacement	D-25	Improve	OI	Contractor	$557,000						$557					$557		$557
Hathaway Street Waterline Improvements	D-26	O&M	OI	Contractor	$536,000		$536									$536		$536
Distribution Main Leak Detection	D-27	O&M	OI	Contractor	$50,000	$50	$50	$50								$150		$150
Del Monte Site Waterline Replacement	D-28	Improve	OI / Dev	Contractor	$523,000											$0	$523	$523
Advanced Metering Infrastructure (AMI) Battery Replacement / System Upgrade	D-29	O&M	OI	TBD	TBD											$0	TBD	TBD
Waterline Replacement Program	D-30	O&M	OI	TBD	$175,000	$175	$175	$175	$175	$175	$175	$175	$175	$175	$175	$1,750	$1,750	$3,500
Water System Expansion																		
New Waterline Installation in Unserved Areas Program	D-31	Growth	Dev	TBD	$150,000	$150	$150	$150	$150	$150	$150	$150	$150	$150	$150	$1,500	$1,500	$3,000
Mill Site Redevelopment	D-32	Growth	Dev	TBD	TBD											$0	TBD	TBD
Planning																		
Water System Plan Update	WP-1	O&M	OI	Contractor	$150,000											$0	$150	$150
TOTAL					**$15,826,000**	**$2,692**	**$3,898**	**$3,750**	**$4,400**	**$2,804**	**$1,807**	**$1,700**	**$2,150**	**$4,400**	**$1,250**	**$28,851**	**$15,325**	**$44,176**

1. All future costs are shown in 2016 dollars. Escalation is required to determine anticipated changes in cost at time of construction/purchase.
2. Purpose of Project: Deficiency = Addresses deficiencies identified in the Water System Plan; Improve = Does not address a deficiency, but improves overall system operation and reliability; Growth = Required to address growth/expansion of the distribution system; O&M = Necessary for proper system maintenance.
3. Source of Funding: OI = Operating Income (Rates); Dev = Developer Funded/Contributed
4. For projects involving ongoing annual costs, the base cost is depicted as the typical annual cost (not the total for the planning period).

9 Financial Program

9.1 Objective and Plan Content

The objective of the financial program is to identify the total cost of providing domestic water service, provide adequate funding to meet the utility improvement schedule, and assist in establishing sufficient fees for service. Statutory authority for financial program is derived from Chapters 43.20, 70.116 and 70.119A RCW. Regulatory authorities include Chapters 246-293 and 246-294 WAC.

The financial program is crucial to the successful implementation of the prescribed capital plan within the Water System Plan as well as ongoing operations. A comprehensive financial program provides a detailed account of the way to fund the capital plan and show the utility is funded in a financially sustainable manner over the course of the planning period. The state of Washington requires a financial program contain details which demonstrate that the financial program is viable. WAC 246-290-100 states a water system plan must contain within their comprehensive plan a description of the Utilities financial program. The code specifically calls for:

> *"(j) Demonstration of financial viability by providing:*
>
> *(i) A summary of past income and expenses*
>
> *(ii) A one-year balanced operational budget for systems serving 1,000 or more connections or a six year balanced operational budget for systems serving less than on thousand connections*
>
> *(iii) A plan for collecting the revenue necessary to maintain cash flow stability and to fund the capital improvement program and emergency improvements; and*
>
> *(iv) An evaluation that has considered:*
>
> *(A) The affordability of water rates; and*
>
> *(B) The feasibility of adopting and implementing a rate structure that encourages water demand efficiency."*

In this chapter, the Washington Administrative Code (WAC) required components, listed above are provided plus some additional information integral to the management of the City's water system.

The financial program for this Water System Plan update includes the following information:

- Past and present financial status
- Sources and uses of funds
- Capital funding plan and project financial results
- An assessment of rates

The methods used in this study followed general industry guidelines for developing utility rates – rates must generate enough revenue to be self-supporting and financially viable, without undue discrimination toward or against any customer.

9.2 Past and Present Financial Status

The City operates their domestic water utility as a self-supporting entity and provides affordable domestic water to its customers. The City conducts regular rate studies, providing independent assessment of the financial health of City utilities. Management strives to keep the price of water as low as possible, providing high quality water to its customers while still maintained an adequate reserve balance. Table 9-1 provides the City's historical revenue and expenditures over the last 8 years.

Table 9-1. Summary of Historic Revenue and Expenditures 2008 - 2015

	2008	2009	2010	2011	2012	2013	2014	2015
Beginning Fund Balance	**$1,889,503**	**$1,860,721**	**$2,110,819**	**$1,919,415**	**$2,015,479**	**$2,910,120**	**$3,236,665**	**$3,550,267**
Revenue								
Charge of Goods & Services	$6,650,755	$7,413,232	$7,320,186	$7,518,241	$8,891,339	$8,208,994	$8,641,103	$8,609,802
Miscellaneous Revenue	$151,628	$134,322	$136,905	$174,619	$208,098	$710,986	$694,097	$594,270
Total Revenue	$6,802,383	$7,547,554	$7,457,091	$7,692,860	$9,099,437	$8,919,980	$9,335,200	$9,204,072
Expenditures								
Water Distribution	$2,216,948	$2,235,430	$2,250,129	$2,241,823	$2,257,299	$2,343,607	$2,288,213	$2,423,354
Potable Water Supply	$1,299,263	$1,461,861	$1,417,172	$1,454,464	$1,523,670	$1,722,577	$1,707,749	$1,673,214
Capital Administration	$49,429	$54,150	$54,255	$55,877	$55,296	$54,709	$92,961	$105,836
Potable Water Administration	$2,594,420	$2,857,204	$3,176,498	$3,111,604	$3,734,493	$3,917,996	$3,977,245	$3,987,322
Debt Service	$671,105	$688,811	$750,422	$733,024	$634,050	$554,545	$955,430	$1,193,644
Total Expenditures	$6,831,165	$7,297,456	$7,648,476	$7,596,793	$8,204,808	$8,593,435	$9,021,598	$9,383,369
Ending Fund Balance	**$1,860,722**	**$2,110,820**	**$1,919,415**	**$2,015,478**	**$2,910,120**	**$3,236,665**	**$3,550,267**	**$3,370,970**

Note: Fluctuations in expenditures within expense categories is due to changes in the way individual expenditure were accounted for from year to year.

9.2.1 Past Studies

Since 1996, it has been the City's practice to conduct a rate study every five years to determine rate adjustments for the next five years. The purpose of the multi-year rate studies was intended to stabilize rates over time, keeping rates to small inflationary increases as often as possible annually rather than waiting until the utility's expenditures are much greater than revenue requiring a substantially increase in rates.

The 2013 Study findings concluded that annual revenue adjustments were necessary in each year of the planning period. Proposed rate adjustments were five years of 4.0 percent increases (2014-2018). The study also proposed a shift in the City's rates, weighting more heavily on the fixed change and less on the consumption rate. The overall change to the rate was from 22 to 27 percent weighted on the fixed charge.

9.2.2 Financial Policies

The City maintains several financial policies in the areas of reserve levels and debt management. Financial policies are important for a few reasons. Financial polices help guide the utilities management into the future in a prudent and sustainable manner. Bond rating agencies consider strong financial policies as favorable when assessing the utilities bond rating. The following financial policies were incorporated into the analyses:

- *Self-Sufficient Enterprise Fund* – The Governmental Accounting Standards board (GASB) defines an "enterprise fund" as a fund that operates a business like activity and is primarily funded by user fees such as water rates. Because the water utility is designated as an enterprise fund, it must be self-sustaining and recover its operating and capital costs. Enterprise funds cannot be subsidize or subsidize another fund including the City's general fund.
- *Reserve Levels* – Reserve balances are necessary to cover current costs as well as future capital expenditures. Adequate cash reserves help the utility run smoothly and maintain stable rates in the future.
    - Operating Reserves provide day to day funding of operations and the balance must be sufficient to cover the utility's bills, payroll and unexpected costs particularly taking into account the seasonal nature of water utility revenue. The most recent rate study recommends between 45 and 60 days of O&M expense or between 12 and 16.5 percent annual O&M expense.
    - Capital Reserve hold funds intended to fund the City's capital plan. The most recent rate study suggests a minimum balance of 1 to 2 percent of fixed assets. Historically the City has maintained a minimum balance of $750,000 which is within the recommended 1 to 2 percent minimum balance. The Capital Reserve may also hold some restricted revenue in the form of impact fees also known as system development fees.
    - Restricted Debt Reserves are reserve funds held with a required balance equal to the City's principal and interest payments. These funds are held to safeguard bond holders in the event the City's current revenue is not sufficient to make bond payments. Generally, these funds are held until the bonds mature and are then used to pay the final bond payment. The City has historically issued bonds to help fund capital improvement projects and this practice is assumed to continue into the future.
- *System Reinvestment Funding* – The purpose of system replacement funding is to provide for the replacement of aging system facilities to ensure sustainability of the system for ongoing operations. The prior rate study incorporates direct rate funding for

capital projects in the amount of $600,000 to $650,000 per year. This level of funding approximates annual depreciation expense less debt principal payment; no additional funding was deemed necessary for system replacement at that time. It should be noted that this method will not fully recover costs equal to asset replacement over time. Simple straight line depreciation will only recover the cost of the asset at the time it was installed or constructed. Water system assets are routinely depreciated over 20 years or more, and assuming construction cost increases of 2.5 percent, the cost to replace a system asset will be 64 percent higher after it is fully depreciated.

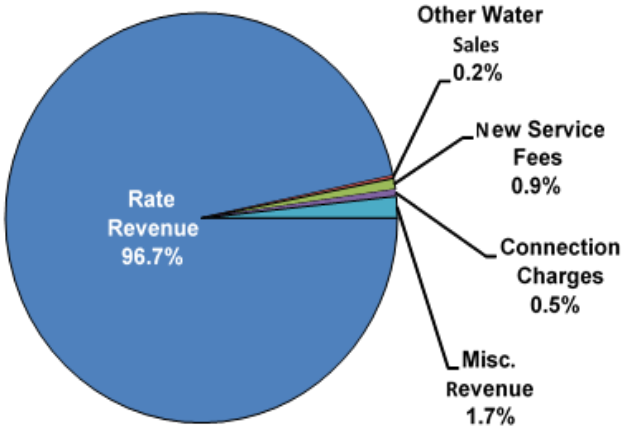
- *Debt Service Coverage Ratio (DSCR)* - The City's current minimum coverage requirement on outstanding revenue bonds is 1.25 times annual revenue bond debt service, using the net revenues of the Utility. The City's has an internal policy to set rates so that the utility will meet coverage of at least 2.0 times annual revenue bond debt service.
- *Debt Management* – The City's general policy is to maintain debt service below 25 percent of the total utility budget. Debt service is currently 9 percent of the budget, increasing to 15 percent of the budget by the end of the study period.

9.3 Sources and Uses of Funds

9.3.1 Sources of Funds

Revenue for the water system operations are derived from rate revenue for metered water sales, miscellaneous revenues such as connection charges and penalties, other water sales, new service fees, connection charges, and miscellaneous revenue. The chart below shows that the vast majority of the operating fund's revenue is received through rate revenue collections.

Figure 9-1. Revenue Sources



The capital plan has been funded by a combination of available sources, low interest loans, grants, cash transfers from the Domestic Water Utility Operating Fund, and interest income.

A Public Works Trust Fund (PWTF) loan was obtained in September of 2003 in the amount of $2,694,500. These loan funds were used for the WTP improvement project which included rapid mix (pumped flash mix) improvements, on-site chlorine for disinfection, new chemical feed and storage equipment, and pipe gallery modifications. A DWSRF loan of $957,200

was obtained in 2004; these funds were used for filter improvement at the WTP. A PWTF loans for $2,257,200 was obtain in 2008 for the Gardner Park Well.

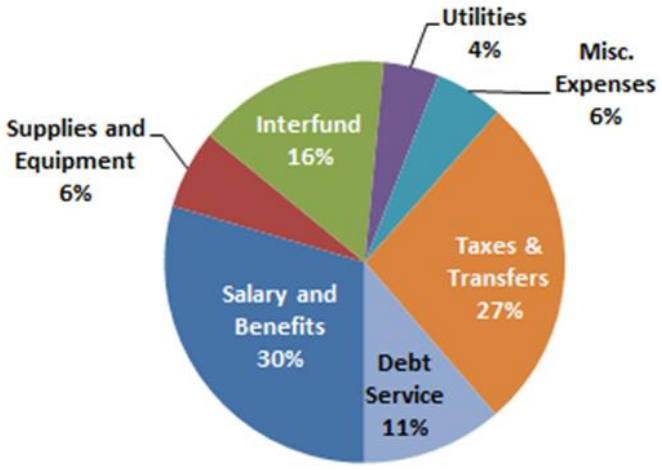
The PWTF and State Revolving Fund (SRF) loan programs have been on the decline in the last few years due to state budget constraints. The analysis assumed utilization of revenue bonds and increased funding through rates fund capital projects. City staff will continue to seek low interest alternatives and grants as they are available.

Interest income is generated from the investment of available annual balances in the water utility capital fund. An average annual interest rate of 4.0 percent was assumed in the 2007 Rate Study. Currently most interest rates are less than 1 percent.

9.3.2 Application of Funds

A water utility incurs a variety of expenditures including O&M, capital funding, debt service and taxes.

Figure 9-2. Revenue Requirement



Operations and Maintenance

O&M expenses are comprised of a variety of costs associated with the day to day operations of the utility. Salaries, benefits, supplies, interfund payments, and utilities are a few of the largest O&M expenses. Growth rates for these objects vary widely. Total salaries, the largest component of O&M, generally can only be reduced by reducing staff as individual salaries generally rise with an index such as the consumer price index or something similar often negotiated with union contract terms. Benefits comprise a wide range of items such as health insurance and pension. Historically health benefits have been growing at a rate significantly higher than inflation.

Taxes

The utility pays two types of taxes, a state tax of 5.029 percent which is charged to all water sales and a Payment in Lieu of Tax (PILOT) which is a payment to the City's general fund. The PILOT is calculated as 20 percent of total revenue less debt service. Since the state tax

and City PILOT are calculated as a percent of revenue, when rates are increased, additional State taxes and City PILOT are incurred equal to a quarter of the overall rate increase.

Capital Funding

Utilities fund capital in many ways, through rate revenues, impact fees, reserves or long-term debt in the form of loans or bonds. Often utilities employ several means of funding capital projects and for a variety of reasons. At times capital funding mechanisms are restricted to certain uses such as funding capacity related projects or possibly loans secured for particular projects. Bonds can also be restricted to what the utility stated they were going to fund with the bonds at the time the bond was issued.

Capital Funded Through Rate Revenue - Some utilities choose to fund their capital plan entirely through current revenue and reserve funds, however is rare because utilities are often discouraged from holding excess cash balances. Most utilities use a mix of capital funding mechanisms such as debt. As it happens the amount of capital a utility funds through rates is indicative of the financial health of the utility.

Debt Service - is the payment of principal and interest on debt issued by the utility. Often when a utility issues debt the issuer imposes covenants on the utility to assure the utility is sufficiently financially sound to be able to repay the debt. One common covenant imposed is a DSCR which is commonly stipulated at 1.25 for revenue bonds. This means after expenditures and taxes are paid, the Utility has revenue equal to 125 percent of the debt service remaining (see equation). The city currently has one outstanding bond issue set to be paid off in 2021 that accounts for approximately 4 percent of the City's total debit. The City's largest portion of debt service is from PWTF and SRF loans which usually have 1.0 DSCR requirement. This financial statistic assures the utility is not spending all of its revenue on operations.

$$\frac{Revenue - Expenditures - Taxes}{Debt\ Service} => 1.25$$

The level of debt the city carries is critical for a utility as the proportion of debt to revenue, called debt service coverage ratio is one financial statistic that determines the City's capacity to borrow additional funds as well as the overall bond rating. The City's target for DSCR is 2.0 which is a well above the typical minimum required by bond covenants and twice the PWTF and SRF loan requirements.

9.4 Capital Funding Plan and Projected Financial Results

As mentioned earlier, a major component of a capital plan is how it will be funded. To adequately determine how a capital plan will be funded a financial plan must be undertaken. A financial plan, while not necessarily as comprehensive as a full rate study, has similar objectives and methods. While there are a few generally accepted methods for conducting a financial plan the City has historically used the cash basis for determining the revenue requirement. This analysis has also used the cash basis to be consistent with past analyses.

The cash basis revenue requirement analysis is the comparison of projected revenue and revenue requirement to determine if the revenue is sufficed to responsibly manage the utility. The components of a cash basis revenue requirement are available funds or revenue, compared to the application of funds (see equation). Table 9-2 summarizes the components that make up the application of funds.

$$Balance\ (Deficiency)\ of\ Funds = (Available\ Funds) - (Application\ of\ Funds)$$

Table 9-2. Overview of a Cash Basis Application of Funds

Application of Funds
Operations & Maintenance
Capital Funded Through Rates
Taxes and Transfers
Debt Service

Capital funded through rates and debt service is the two areas where the capital funding plan affects the revenue requirement. In the capital funding plan the assumed bond issues will increase the debt service in addition to an increased level of capital funding through rates.

The central purpose of this analysis is to develop a funding strategy for the capital plan developed for this Water System Plan. To that end, the capital plan used for this analysis is a real dollar representation of the capital plan developed in the earlier section of this document. Table 9-3 is the capital plan with project escalated to real dollars. Table 9-4 is the funding plan for the capital plan.

Table 9-3. Capital Plan

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Rechanneling River Intake	$769	-	-	-	-	-	-	-	-	-
Additional Source Wells (ASR)	-	$473	$969	$3,477	-	-	$535	$1,097	$3,934	-
Stone Church Pump Station Improvements	-	$80	-	-	-	-	-	-	-	-
North 41st Avenue and North 42nd Avenue Waterline Fire Flow Improvements	-	-	$798	-	-	-	-	-	-	-
Peach Street Waterline Fire Flow Improvements	-	$54	-	-	-	-	-	-	-	-
North 3rd Street Hydrant Improvement	-	$34	-	-	-	-	-	-	-	-
Chesterly Lane Hydrant Improvement	-	$32	-	-	-	-	-	-	-	-
North 3rd Avenue Waterline Fire Flow Improvements	-	$91	-	-	-	-	-	-	-	-
North 31st Avenue Hydrant Improvement	-	$17	-	-	-	-	-	-	-	-
East Mead Avenue Water Main Fire Flow Improvements	-	-	-	-	$286	-	-	-	-	-
Open Gear Valve Replacement Program	$26	$26	$27	$28	$28	$29	$30	$30	$31	$32
East Viola Avenue Waterline Improvements	-	-	$871	-	-	-	-	-	-	-
Viola Avenue Freeway Crossing Improvements	$429	-	-	-	-	-	-	-	-	-
North 1st Street Waterline Improvements - Phase 1	-	$473	-	-	-	-	-	-	-	-
North 1st Street Waterline Improvements - Phase 2	-	$520	-	-	-	-	-	-	-	-
North 1st Street Waterline Improvements - Phase 3	-	$617	-	-	-	-	-	-	-	-
North Front Street Waterline Improvements	-	-	-	-	$878	-	-	-	-	-
West I Street Waterline Improvements	-	-	-	-	$594	-	-	-	-	-
Yakima Avenue and Other Future, Not Yet Identified Replacements	$923	$946	$969	$993	$1,018	$1,044	$1,070	$1,097	$1,124	$1,152

Table 9-3. Capital Plan (Cont'd.)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Englewood Avenue AC Waterline Replacement	-	-	-	-	-	$646	-	-	-	-
Hathaway Street Waterline Improvements	-	$563	-	-	-	-	-	-	-	-
Distribution Main Leak Detection	$51	$53	$54	-	-	-	-	-	-	-
Waterline Replacement Program	$179	$184	$188	$193	$198	$203	$208	$213	$219	$224
New Waterline Installation in Unserved Areas Program	$154	$158	$162	$166	$170	$174	$178	$183	$187	$192
Total Capital Improvement Plan	**$2,531**	**$4,320**	**$4,038**	**$4,857**	**$3,172**	**$2,096**	**$2,021**	**$2,620**	**$5,495**	**$1,600**

Note: Table Values in Real Dollars Expressed in $1,000s

Table 9-4. Capital Funding Plan

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Total Capital Improvement Plan	$2,531	$4,320	$4,038	$4,857	$3,172	$2,096	$2,021	$2,620	$5,495	$1,600
Transfer to Capital Reserve Fund	$701	$980	-	$1,943	-	$604	-	$3,780	-	$100
Total Capital Needs	**$3,232**	**$5,300**	**$4,038**	**$6,800**	**$3,172**	**$2,700**	**$2,021**	**$6,400**	**$5,495**	**$1,700**
Less Other Funding										
Capital Funded Through Rates	$750	$800	$1,050	$1,100	$1,250	$1,350	$1,450	$1,500	$1,650	$1,700
Use of Capital Reserve Funds	$2,482	-	$2,988	-	$1,922	-	$571	-	$3,845	-
New Bond Issue	-	$4,500	-	$5,700	-	$1,350	-	$4,900	-	-
Total Capital Funding Sources	**$3,232**	**$5,300**	**$4,038**	**$6,800**	**$3,172**	**$2,700**	**$2,021**	**$6,400**	**$5,495**	**$1,700**

Note: Table Values in $1,000s

For this analysis the city's 2017 budget was used as a starting point for projecting both revenue and the revenue requirement. Beyond 2017 escalation factors were used for the projections. Escalation factors were ranged from 6 to 0 percent depending on the particular expense or revenue. Table 9-5 provides the escalation factors used in the financial plan.

Table 9-5. Escalation Factors

Sources of Revenue and Expenditures	2018-2026
Revenue	
Rate Revenue Growth	0.2%
Connection Charges	0.0%
Miscellaneous Revenue	2.0%
Expenditures	
Salary	3.5%
Benefits	6.0%
Supplies and Equipment	2.2%
Chemicals	3.0%
Electricity	2.0%
Other Utilities	3.0%
Professional Services	3.0%
Miscellaneous	2.2%
Fuel	3.0%

Table 9-6 on the following page shows the revenue requirement analysis which is a balanced operations budget for the 10 years Capital Improvement Program as well as a plan for collecting the revenue necessary to maintain cash flow stability and to fund the Capital Improvement Program and emergency improvements if necessary. The revenue requirement analysis is designed around several assumptions including the City's existing financial policies as well as consideration for minimizing rates as much as possible for the City's customers. The results of the analysis showed the need for 8.5 percent rate increases in both 2017 and 2018, then 5 percent annual increases in 2019 through 2023, and then settling on 3 percent per year thereafter. The impact to the City's average single family customers peaks at $2.40 per two month billing period to in 2018 but otherwise averages $1.68 per bill among all the analysis period

Table 9-6. Revenue Requirement Analysis

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Available Funds										
Rate Revenue	$8,782	$8,800	$8,817	$8,835	$8,852	$8,870	$8,888	$8,906	$8,923	$8,941
Miscellaneous Revenue	$303	$317	$330	$333	$336	$341	$347	$354	$360	$367
Total Available Funds	**$9,085**	**$9,117**	**$9,147**	**$9,168**	**$9,189**	**$9,211**	**$9,235**	**$9,260**	**$9,284**	**$9,308**
Application of Funds										
Operations & Maintenance	$5,942	$6,049	$6,243	$6,445	$6,654	$6,870	$7,095	$7,329	$7,571	$7,823
Capital Funded Through Rates	$750	$800	$1,050	$1,100	$1,250	$1,350	$1,450	$1,500	$1,650	$1,700
Taxes and Transfers	$1,866	$2,033	$2,239	$2,019	$2,131	$2,246	$2,445	$2,306	$2,272	$2,387
Debt Service	$1,093	$1,416	$1,190	$1,623	$1,618	$1,683	$1,678	$1,914	$1,909	$1,857
Total Application of Funds	**$9,651**	**$10,298**	**$10,723**	**$11,187**	**$11,653**	**$12,149**	**$12,668**	**$13,049**	**$13,402**	**$13,767**
Cumulative Balance (Deficit) of Funds	($566)	($1,181)	($1,576)	($2,019)	($2,464)	($2,938)	($3,433)	($3,789)	($4,118)	($4,458)
Cumulative Balance(Deficit) as a % of Rates	8.5%	17.7%	23.6%	29.8%	36.3%	43.1%	50.2%	54.8%	59.4%	64.2%
Proposed Rate Adjustment	**8.5%**	**8.5%**	**5.0%**	**5.0%**	**5.0%**	**5.0%**	**5.0%**	**3.0%**	**3.0%**	**3.0%**
Additional Revenue from Rate Adj.	$746	$1,560	$2,082	$2,632	$3,212	$3,822	$4,466	$4,876	$5,300	$5,738
Less Additional Taxes From Rate Increase	$180	$378	$505	$613	$748	$884	$1,033	$1,087	$1,182	$1,280
Net Adjustment After Rate Increase	**$566**	**$1,181**	**$1,576**	**$2,019**	**$2,464**	**$2,938**	**$3,433**	**$3,789**	**$4,118**	**$4,458**
Avg. Single Family Residential Bill (12 CCF)	$28.51	$30.91	$32.48	$34.10	$35.78	$37.58	$39.44	$40.65	$41.88	$43.14
Annual $ Change	$2.21	$2.40	$1.57	$1.62	$1.68	$1.80	$1.86	$1.21	$1.23	$41.26
Cumulative $ Change	$2.21	$4.61	$6.18	$7.80	$9.48	$11.28	$13.14	$14.35	$15.58	$16.84

Note: Table Values in $1,000s

Table 9-7. Financial Policy Metrics

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Debt Service Coverage Ratio Before Adj.	0.94	0.66	0.64	0.41	0.29	0.17	0.05	(0.03)	(0.15)	(0.27)
Debt Service Coverage Ratio After Adj.	1.45	1.49	1.97	1.65	1.82	1.92	2.10	1.95	2.01	2.13
Debt Service as a % of Rev Requirement	11%	14%	11%	15%	14%	14%	13%	15%	14%	13%
Operating Fund										
Beginning Fund Balance	$2,463	$2,006	$1,696	$1,583	$1,326	$1,171	$1,134	$1,284	$1,359	$1,389
Additions	-	-	-	-	-	-	$150	$75	$29	$132
Uses	($457)	($310)	($113)	($257)	($155)	($37)	-	-	-	-
Ending Fund Balance	$2,006	$1,696	$1,583	$1,326	$1,171	$1,134	$1,284	$1,359	$1,389	$1,521
Days of O&M (Target = 60)	123	102	93	75	64	60	66	68	67	71
Capital Reserve Fund										
Beginning Fund Balance	$4,555	$2,774	$3,755	$766	$2,709	$787	$1,391	$821	$4,601	$756
Additions	$701	$980	-	$1,943	-	$604	-	$3,780	-	$100
Uses	($2,482)	-	($2,988)	-	($1,922)	-	($571)	-	($3,845)	-
Ending Fund Balance	$2,774	$3,755	$766	$2,709	$787	$1,391	$821	$4,601	$756	$856
Target Balance	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750

Note: Table Values in $1,000s

Several of the City's financial policy metrics are contained in Table 9-7. The table shows that DSCR fluctuates from year to year depending on the level of outstanding debt and the revenue including assumed rate adjustment in any year. The City's policy is that DSCR should target 2.0, meaning the funds remaining after subtracting O&M, taxes and transfers should be twice the annual debt service payment. Rating agencies consider a 2.0 as a very strong DSCR. The results show that the City is within range of their target in most years and averages 1.9 over the analysis period. The City's maximum debt service as a percentage of revenue requirement is well below the policy of 25 percent throughout the analysis period. The Operating Fund balance target is 60 days of O&M. The analysis indicates that the City is estimated be at a minimum of 68 days and as high as 123 days of O&M expense. The Capital Reserve Fund balance fluctuates year to year depending on the timing of bond issues. On average, during the analysis period the ending fund balance greatly exceeds the $750,000 target and on an annual basis the ending fund balance in not expected to drop below the City's ending fund balance target.

9.5 Assessment of Rates

Given the rate adjustment proposed in this section, the City should be able to adequately fund the capital program and run its operations in a sustainable manner.

The City bills its customer on a bimonthly basis. The existing water rate structure consists of a ready to serve charge based on meter size and a volumetric rate per hundred cubic feet (CCF) of consumption. Table 9-8 provides a historical perspective of the City's rates from 2009 to 2015. Previous to 2009, the City's rates were declining rate which is not considered conservation oriented rates. Declining rates is based on the premise of a volume discount which has been found to be contrary to conservation efforts.

Table 9-8. Historical Water Rates

	2009	2010	2011	2012-2013	2014 -2015
Inside City Rates (Bi-Monthly) Ready to Serve Charge					
3/4 inch and smaller	$9.79	$10.42	$11.04	$15.91	$17.54
1 inch	$13.57	$14.47	$15.33	$20.09	$22.14
1-1/2 inch	$22.94	$24.52	$25.95	$31.24	$34.43
2 inch	$34.24	$36.62	$38.74	$44.67	$49.23
3 inch	$60.60	$64.89	$68.62	$76.03	$83.80
4 inch	$98.25	$105.26	$111.30	$120.82	$133.17
6 inch	$192.31	$206.09	$217.90	$232.70	$256.48
8 inch	$380.52	$407.89	$431.22	$453.59	$499.94
10 inch	$568.68	$609.62	$644.47	$680.41	$749.93
12 inch	$832.15	$892.09	$943.08	$993.82	$1,095.37
Charge for Water Consumed (per CCF)	$1.29	$1.36	$1.44	$1.51	$1.46

Notes:
1. The minimum use charge is computed as the cost for six units of consumption divided by sixty days.
2. The minimum charge is the daily ready-to-serve charge plus the daily minimum use charge.
3. All charges for water supplied outside the city are computed by multiplying the applicable rates described above by one and one-half.

As has been the City's practice, the next rate study will be conducted in 2017. Rate studies often include some analysis of alternative rate structures the City can implement which address issues such as revenue stability and conservation goals. The City has been slowly shifting their rates to a structure that encourages conservation. Table 9-9 and Table 9-10 provide projected future rates given its current rate structure and the proposed rate increases. It should be noted that this is a somewhat simplified projection given the available data at the time of this study, and the rate study that is schedules to take place in 2017 may have results that very from this table due to updated data.

All charges for water supplied outside the city, including fire service shall be computed by multiplying the applicable rates set forth in Table 9-9 and Table 9-10 of this section by one and one-half (1.50).

Table 9-9. Projected Inside City Water Rates

	Current Rates	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Proposed Rate Increase		**8.5%**	**8.5%**	**5.0%**	**5.0%**	**5.0%**	**5.0%**	**5.0%**	**3.0%**	**3.0%**	**3.0%**
Inside City Rates (Bi-Monthly) Ready to Serve Charge											
3/4 inch and smaller	$17.54	$19.03	$20.65	$21.68	$22.76	$23.90	$25.10	$26.36	$27.15	$27.96	$28.80
1 inch	$22.14	$24.02	$26.06	$27.36	$28.73	$30.17	$31.68	$33.26	$34.26	$35.29	$36.35
1-1/2 inch	$34.43	$37.36	$40.54	$42.57	$44.70	$46.94	$49.29	$51.75	$53.30	$54.90	$56.55
2 inch	$49.23	$53.41	$57.95	$60.85	$63.89	$67.08	$70.43	$73.95	$76.17	$78.46	$80.81
3 inch	$83.80	$90.92	$98.65	$103.58	$108.76	$114.20	$119.91	$125.91	$129.69	$133.58	$137.59
4 inch	$133.17	$144.49	$156.77	$164.61	$172.84	$181.48	$190.55	$200.08	$206.08	$212.26	$218.63
6 inch	$256.48	$278.28	$301.93	$317.03	$332.88	$349.52	$367.00	$385.35	$396.91	$408.82	$421.08
8 inch	$499.94	$542.43	$588.54	$617.97	$648.87	$681.31	$715.38	$751.15	$773.68	$796.89	$820.80
0 inch	$749.93	$813.67	$882.83	$926.97	$973.32	$1,021.99	$1,073.09	$1,126.74	$1,160.54	$1,195.36	$1,231.22
12 inch	$1,095.37	$1,188.48	$1,289.50	$1,353.98	$1,421.68	$1,492.76	$1,567.40	$1,645.77	$1,695.14	$1,745.99	$1,798.37
Charge for Water Consumed per CCF	$1.46	$1.58	$1.71	$1.80	$1.89	$1.98	$2.08	$2.18	$2.25	$2.32	$2.39

Note: The City will apply the per CCF charge for all consumption beginning in 2017.

Table 9-10. Proposed Inside City Fire Service Rates

	Current Rates	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Proposed Rate Increase		**8.5%**	**8.5%**	**5.0%**	**5.0%**	**5.0%**	**5.0%**	**5.0%**	**3.0%**	**3.0%**	**3.0%**
Bulk (Hydrant) - Meter Assembly Use/Rent Daily Charge	$4.00	$4.00	$4.00	$4.20	$4.41	$4.63	$4.86	$5.10	$5.25	$5.41	$5.57
Charge for Water Consumed per CCF	$1.46	$1.58	$1.71	$1.80	$1.89	$1.98	$2.08	$2.18	$2.25	$2.32	$2.39
Fire Service Charges											
2 inch	$6.00	$6.51	$7.06	$7.41	$7.78	$8.17	$8.58	$9.01	$9.28	$9.56	$9.85
3 inch	$8.76	$9.50	$10.31	$10.83	$11.37	$11.94	$12.54	$13.17	$13.57	$13.98	$14.40
4 inch	$17.54	$19.03	$20.65	$21.68	$22.76	$23.90	$25.10	$26.36	$27.15	$27.96	$28.80
6 inch, including hydrant only	$51.56	$55.94	$60.69	$63.72	$66.91	$70.26	$73.77	$77.46	$79.78	$82.17	$84.64
8 inch	$109.82	$119.15	$129.28	$135.74	$142.53	$149.66	$157.14	$165.00	$169.95	$175.05	$180.30
10 inch	$197.46	$214.24	$232.45	$244.07	$256.27	$269.08	$282.53	$296.66	$305.56	$314.73	$324.17
12 inch	$319.12	$346.25	$375.68	$394.46	$414.18	$434.89	$456.63	$479.46	$493.84	$508.66	$523.92

9.5.1 Affordability

Water utility rates across the country are growing at a rate greater than inflation. This is due to significant capital improvement projects utilities must fund to properly maintain the water system and be in compliance with state and federal regulations.

A threshold of affordability has not been widely accepted within the water utility industry. Though it has not been deemed an industry standard, the EPA stated in a 1997 paper titled *EPA published Guidance for Financial Capability Assessment and Schedule Development*, that an unaffordable rate would be an annual bill in excess of 2 percent of Median Household Income.

The Census Bureau's American Community Survey estimates the City of Yakima's Median Household Income to be $40,726 per year in 2015. An average single family household's annual water bill is estimated to be $158 per year. Dividing the average annual bill by the Median Household Income produces values from 0.3 to 0.4 percent in 2009 and through 2015 as shown in Table 9-11.

Table 9-11. Median Household Income Compared to Average Single Family Rates

	2009	2010	2011	2012	2013	2014	2015
Median Household Income	$37,351	$39,706	$41,071	$40,569	$39,462	$40,189	$40,726
Estimated Annual Single Family Water Bill	$105	$111	$118	$150	$158	$158	$158
Water Costs as % of MHI	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%

If one were to consider 2 percent of Median Household Income a threshold of affordability it would be very clear that the City's rates are very affordable. For the City's rates to rise to the level to be unaffordability using this measure, the rates would have to increase by five times its current level assuming no growth in Median Household Income. The cumulative effect of the rate increases for this analysis is 64 percent, which means that the City's rates will likely remain affordable during the analysis period of this plan.