3 | SYSTEM ANALYSIS

INTRODUCTION

This chapter presents the City of Richland's (City) performance standards for infrastructure and an evaluation of the water system facilities' ability to meet current and future water demands based on adopted design standards included in this chapter. This evaluation addresses system facilities, including source of supply, water treatment, storage, transmission, and the distribution system. A summary of system deficiencies is presented together with alternatives to correct the deficiencies.

SYSTEM DESIGN STANDARDS

The City has adopted design and construction standards for all new construction. All City and developer constructed projects are required to be designed and constructed to these standards. Standards related to physical configuration and operational requirements can be found in **Chapter 7**. The City adopts the most current versions of the following agency and organizational standards as minimum requirements.

- Washington State Department of Health (DOH) – *Water System Design Manual*
- Washington Administrative Code (WAC) – Chapter 246-290
- Revised Code of Washington (RCW)
- American Public Works Association (APWA)
- Washington State Department of Transportation (WSDOT) – *Standard Specifications for Road, Bridge, and Municipal Construction*
- WSDOT – Local Agency General Special Provisions
- American Water Works Association (AWWA)
- International Building Code (IBC)
- International Plumbing Code (IPC)

A copy of the standard specifications and details available to the public are included in **Appendix I**. Current versions of the standard specifications and details are also available on the City's website. The following sections describe the City's performance standards that may not be addressed or exceed those listed in the above standards.

WATER QUALITY

1. The City will pursue steps to meet or exceed water quality laws and standards. The City will take reasonable measures to protect its system and customers.
2. Water quality criteria shall meet, at a minimum, the requirements of WAC 246-290-300, 246-290-310, 246-290-320, 246-290-451, and 246-290-480.
3. Drinking water additives shall be compliant with National Sanitation Foundation (NSF) 60 and coatings in contact with drinking water shall be compliant with NSF 61.
4. The quality of the water source shall continuously meet the primary and secondary drinking water standards of the State of Washington and the U.S. Environmental Protection Agency's Safe Drinking Water Act.

AVERAGE AND MAXIMUM DAILY DEMANDS

1. Demand sizing shall comply with WAC 246-290-221.
2. The capacity of the source of supply pumps and transmission mains shall be sufficient to meet maximum day demands (MDD) and replenish storage used during a fire within 72 hours of a fire or other emergency. The supply system should be capable of meeting these criteria with the largest regular supply pump out of service or any other combination of failure that is considered reasonably possible that has an effect on supply sizing, locating, or planning.

PEAK HOUR DEMAND

1. Demand sizing shall comply with WAC 246-290-221.
2. Each pressure zone shall be capable of providing, through supply and storage, the peak hour demand of that pressure zone, without the need for outside or emergency supply.

PUMP STATIONS

1. Pump stations shall include a minimum of two pumps, each sized to meet the MDD requirements. The City shall decide if a spare third bay for installation of an additional pump is required in the future.
2. Pump stations shall be designed to provide ample working space with minimal structural maintenance requirements.
3. Pumps shall be selected to operate within 2 percent of their maximum rated efficiency point at normal system operating conditions.
4. The City shall evaluate and decide if a variable speed drive is required for any new or upgraded pump station.

STORAGE

1. Storage sizing shall comply with WAC 246-290-222 and 246-290-250.
2. Storage must be of sufficient capacity to supplement transmission supply when MDDs are greater than the supply rate and still maintain sufficient storage for a fire or other emergency condition.
3. Under normal conditions, equalizing storage should be replenished within a 24-hour cycle.
4. Standby storage volume must be replenished in 72 hours while continuing to deliver MDD.
5. Nesting of standby and fire flow storage is allowed.
6. Two tanks per pressure zone shall be provided, if practical, to maximize reliability by keeping one reservoir active should the other need to be taken out of service for maintenance.
7. Sizing of new reservoirs will consider current fire flow standards for "grandfathered" facilities.
8. The City will have high-water level and low-water level alarms at the Operations and Maintenance office.
9. A water level indicator will be located at the Operations and Maintenance office.
10. Storage facilities will be located in areas where they will satisfy the following requirements.

a. Minimum fluctuations in system pressure during normal demands.
b. Maximum use of the storage facilities during fires and peak demands.
c. Improve the reliability of supply to the City.

FIRE FLOW

1. Fire Flow rate and duration as established by the City shall be the design basis for sizing system improvements, including storage and distribution.
2. The following documents are additionally used to establish the minimum standards: American Water Works Association – *Distribution System Requirements for Fire Protection;* Insurance Services Office – *Fire Suppression Rating Schedule*; DOH – *Group A Public Water Systems* and DOH – *Water System Design Manual.*

Fire flow demand is the amount of water required during firefighting as defined by applicable codes. Fire flow requirements are nationally established for individual buildings and expressed in terms of flow rate (gallons per minute (gpm)) and flow duration (hours). Fighting fires imposes the greatest demand on the water system because a high rate of water must be supplied over a period of time, thus requiring each component of the system to be properly sized and configured to operate at its optimal condition while continuing to provide potable water to the community. Adequate storage and supply is ineffective if the transmission or distribution system cannot deliver water at the required rate and pressure necessary to extinguish a fire.

Planning-level fire flow requirements are established by the City for the different land use categories to provide a target level of service for planning and sizing future water facilities. The City's planning-level fire flow requirement for each land use category is shown in **Table 3-1**; the water system analyses presented in this chapter are based on an evaluation of the water system providing sufficient fire flow in accordance with these requirements in addition to the system's projected demands. The fire flow requirements shown do not necessarily equate to actual existing or future fire flow requirements at all buildings, as requirements are typically based on actual building size, construction type, and fire suppression systems provided. Improvements to increase the available fire flow to exceed the fire flow requirements shown in **Table 3-1** shall be the responsibility of the developer. **Table 3-1** does not include potential reductions in fire flow if automatic sprinkler systems are installed within buildings. Automatic sprinkler systems generally reduce the fire flow requirement for new buildings, which will likely result in fire flow requirements that are lower than the general planning-level fire flow requirements.

Table 3-1
Planning-level Fire Flow Requirements

Land Use	Planning-level Fire Flow Requirement (gpm)	Duration (hours)
Single-family Residential	1,500	2
Multi-family Residential	1,500	2
Commercial/Schools	3,500	3
Industrial	4,000	4
Heavy Industrial	4,500	5

The City will endeavor to provide these capacities in the appropriate land use area. However, there may be individual buildings or developments that exceed the typical requirements of the local land use. In these cases, the City will require those developments to provide the infrastructure improvements necessary to meet the additional fire flow needs. When such improvements provide benefit to the City as a whole, the City may elect to share the costs of the improvements.

PRESSURE

1. The City shall endeavor to provide a minimum of 40 pounds per square inch (psi) at customer meters during normal demand conditions, and 30 psi at customer meters during peak hour demand (PHD), not including a fire or emergency.
2. The City shall endeavor to provide a maximum of 120 psi at customer meters during normal demand conditions, not including pressure surges. Individual customers are responsible for providing pressure reducing valves at their service when pressure exceeds 80 psi.
3. During a failure of any part of the system, the maximum pressure shall not exceed the normal pressure rating of the weakest components, generally 150 psi.

PIPELINES

1. The minimum water main size shall be 8-inch diameter. At the City's discretion, smaller pipes may be used for dead-end mains.
2. Where practical, the velocity of water in transmission and distribution mains should be less than 8 feet per second (fps) during PHD.
3. Where practical, distribution mains shall be looped to increase reliability and water quality, and decrease head losses.
4. All pipes larger than 8-inch diameter and in commercially zoned areas shall be ductile iron. Pipes 8-inches in diameter and smaller in residential areas may be C900 polyvinyl chloride (PVC) or ductile iron.
5. A minimum of 10 feet of separation shall be maintained between storm, sewer, and water mains unless it can be shown that such separation is unfeasible.
6. Clearance between water mains and both sanitary sewer and irrigation mains shall follow Washington State Department of Ecology (Ecology) and DOH separation standards.
7. All water mains shall be installed with a minimum of 48 inches of cover.

TELEMETRY SYSTEM

1. Pump stations and reservoirs shall be equipped with telemetry control panels and a programmable logic controller (PLC). The telemetry equipment shall be compatible with the City's current technology, allowing the City to access facility information, control, and alarms from the master telemetry unit (MTU), remote computers, cell phones, iPads, and pagers.
2. Telemetry equipment shall include backup power, surge, and lightning protection, and be easily capable of expansion for additional input and output signals.
3. Telemetry equipment shall be programmed by an integrator of the City's choice. Preprogrammed "package" control units are not allowed.

BACK-UP POWER REQUIREMENTS

1. Reliability standards per WAC 246-293-660 shall be followed.

2. Closed zone pump stations shall have permanent backup power installed onsite with an automatic transfer switch.
3. All new pump stations shall include provisions for connecting a portable engine generator to run the facility in the event of a power failure.
4. All telemetry equipment shall include an automatic battery backup.

VALVE AND HYDRANT SPACING

1. Zone valves shall be located at all pressure zone interfaces to allow future pressure zone realignment without the need for additional pipe construction.
2. Isolation valves shall be located wherever necessary to allow individual pipelines to be shut down for repair or installation of new branch mains. In general, three valves shall be provided per cross and two valves per tee.
3. Valves shall be placed at a maximum of 1,000-foot intervals where practical.
4. Combination air/vacuum valves shall be evaluated on a case-by-case basis at all high points.

WATER SYSTEM ANALYSIS

PRESSURE ZONES

The ideal static pressure of water supplied to customers is between 40 and 80 psi. Pressures within a water distribution system are commonly as high as 120 psi, requiring pressure regulators on individual service lines to reduce the pressure to 80 psi or less. It is difficult for the City's water system (and most others) to maintain distribution pressures between 40 and 80 psi, primarily due to the topography of the water service area. The City's plat maps identify the need for individual PRVs at specific high-pressure locations, and it is the developer's responsibility to review the plat maps and notify home builders of the need for an individual PRV. The City's building department also identifies the need for an individual PRV on the field set of plans during the construction of each new building.

Table 3-2 lists each of the City's nine pressure zones, the highest and lowest elevation served in each zone, and the minimum and maximum distribution system pressures within each zone, based on maximum static water conditions (full reservoirs and zero demands). The City is currently providing water at pressures of at least 35 psi throughout the entire water system, as shown in the table. These pressures are higher than the Washington State Department of Health (DOH) minimum requirement of 30 psi. The lowest pressures in the distribution system occur in the Tapteal I pressure zone along Orchard Way west of Leslie Road. The highest pressures in the water system occur on the west side of the Tapteal IV pressure zone in transmission main on the discharge side of the Badger Mountain South Booster Pump Station (BPS). The highest pressures in the Tapteal II pressure zone, on the west side of Riverwood Street. The services at this location, as well as services in other pressure zones, have static pressures greater than 80 psi. All water services in these high pressure areas have individual pressure reducing valves to reduce the service pressure to 80 psi or less.

Table 3-2
Minimum and Maximum Distribution System Pressures

Pressure Zone	Zone Hydraulic Grade (feet)	Highest Elevation Served		Lowest Elevation Served	
		Elevation (feet)	Static Pressure (psi)	Elevation (feet)	Static Pressure (psi)
Core 548	548	427	53	353	84
Horn Rapids	603	488	50	393	91
Tapteal I	657	577	35	412	106
Tapteal II	798	698	43	442	154
Tapteal III	902	813	39	675	98
Tapteal IV	1,052	894	68	618	188
Tapteal V	1,203	1,091	49	1,000	88
Core Y	561	423	60	353	90
Riverwood	558	432	55	412	64

NOTE: All hydraulic grades and elevations are based on the North American Vertical Datum of 1988.

SOURCE ANALYSIS

This section evaluates the City's sources to determine if they have sufficient capacity to provide water supply to the system at a rate that meets the existing and future demands of the system. This section also identifies deficiencies that are unrelated to the capacity of the facilities.

Source Analysis Criteria

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

Source Analysis Results

The City's existing active sources include North Richland Wellfield and Wellsian Way Wells, and the City's Columbia River surface water treatment plant (WTP). The combined capability of these sources to meet both existing and future demand requirements, based on existing pumping capacities of the individual supply facilities, is presented in **Table 3-3**.

Table 3-3
Water Source Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Source Capacity (gpm)					
Maximum Day Demand	24,786	28,940	30,717	31,606	35,671
BMID Interie	158	200	228	242	368
West Richland Intertie	2,500	2,500	2,500	2,500	2,500
Total	**27,444**	**31,640**	**33,445**	**34,348**	**38,540**
Available Source Capacity (gpm)					
Columbia Well - 1100B	730	730	730	730	730
WTP	25,000	25,000	25,000	25,000	25,000
Wellsian Way - 5 Wellsian Way -14	1,500	1,500	1,500	1,500	1,500
N. Richland Wellfield	10,400	10,400	10,400	10,400	10,400
South Richland Well	---	---	---	---	1,500
Total Source Capacity	**37,630**	**37,630**	**37,630**	**37,630**	**39,130**
Surplus or Deficient Source Capacity (gpm)					
Surplus or Deficient Amount	**10,186**	**5,990**	**4,185**	**3,282**	**590**

The projected MDD shown in **Table 3-3** are the demand projections without reductions from water use efficiency efforts, as shown in **Table 2-13** of **Chapter 2**. Therefore, if additional reductions in water use are achieved through water use efficiency efforts, the total source capacity required in the future will be less than that shown in the table.

The results of the source capacity evaluation indicate the City has approximately 10,186 gpm of surplus source capacity to meet existing demands. The City's existing active sources are sufficient to meet the projected demands of the system beyond 2027, but additional source capacity is needed to meet the projected 2036 demands. The City has an Ecology groundwater well permit for a 1,500 gpm well in south Richland. The City drilled a pilot well in Summer 2016, and found that the water quality of the well is not suitable for use in the City's system. The City plans to evaluate other locations in south Richland that may have acceptable water quality throughout the 2027 planning period. Additional source capacity is not needed within the 12-year (2027) planning period of this WSP. The projected 2036 source capacity shown in **Table 3-3** assumes that a 1,500 gpm south Richland well is connected to the system.

Source Deficiencies

The United States Army Corps of Engineers, Walla Walla District, published an environmental assessment in November 2015 regarding water intake facilities in the McNary and Ice Harbor Reservoirs. The City's Columbia River intake facility, originally constructed in 1963 and equipped with screens that do not meet the current National Marine Fisheries Service (NMFS) screen criteria for fry protection, was identified as requiring screen upgrades prior to 2020 in order to receive a renewed easement for the intake facility. An improvement to resolve this deficiency is identified in **Chapter 8**.

The High Service BPS at the City's WTP has adequate pumping capacity to meet the existing supply requirements of the water system. However, the loss of one or more large pumps would put a strain on water supply in the summer. Specifically, the loss of High Service Pump No. 7 (HS7), which is the only pump at the High Service BPS equipped with a variable frequency drive (VFD), could make operation of the WTP cumbersome until HS7 could be returned to operation. A new pump is identified to be installed in **Chapter 8**.

SUPPLY ANALYSIS

This section evaluates the City's existing supply facilities to determine if they have sufficient capacity to provide water supply at a rate that meets the existing and future demands of the one or more zones that they supply. This section also identifies facility deficiencies that are not related to the capacity of the supply facilities.

Supply Analysis Criteria

The evaluation to determine if supply facilities have adequate capacity is based on one of two criteria, as follows: 1) if the pressure zone that the facility provides supply into has water storage, then the amount of supply required is equal to the MDD of the zone; or 2) if the pressure zone that the facility provides supply into does not have water storage, then the amount of supply required is equal to the PHD and the maximum fire flow requirement of the zone. The higher supply requirement of the latter criteria is due to the lack of equalizing and fire flow storage that is typically utilized to provide short-term supply during times of peak system demands.

The available supply to each pressure zone is based on the maximum pumping capacity of each facility with all pumping units operating, per the requirements of WAC 246-290-230. The DOH *Water System Design Manual* recommends that additional capacity or redundancy be considered, and that new pumping facilities also be designed to provide the average day demand (ADD) of the zone with the largest pumping unit out of service. Calculations were performed for each pressure zone based on each criterion, with a description of the results provided for each pressure zone in the following sections.

Supply Analysis Results

Core 548 Facilities

The Columbia River WTP, NRW, Columbia Well, and Wellsian Way Wells provide water supply directly to the Core 548 Zone, and the City's future Duportail Well will also provide supply directly to the Core 548 Zone. These supply facilities directly and indirectly supply all of the City's customers, via pressure reducing stations and booster pump stations (BPS), and therefore, are required to meet the system's existing and projected MDDs. The system-wide supply evaluation presented in **Table 3-3** is identical to the supply evaluation for the Core 548 Zone. The results of the analyses indicate that the existing configurations have sufficient capacity to meet the required demands through the 2027 planning period, and additional source capacity is needed to meet the projected 2036 demands.

Calculations were performed for the Core 548 Zone based on the ADD supply requirements and the available supply with the largest pumping unit out of service. The results indicate that the calculations presented in **Table 3-3**, which are based on the MDD supply requirements and the full pumping capacity of the supply facilities, are more conservative, resulting in a smaller supply surplus in the existing and future planning periods. Further, based on the ADD supply requirements, the existing sources are sufficient to supply the system through the 2036 planning period, without additional source capacity.

Horn Rapids Facilities

Water supply to the Horn Rapids Zone is currently provided by the Horn Rapids BPS. The Horn Rapids BPS is required to meet the existing and projected MDDs for the Horn Rapids Zone. **Table 3-4** summarizes the existing and future supply requirements of Horn Rapids Zone. The results of the analyses indicate that the existing BPS has sufficient capacity to meet existing and projected demands.

Table 3-4
Horn Rapids Zone Supply Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Supply (gpm)					
Horn Rapids MDD	326	845	1,067	1,178	1,687
Other Zones MDD	0	0	0	0	0
Total Required Supply	**326**	**845**	**1,067**	**1,178**	**1,687**
Available Supply (gpm)					
Horn Rapids BPS	3,880	3,880	3,880	3,880	3,880
Total Available Supply	**3,880**	**3,880**	**3,880**	**3,880**	**3,880**
Surplus or Deficient Supply (gpm)					
Surplus or Deficient Amount	**3,554**	**3,035**	**2,813**	**2,702**	**2,193**

Calculations were performed for the Horn Rapids Zone based on the ADD supply requirements and the available supply with the largest pumping unit out of service. The results indicate that the calculations based on the ADD supply requirements are more conservative than the MDD-based calculations presented in **Table 3-4**. However, the calculated Horn Rapids Zone supply surplus exceeds 1,500 gpm in each of the existing and future planning periods, and therefore the analyses indicate that the existing Horn Rapids BPS has sufficient capacity to meet existing and projected demands.

Tapteal I Zone Facilities

Water supply to the Tapteal I Zone is currently provided by the Badger Mountain 1 and 2 BPSs. These BPSs also indirectly supply the Tapteal II, III, IV, and V Zones, and the City of West Richland Intertie, via other BPSs. The Tapteal I BPSs are required to meet the existing and projected MDDs for the Tapteal I Zone, and the MDDs of the indirectly supplied pressure zones. **Table 3-5** summarizes the existing and future supply requirements of the Tapteal I Zone. The results of the analyses indicate that the existing BPSs have sufficient capacity to meet the existing and projected 2021 demands, which include the BMID demands for the purpose of these analyses. Additional supply capacity will be required between the 2021 and 2025 planning periods to resolve the projected pumping deficiency if supply is still provided to BMID. If the City's temporary supply agreement with BMID is discontinued prior to 2025, the existing Tapteal I Zone supply facilities will have sufficient capacity through 2025, but not through 2027. Capital improvement program (CIP) P1, described in detail in **Chapter 8**, identifies an increase in pumping capacity at the Badger Mountain 1 BPS to resolve the projected 2025 supply deficiency, with the improvement scheduled to be completed in 2021.

Table 3-5
Tapteal I Zone Supply Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Supply (gpm)					
Tapteal I MDD	3,936	4,308	4,467	4,547	4,912
Other Zones MDD	2,344	3,129	3,488	3,665	4,533
West Richland MDD	2,500	2,500	2,500	2,500	2,500
Total Required Supply	**8,779**	**9,937**	**10,456**	**10,712**	**11,945**
Available Supply (gpm)					
Badger Mt. 1 BPS	4,300	4,300	4,300	4,300	4,300
Badger Mt. 2 BPS	6,000	6,000	6,000	6,000	6,000
Total Available Supply	**10,300**	**10,300**	**10,300**	**10,300**	**10,300**
Surplus or Deficient Supply (gpm)					
Surplus or Deficient Amount	**1,521**	**363**	**(156)**	**(412)**	**(1,645)**

Calculations were performed for the Tapteal I Zone based on the ADD supply requirements and the available supply with the largest pumping unit out of service. The results indicate that the calculations presented in **Table 3-5**, which are based on the MDD supply requirements and the full pumping capacity of the supply facilities, are more conservative, with the ADD-based evaluation calculating that the existing pumping facilities are sufficient to supply the system through the 2036 planning period with the largest pumping unit out of service.

Tapteal II Zone Facilities

Water supply to the Tapteal II Zone is currently provided by the Tapteal II and Keene Road BPSs. These BPSs also indirectly supply Tapteal III and V Zones via other BPSs, and will indirectly supply a portion of the Tapteal IV in the future. The Tapteal II Zone BPSs are required to meet the existing and projected MDDs for the Tapteal II Zone and the indirectly supplied pressure zones. **Table 3-6** summarizes the existing and future supply requirements of the Tapteal II Zone. The results of the analyses indicate that the existing BPSs have sufficient capacity to meet existing and projected demands through the 2036 planning period.

Table 3-6
Tapteal II Zone Supply Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Supply (gpm)					
Tapteal II MDD	1,310	1,434	1,487	1,514	1,635
Other Zones MDD	411	473	513	530	900
Total Required Supply	**1,721**	**1,907**	**2,000**	**2,044**	**2,536**
Available Supply (gpm)					
Tapteal II BPS	1,900	1,900	1,900	1,900	1,900
Keene Rd. BPS	1,600	1,600	1,600	1,600	1,600
Total Available Supply	**3,500**	**3,500**	**3,500**	**3,500**	**3,500**
Surplus or Deficient Supply (gpm)					
Surplus or Deficient Amount	**1,779**	**1,593**	**1,500**	**1,456**	**964**

Calculations were performed for the Tapteal II Zone based on the ADD supply requirements and the available supply with the largest pumping unit out of service. The results indicate that the calculations presented in **Table 3-6**, which are based on the MDD supply requirements and the full pumping capacity of the supply facilities, present approximately the same supply surplus in the existing planning period and are more conservative for the future planning periods.

Tapteal III Zone Facilities

The existing Tapteal III Zone is currently comprised of two distinct areas, one served by the Westcliffe BPS and Reservoirs, and one served by a pressure reducing valve (PRV) from the Tapteal V Zone. A future transmission main is proposed to connect these two operating areas, as described in **Chapter 8**. For the purposes of these analyses, half of the Tapteal III water supply is assumed to be supplied by the Westcliffe BPS for the existing, 2021, 2025, and 2027 analyses, with the remaining supply conveyed from the Tapteal V Zone via an existing PRV. The proposed Tapteal III Zone transmission main is anticipated to be constructed between 2027 and 2036, and the 2036 analyses therefore assume all Tapteal III Zone supply to be provided by the Westcliffe BPS. The existing Tapteal III Zone does not provide indirect supply to other pressure zones, the Tapteal III Zone will indirectly supply a portion of the Tapteal IV Zone in the future. **Table 3-7** summarizes the existing and future supply requirements of the Tapteal III Zone. The results of the analyses indicate that the existing BPS has sufficient capacity to meet existing and projected demands through the 2036 planning period.

Table 3-7
Tapteal III Zone Supply Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Supply (gpm)					
Tapteal III MDD	205	225	233	237	513
Other Zones MDD	0	0	0	0	294
Total Required Supply	**205**	**225**	**233**	**237**	**807**
Available Supply (gpm)					
Westcliffe BPS	1,400	1,400	1,400	1,400	1,400
Total Available Supply	**1,400**	**1,400**	**1,400**	**1,400**	**1,400**
Surplus or Deficient Supply (gpm)					
Surplus or Deficient Amount	**1,195**	**1,175**	**1,167**	**1,163**	**593**

Calculations were performed for the Tapteal III Zone based on the ADD supply requirements and the available supply with the largest pumping unit out of service. The results indicate that the calculations based on the ADD supply requirements are more conservative than the MDD-based calculations presented in **Table 3-7**. However, the calculated Tapteal III Zone supply surplus exceeds 375 gpm in each of the existing and future planning periods, and therefore the analyses indicate that the existing Westcliffe BPS has sufficient capacity to meet existing and projected demands.

Tapteal IV Zone Facilities

Water supply to the Tapteal IV Zone is currently provided by the Badger Mountain South BPS. The Badger Mountain South BPS is required to meet the existing and projected MDDs for the Tapteal IV pressure zone, the isolated portion of the Tapteal III Zone in the Badger Mountain South area, and the BMID MDD. Future water system improvements are proposed to provide additional supply from the Tapteal V Zone to the Tapteal IV Zone, as described in **Chapter 8**. **Table 3-8** summarizes the existing and future supply requirements of Tapteal IV with only the existing Badger Mountain South BPS operating. The results of the analyses indicate that the existing configuration has sufficient capacity to meet existing and projected 2021, 2025, and 2027 planning period demands, including the BMID demands. Additional supply capacity will be required between 2025 and 2027 to resolve the projected pumping deficiency if supply to BMID is still necessary. If the City's temporary agreement with BMID is terminated prior to 2027, the existing configuration is sufficient to meet the supply requirements of the Tapteal IV Zone. The City proposes to resolve any future Tapteal IV Zone supply deficiency with supply from the Tapteal V Zone via a PRV.

Table 3-8
Tapteal IV Zone Supply Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Supply (gpm)					
Tapteal IV MDD	65	438	605	688	1,069
Badger Mt. South Tapteal III MDD	0	146	202	229	356
BMID MDD	158	200	228	242	368
Total Required Supply	**223**	**785**	**1,035**	**1,160**	**1,794**
Available Supply (gpm)					
Badger Mt. South BPS	1,500	1,500	1,500	1,500	1,500
Total Available Supply	**1,500**	**1,500**	**1,500**	**1,500**	**1,500**
Surplus or Deficient Supply (gpm)					
Surplus or Deficient Amount	**1,277**	**715**	**465**	**340**	**(294)**

Calculations were performed for the Tapteal IV Zone based on the ADD supply requirements and the available supply with the largest pumping unit out of service. The results indicate that the calculations presented in **Table 3-8**, which are based on the MDD supply requirements and the full pumping capacity of the supply facilities, are more conservative, resulting in a smaller supply surplus in the 2021, 2025, 2027, and 2036 planning periods, and a smaller deficiency in the 2036 planning period.

Tapteal V Zone Facilities

Water supply to the Tapteal V Zone is provided by the Meadow Hills BPS, which is required to meet the existing and projected demands for the Tapteal V Zone. The Tapteal V Zone currently provides indirect supply to an isolated portion of the Tapteal III Zone via an existing PRV. It is assumed that the Tapteal V Zone will continue to indirectly supply this portion of the Tapteal III Zone through the 2027 planning period. The Tapteal V Zone will also provide indirect supply to the Badger Mountain South subarea in the future, which for the purposes of these analyses was assumed to be equivalent to the Tapteal IV Zone supply deficiency in the 2036 planning period. **Table 3-9** summarizes the existing and future supply requirements of the Tapteal V Zone. The results of the analyses indicate that the existing BPS has sufficient capacity to meet existing and future demands, even if supply to BMID is still necessary through the 2036 planning period.

Table 3-9
Tapteal V Zone Supply Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Supply (gpm)					
Tapteal V MDD	0	23	47	55	93
Other Zones MDD	205	225	233	237	294
Total Required Supply	**205**	**248**	**280**	**292**	**387**
Available Supply (gpm)					
Meadow Hills BPS	700	700	700	700	700
Total Available Supply	**700**	**700**	**700**	**700**	**700**
Surplus or Deficient Supply (gpm)					
Surplus or Deficient Amount	**495**	**452**	**420**	**408**	**313**

Calculations were performed for the Tapteal V Zone based on the ADD supply requirements and the available supply with the largest pumping unit out of service. The results indicate that the calculations presented in **Table 3-9**, which are based on the MDD supply requirements and the full pumping capacity of the supply facilities, are more conservative, resulting in a smaller supply surplus in the existing and future planning periods.

Supply Facility Deficiencies

No BPS deficiencies exist beyond the capacity deficiencies summarized in the previous sections. The City is planning a pump and motor condition assessment for each pump in the water system within the next six years, as identified in **Chapter 8**. Condition-related deficiencies identified as part of the assessment will be prioritized and resolved on an as-needed basis.

SYSTEM STORAGE ANALYSIS

This section evaluates the City's existing water storage facilities to determine if they have sufficient capacity to meet the existing and future storage requirements of the system. This section also identifies facility deficiencies that are unrelated to the capacity of the water reservoirs.

Analysis Criteria

Water storage typically includes the following components: operational storage; equalizing storage; standby storage; fire flow storage; and dead storage. Each storage component serves a different purpose and will vary from system to system. A definition of each storage component used to evaluate the capacity of the City's reservoirs follows.

Operational Storage – Volume of the reservoir represented by the average amount of drawdown during normal operating conditions, which is essentially storage that will most likely not be available for equalizing, fire flow, or standby storage.

Equalizing Storage – Volume of the reservoir used to supply the water system under peak demand conditions when the system demand exceeds the total rate of supply of the sources. DOH requires that equalizing storage be stored above an elevation that will provide a minimum pressure of 30 psi at all connections throughout the system under PHD conditions. DOH requires the minimum equalizing storage volume to be calculated with Equation 9-1 from the DOH *Water System Design Manual*.

Equation 9-1: $ES = (PHD - Q_S)(150\ \text{minutes})$, but in no case less than zero.

Where:

ES = Equalizing Storage, in gallons.

PHD = Peak Hour Demand, in gpm.

Q_S = Sum of all installed and active sources, except emergency supply, in gpm.

Standby Storage – Volume of the reservoir used to supply the water system under emergency conditions, when supply facilities are out of service due to equipment failures, power outages, loss of supply, or transmission main breaks, and any other situation that disrupts the supply source. The DOH recommends that standby storage be stored above an elevation that will provide a minimum pressure of 20 psi at all service connections throughout the system. Equation 9-3 from the DOH *Water System Design Manual* presents the formula for calculating standby storage.

Equation 9-3: $SB = (2\ \text{days})[(ADD)(N) - t_m (Q_S - Q_L)]$

Where:

SB = Standby Storage, in gallons.

ADD = Average Day Demand per equivalent residential unit (ERU), in gallons per day (gpd) per ERU.

N = Number of ERUs.

Q_S = Sum of all installed and continuously available sources, except emergency supply, in gpm.

Q_L = The capacity of the largest source available to the system, in gpm.

t_m = Time the remaining sources are pumped on the day when the largest source is not available, in minutes. Unless otherwise restricted, this value is 1,440 minutes.

In addition to the standby storage requirements calculated from Equation 9-3, DOH recommends that the minimum standby storage volume be no less than 200 gallons per ERU.

Fire Flow Storage – Volume of the reservoir used to supply water to the system at the maximum rate and duration required to extinguish a fire at a building with the highest fire flow requirement. The magnitude of the fire flow storage is based on the volume of the building being protected, the occupancy hazard, and the construction class. The DOH requires that fire flow storage be stored above an elevation that will provide a minimum pressure of 20 psi at all service connections throughout the system under MDD conditions. The flow rate and duration of the maximum fire flow in each pressure zone are presented in each table in the evaluations that follow.

The City permits nesting of standby and fire flow storage. Nesting allows these two components to occupy the same space in the reservoir. The rationale behind nesting assumes it is highly unlikely a fire demand will occur at the same time as a major supply failure. The fire flow and standby storage components were nested the storage evaluations that follow.

Dead Storage – Volume of the reservoir that cannot be used because it is stored at an elevation that does not provide system pressures that meet the minimum pressure requirements established by the DOH without pumping. This unusable storage occupies the lower portion of most ground-level reservoirs. Water that is stored below an elevation that cannot provide a minimum pressure of 20 psi is considered dead storage for the analyses that follow.

Storage Analysis Results

System-wide Storage

The storage analyses are based on an evaluation of the existing storage facilities providing water to the City's distribution system. The maximum combined storage capacity of the City's reservoirs is 23.48 MG, as shown in **Table 3-10**. This volume does not include the capacity of storage facilities used for treatment that require pumping to higher pressure zones to be utilized by the City's customers, such as the WTP clearwell and the 1182 Reservoirs. Operational storage is based on BPS setpoints provided by the City. The resulting operational storage levels are presented in **Table 3-11**. Equalizing storage is based Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system for the existing and 2021 planning periods, as it is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. The standby storage for the 2025, 2027, and 2036 planning periods is based on the results of Equation 9-3 in the DOH *Water System Design Manual*. The only dead storage (i.e., non-usable storage) in the water system is in the Tapteal IV Zone, as a result of outlet piping configuration within the Badger Mountain South reservoirs. The results of the existing storage evaluation, as shown in **Table 3-10**, indicate that the system currently has a storage surplus of approximately 9.28 MG.

Table 3-10
System-wide Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	23.48	23.48	23.48	23.48	23.48
Dead (Non-usable) Storage	0.06	0.06	0.06	0.06	0.06
Total Available Storage	**23.42**	**23.42**	**23.42**	**23.42**	**23.42**
Required Storage (MG)					
Additive Components					
Operational Storage	9.67	9.67	9.67	9.67	9.67
Equalizing Storage	0.00	0.67	1.03	1.22	1.85
Totals	**9.67**	**10.34**	**10.71**	**10.89**	**11.53**
Nested Components					
Standby Storage	4.46	5.32	6.33	7.69	9.84
Fire Flow Storage (4,500 gpm for 5 hours)	1.35	1.35	1.35	1.35	1.35
Total (Larger of Standby and Fire Flow)	**4.46**	**5.32**	**6.33**	**7.69**	**9.84**
Total Required Storage					
Total Required Storage	**14.14**	**15.66**	**17.04**	**18.58**	**21.37**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**9.28**	**7.76**	**6.38**	**4.84**	**2.05**

The system's future storage requirements, also shown in **Table 3-10**, were computed for 2021, 2025, 2027, and 2036 planning periods, based on the corresponding demand projections shown in **Chapter 2**. The City is projected to have a system-wide storage surplus through the 21-year (2036) planning period.

Table 3-11
Existing System Operational Storage Water Levels

Name	Operational Storage Height	
	Water Level (feet)	HGL (feet)
Core 548 - 5 MG	9.0	537.4
Core 548 - 10 MG	21.0	537.9
Horn Rapids	9.0	606.4
Tapteal IA	24.0	650.4
Tapteal IB	24.0	650.4
Tapteal IIA	8.0	791.4
Tapteal IIB	11.5	791.4
Country Ridge A	9.0	785.4
Country Ridge B	9.0	785.4
Westcliffe A	11.0	892.4
Westcliffe B	11.0	892.4
Badger South - North	5.5	1,036.9
Badger South - South	5.5	1,036.9
Meadow Hills A	7.0	1,195.9
Meadow Hills B	7.0	1,195.9

NOTE: Hydraulic grades are shown based on NAVD 88.

Core 548 Zone Storage

The storage capacity of the Core 548 zone's reservoirs is 16.14 MG, as shown in **Table 3-12**. Operational storage is based on BPS setpoints provided by the City. Equalizing storage is based on Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. There is currently no dead storage in the Core 548 zone. The results of the existing storage evaluation, as shown in **Table 3-12**, indicate that the zone currently has a storage surplus of approximately 6.61 MG.

Table 3-12
Core 548 Zone Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	16.14	16.14	16.14	16.14	16.14
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00	0.00
Total Available Storage	**16.14**	**16.14**	**16.14**	**16.14**	**16.14**
Required Storage (MG)					
Additive Components					
Operational Storage	6.48	6.48	6.48	6.48	6.48
Equalizing Storage	0.00	0.00	0.00	0.00	0.00
Totals	**6.48**	**6.48**	**6.48**	**6.48**	**6.48**
Nested Components					
Standby Storage	3.05	3.51	3.69	3.78	4.20
Fire Flow Storage (4,500 gpm for 5 hours)	1.35	1.35	1.35	1.35	1.35
Total (Larger of Standby and Fire Flow)	**3.05**	**3.51**	**3.69**	**3.78**	**4.20**
Total Required Storage					
Total Required Storage	**9.53**	**9.99**	**10.17**	**10.26**	**10.67**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**6.61**	**6.15**	**5.97**	**5.88**	**5.46**

The zone's future storage requirements, also shown in **Table 3-12**, were computed for the 2021, 2025, 2027, and 2036 planning periods, based on the corresponding demand projections shown in **Chapter 2**. The zone is projected to have a storage surplus through the 21-year (2036) planning period.

Horn Rapids Zone Storage

The storage capacity of Horn Rapids elevated reservoir is 0.89 MG, as shown in **Table 3-13**. Operational storage is based on BPS setpoints provided by the City. Equalizing storage is based on Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system for the existing system, as it is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. The standby storage for all future planning periods is based on the results of Equation 9-3 in the DOH *Water System Design Manual*. There is currently no dead storage in the Horn Rapids elevated reservoir. The results of the existing storage evaluation, as shown in **Table 3-13**, indicate that the zone currently has a storage deficit of approximately 0.38 MG.

Table 3-13
Horn Rapids (Open System) Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	0.89	0.89	0.89	0.89	0.89
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00	0.00
Total Available Storage	**0.89**	**0.89**	**0.89**	**0.89**	**0.89**
Required Storage (MG)					
Additive Components					
Operational Storage	0.67	0.67	0.67	0.67	0.67
Equalizing Storage	0.00	0.00	0.00	0.00	0.00
Totals	**0.67**	**0.67**	**0.67**	**0.67**	**0.67**
Nested Components					
Standby Storage	0.05	0.14	0.18	0.20	0.28
Fire Flow Storage (4,000 gpm for 4 hours)[1]	0.60	0.60	0.60	0.60	0.60
Total (Larger of Standby and Fire Flow)	**0.60**	**0.60**	**0.60**	**0.60**	**0.60**
Total Required Storage					
Total Required Storage	**1.27**	**1.27**	**1.27**	**1.27**	**1.27**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**(0.38)**	**(0.38)**	**(0.38)**	**(0.38)**	**(0.38)**

(1) The maximum fire flow requirement of the Horn Rapids Zone is 4,000 gpm for 4 hours but has been reduced by 1,500 gpm in this evaluation to match the pumping capacity of the largest pump at the Horn Rapids BPS.

The Horn Raids BPS was constructed prior to the construction of the Horn Rapids elevated reservoir, and therefore was designed to be operated as a closed system, originally capable of meeting the PHD of the zone and fire flow up to approximately 3,000 gpm if all pumps are operational. With the Horn Rapids elevated tank now in service, the City designates the majority of the tank volume as operational storage to ensure acceptable water quality in the pressure zone as a result of the relatively low existing demands in the pressure zone compared to the reservoir's storage volume. This operational constraint results in an existing storage deficiency in the Horn Rapids Zone based on conventional storage calculation.

The Horn Rapids BPS is equipped with a 230 kW standby diesel generator with automatic transfer switch to maintain operation during a power failure. The City proposes to evaluate the Horn Rapids Zone as a closed zone, with storage utilized to minimize pump runtime and only for emergency conditions. The results of the Horn Rapids Zone supply evaluation are shown in **Table 3-14**, which indicate that the existing Horn Rapids BPS has a 901 gpm deficiency based on the existing PHD and maximum fire flow requirement. The City relies upon the Horn Rapids elevated reservoir to resolve this supply deficiency, which is calculated to be equivalent to 0.22 MG for the existing system, resulting in a required operational storage water level of 606.1 feet. The City is currently operating the Horn Rapids elevated reservoir at an elevation of 606.4 feet to meet the existing requirements of the zone. The City will increase the operating level of the reservoir as growth occurs in the Horn Rapids Zone, with an estimated water level of 612.9 feet required in 2021, 615.8 feet required in 2025, 617.3 feet required in 2027, and 623.9 feet required in 2036, as shown in **Table 3-14**.

Table 3-14
Horn Rapids (Closed System) Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Required Supply (gpm)					
Horn Rapids PHD	441	1,145	1,446	1,596	2,285
Maximum Fire Flow Requirement	4,000	4,000	4,000	4,000	4,000
Total Required Supply	**4,441**	**5,145**	**5,446**	**5,596**	**6,285**
Available Supply (gpm)					
Horn Rapids BPS[1]	3,540	3,540	3,540	3,540	3,540
Total Available Supply	**3,540**	**3,540**	**3,540**	**3,540**	**3,540**
Surplus or Deficient Supply (gpm)					
Surplus or Deficient Amount	**(901)**	**(1,605)**	**(1,906)**	**(2,056)**	**(2,745)**
Emergency Storage Requirements					
Available Storage (MG)	0.89	0.89	0.89	0.89	0.89
Pumping Deficiency Volume (MG)	0.22	0.39	0.46	0.49	0.66
Volume Remaining for Operational Storage (MG)	**0.68**	**0.51**	**0.44**	**0.40**	**0.23**
Minimum Operational Storage Water Level (feet)	606.1	612.9	615.8	617.3	623.9

(1) Pumping capacity with the largest routinely used booster pump out of service, per WAC 246-293-660(1).

Based on the results of the closed system storage evaluation, there are no capacity deficiencies in the existing or projected Horn Rapids Zone. However, as growth occurs in the Horn Rapids Zone and demands increase, it will become easier for the City to maintain acceptable water quality in the zone. In the future, the City will evaluate adding additional pumping and/or storage capacity in the Horn Rapids Zone as dictated by increased demands and operational needs.

Tapteal I Zone Storage

The storage capacity of Tapteal IA and Tapteal IB reservoirs is 3.43 MG, as shown in **Table 3-15**. Operational storage is based on BPS setpoints provided by the City. Equalizing storage is based on Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. There is currently no dead storage in the Tapteal IA or IB reservoirs. The results of the existing storage evaluation, as shown in **Table 3-15**, indicate that the zone currently has a storage surplus of approximately 1.65 MG.

Table 3-15
Tapteal I Zone Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	3.43	3.43	3.43	3.43	3.43
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00	0.00
Total Available Storage	**3.43**	**3.43**	**3.43**	**3.43**	**3.43**
Required Storage (MG)					
Additive Components					
Operational Storage	0.83	0.83	0.83	0.83	0.83
Equalizing Storage	0.00	0.00	0.00	0.00	0.00
Totals	**0.83**	**0.83**	**0.83**	**0.83**	**0.83**
Nested Components					
Standby Storage	0.96	1.13	1.20	1.24	1.45
Fire Flow Storage (3,500 gpm for 3 hours)	0.63	0.63	0.63	0.63	0.63
Total (Larger of Standby and Fire Flow)	**0.96**	**1.13**	**1.20**	**1.24**	**1.45**
Total Required Storage					
Total Required Storage	**1.78**	**1.95**	**2.03**	**2.07**	**2.28**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**1.65**	**1.48**	**1.40**	**1.36**	**1.16**

The zone's future storage requirements, also shown in **Table 3-15**, were computed for the 2021, 2025, 2027, and 2036 planning periods, based on the corresponding demand projections shown in **Chapter 2**. The zone is projected to have a storage surplus through the 21-year (2036) planning period.

Tapteal II Zone Storage

The storage capacity of the Tapteal II Zone's four reservoirs, the Tapteal IIA, Tapteal IIB, Country Ridge A, and Country Ridge B, is 1.23 MG, as shown in **Table 3-16**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. There is currently no dead storage in the Tapteal II Zone reservoirs. The results of the existing storage evaluation, as shown in **Table 3-16**, indicate that the zone currently has a storage surplus of approximately 0.05 MG. The City has intentionally set the operational storage range of the Tapteal II and Country Ridge Reservoirs to meet the storage requirements of the zone.

Table 3-16
Tapteal II Zone Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	1.23	1.23	1.23	1.23	1.23
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00	0.00
Total Available Storage	**1.23**	**1.23**	**1.23**	**1.23**	**1.23**
Required Storage (MG)					
Additive Components					
Operational Storage	0.56	0.56	0.56	0.56	0.56
Equalizing Storage	0.00	0.00	0.00	0.00	0.00
Totals	**0.56**	**0.56**	**0.56**	**0.56**	**0.56**
Nested Components					
Standby Storage	0.22	0.24	0.25	0.25	0.28
Fire Flow Storage (3,500 gpm for 3 hours)	0.63	0.63	0.63	0.63	0.63
Total (Larger of Standby and Fire Flow)	**0.63**	**0.63**	**0.63**	**0.63**	**0.63**
Total Required Storage					
Total Required Storage	**1.19**	**1.19**	**1.19**	**1.19**	**1.19**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**

The zone's future storage requirements, also shown in **Table 3-16**, were computed for the 2021, 2025, 2027, and 2036 planning periods, based on the corresponding demand projections shown in **Chapter 2**. The zone is projected to have a slight storage surplus through the 21-year (2036) planning period.

Tapteal III Storage

The combined storage capacity of the Westcliffe A and B Reservoirs is 0.40 MG, as shown in **Table 3-17**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. There is currently no dead storage in the Tapteal III Zone reservoirs. The results of the existing storage evaluation, as shown in **Table 3-17**, indicate that the zone currently has a storage surplus of approximately 0.03 MG. The City has intentionally set the operational storage range of the Westcliffe A and B Reservoirs to meet the storage requirements of the zone.

Table 3-17
Tapteal III Zone Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	0.40	0.40	0.40	0.40	0.40
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00	0.00
Total Available Storage	**0.40**	**0.40**	**0.40**	**0.40**	**0.40**
Required Storage (MG)					
Additive Components					
Operational Storage	0.19	0.19	0.19	0.19	0.19
Equalizing Storage	0.00	0.00	0.00	0.00	0.00
Totals	**0.19**	**0.19**	**0.19**	**0.19**	**0.19**
Nested Components					
Standby Storage	0.03	0.04	0.04	0.04	0.09
Fire Flow Storage (1,500 gpm for 2 hours)	0.18	0.18	0.18	0.18	0.18
Total (Larger of Standby and Fire Flow)	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**
Total Required Storage					
Total Required Storage	**0.37**	**0.37**	**0.37**	**0.37**	**0.37**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**

The zone's future storage requirements, also shown in **Table 3-17**, were computed for the 2021, 2025, 2027, and 2036 planning periods, based on the corresponding demand projections shown in **Chapter 2**. The zone is projected to continue to have a slight storage surplus through the 21-year (2036) planning period.

Tapteal IV Storage

The storage capacity of the Badger Mountain South Reservoirs is 0.98 MG, as shown in **Table 3-18**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. Approximately 0.06 MG of dead storage exists due to the outlet piping configuration within the reservoirs. The results of the existing storage evaluation, as shown in **Table 3-18**, indicate that the zone currently has a storage surplus of approximately 0.01 MG. The City has intentionally set the operational storage range of the Badger Mountain South Reservoirs to meet the storage requirements of the zone.

Table 3-18
Tapteal IV Zone Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	0.98	0.98	0.98	0.98	0.98
Dead (Non-usable) Storage	0.06	0.06	0.06	0.06	0.06
Total Available Storage	**0.92**	**0.92**	**0.92**	**0.92**	**0.92**
Required Storage (MG)					
Additive Components					
Operational Storage	0.73	0.73	0.73	0.68	0.68
Equalizing Storage	0.00	0.00	0.00	0.03	0.12
Totals	**0.73**	**0.73**	**0.73**	**0.71**	**0.80**
Nested Components					
Standby Storage	0.05	0.15	0.19	0.21	0.33
Fire Flow Storage[1]	0.18	0.18	0.18	0.18	0.63
Total (Larger of Standby and Fire Flow)	**0.18**	**0.18**	**0.19**	**0.21**	**0.63**
Total Required Storage					
Total Required Storage	**0.91**	**0.91**	**0.92**	**0.92**	**1.43**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**0.01**	**0.01**	**0.00**	**0.00**	**(0.51)**

(1) Existing, 6-, 10-, and 12-year requirement of 1,500 gpm for 2 hours. A school is anticipated to be constructed between the 12 and 21-year planning period, with a fire flow requirement of 3,500 gpm for 3 hours.

The zone's future storage requirements, also shown in **Table 3-18**, were computed for the 2021, 2025, 2027, and 2036 planning periods, based on the corresponding demand projections shown in **Chapter 2**. The zone is projected to have a storage surplus through 2025 based on the current operating level. An increased operational water level will be required in the following 2025 to meet the future demands of the operating area. The reservoirs are not currently completely filled during normal operations, and therefore have additional capacity that can be utilized in the future planning periods. The 2027 analyses assume the operational level of the Badger Mountain South Reservoirs is adjusted such that the zone has a projected storage surplus through 2027. The 2036 analyses assume the Tapteal V Zone is providing supplemental supply to the Tapteal IV Zone in the Badger

Mountain South Subarea. For the purposes of these analyses, the supplemental supply was assumed to be equivalent to the Tapteal IV Zone supply deficiency shown in **Table 3-8**.

Tapteal V Storage

The storage capacity of the Meadow Hills A and B reservoirs is 0.40 MG, as shown in **Table 3-19**. Operational storage is based on BPS set points provided by the City. Equalizing storage is based on Equation 9-1 in the DOH *Water System Design Manual*. Standby storage is calculated using two methods. Standby storage is based on a rate of 200 gpd per ERU in the system, which is more conservative than the results of Equation 9-3 in the DOH *Water System Design Manual*. There is currently no dead storage in the Meadow Hills reservoirs. The results of the existing storage evaluation, as shown in **Table 3-19**, indicate that the zone currently has a storage surplus of approximately 0.001 MG. The City has intentionally set the operational storage range of the Meadow Hills Reservoirs to meet the storage requirements of the zone.

Table 3-19
Tapteal V Zone Water Storage Capacity Evaluation

Description	Existing	Future Projections			
	2015	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)	2036 (+21 years)
Available/Usable Storage (MG)					
Maximum Storage Capacity	0.40	0.40	0.40	0.40	0.40
Dead (Non-usable) Storage	0.00	0.00	0.00	0.00	0.00
Total Available Storage	**0.400**	**0.400**	**0.400**	**0.400**	**0.400**
Required Storage (MG)					
Additive Components					
Operational Storage	0.22	0.22	0.22	0.22	0.22
Equalizing Storage	0.00	0.00	0.00	0.00	0.00
Totals	**0.22**	**0.22**	**0.22**	**0.22**	**0.22**
Nested Components					
Standby Storage	0.03	0.04	0.05	0.05	0.07
Fire Flow Storage (1,500 gpm for 2 hours)	0.18	0.18	0.18	0.18	0.18
Total (Larger of Standby and Fire Flow)	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**
Total Required Storage					
Total Required Storage	**0.399**	**0.399**	**0.399**	**0.399**	**0.399**
Surplus or Deficient Storage (MG)					
Surplus or Deficient Amount	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**

The zone's future storage requirements, also shown in **Table 3-19**, were computed for the 2021, 2025, 2027, and 2036 planning periods, based on the corresponding demand projections shown in **Chapter 2**. The zone is projected to have a slight storage surplus through the 21-year (2036) planning period. The 2036 analyses assume the Tapteal V Zone is providing supplemental supply to the Tapteal IV Zone in the Badger Mountain South subarea. For the purposes of these analyses, the supplemental supply was assumed to be equivalent to the Tapteal IV Zone supply deficiency shown in **Table 3-8**.

Storage Facility Deficiencies

The City inspects all reservoirs on an every-other-year basis, and performs repairs based on the results of the inspections in a timely manner. Currently, the Tapteal 1A Reservoir requires new coating, a new access hatch, and a new roof access ladder. Improvements to resolve existing storage deficiencies are typically funded from the City's operations and maintenance budget.

DISTRIBUTION AND TRANSMISSION SYSTEM ANALYSIS

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

Analysis Criteria

Distribution and transmission water mains must be capable of adequately and reliably conveying water throughout the system at acceptable flow rates and pressures. The criteria used to evaluate the City's distribution and transmission system are the state-mandated requirements for Group A water systems contained in WAC 246-290-230, Distribution Systems. The pressure analysis criteria state that the distribution system "…shall be designed with the capacity to deliver the design PHD quantity of water at 30 psi under PHD flow conditions measured at all existing and proposed service water meters." It also states that if fire flow is to be provided, "… the distribution system shall also provide maximum day demand (MDD) plus the required fire flow at a pressure of at least 20 psi at all points throughout the distribution system."

Hydraulic analyses of the existing system were performed under existing PHD conditions to evaluate the current pressure capabilities and identify existing system deficiencies. The existing system was also analyzed under existing MDD conditions to evaluate the current fire flow capabilities and identify additional existing system deficiencies. Additional hydraulic analyses were then performed with the same hydraulic model under future MDD conditions and with proposed improvements to demonstrate that the identified improvements will eliminate the deficiencies and meet the requirements far into the future. The following is a description of the hydraulic model, and the operational conditions and facility settings used in the analyses.

Hydraulic Model

Description

A computer-based hydraulic model of the existing water system was updated to version 8.0 of the WaterGEMS program, developed by Bentley Systems, in 2008 for the purposes of the 2010 Comprehensive Water System Plan (WSP), and was subsequently updated to version 8i of WaterGEMS for this WSP. The model was updated with recent water system improvement information provided by the City. Model calibration was performed prior to the hydraulic model update in 2008.

All facilities and water mains in the City's water system, including dead-end mains (but no service lines), were modeled. Pressure control valves, pump curves, tank dimensions, and operational controls were also modeled. For the purpose of ensuring accurate model results, sites that have two adjacent reservoirs are modeled as a single reservoir of equivalent volume. Adjacent reservoirs typically cause modeling problems when the numerical engine tries to balance the two tanks.

Demand Data

The hydraulic model of the existing system contains 2014 ADD data. Consumption data from 2014 metered billing records was distributed based on the recorded usage for each parcel to the closest representative junction node of the model, which was then uniformly scaled to simulate the 2014 MDD and PHD. The peaking factors calculated in **Chapter 2** were used to analyze the system under PHD and MDD conditions.

The hydraulic model of the proposed system contains 6-year, 10-year, 12-year, and 21-year demand levels that are projected for the years 2021, 2025, 2027, and 2036, respectively. The City's future demand distribution was based on a large concentration of growth occurring within the commercial and industrial areas in north Richland, encompassing the City's Core 548 and Horn Rapids Zones. Large concentrations of growth are also anticipated to occur in the predominantly low-density residential area in the Badger Mountain South Subarea, which is within, or indirectly served by, the Tapteal IV Zone. The future ADD allocations in each pressure zone are shown in **Table 3-20**.

Table 3-20
Future Pressure Zone Demand Allocation

Pressure Zone	ADD (gpm)				
	Existing	2021	2025	2027	2036
Core 548	8,063	9,175	9,643	9,879	10,957
Horn Rapids	143	372	469	518	742
Tapteal I[1]	1,731	1,895	1,965	2,000	2,160
Tapteal I - to West Richland	803	1,046	1,178	1,249	1,630
Tapteal II	576	631	654	666	719
Tapteal III	181	198	205	209	226
Tapteal IV	29	257	355	404	627
Tapteal IV - to BMID	97	122	139	148	225
Tapteal V	0	10	20	24	41
Core Y	138	151	157	160	172
Riverwood	37	41	42	43	47
Total	**11,798**	**13,899**	**14,829**	**15,300**	**17,547**

(1) Does not include West Richland intertie supply.

Facilities

The hydraulic model for the pressure analysis contains active, existing system facilities. For the proposed system analyses in the years 2021, 2025, 2027, and 2036, the hydraulic model contains active, existing system facilities and the proposed system improvements identified in **Chapter 8** for the 6-year, 10-year, 12-year, and 21-year planning periods, respectively.

The facility settings for the pressure analyses correspond to a PHD event in the water system. All sources of supply that are currently available to the system, or will be available in the future for the years 2021, 2025, 2027, and 2036 analyses, were operating at their normal summertime pumping rates during a peak period. The reservoir levels were modeled to reflect full utilization of operational and equalization storage. All active PRVs were modeled as being in service and at their normal set points, which are shown in **Appendix J**. The operational conditions for the pressure analyses are summarized in **Table 3-21**.

Table 3-21
Hydraulic Analyses Operational Conditions

Description	PHD Pressure Analyses					Fire Flow Analyses				
	2014	2021 (+6 yrs)	2025 (+10 yrs)	2027 (+12 yrs)	2036 (+21 yrs)	2014	2021 (+6 yrs)	2025 (+10 yrs)	2027 (+12 yrs)	2036 (+21 yrs)
Demand	2014 PHD	2021 PHD	2025 PHD	2027 PHD	2036 PHD	2014 MDD	2021 MDD	2025 MDD	2027 MDD	2036 MDD
Storage Facilities HGL (feet)										
WTP Clearwell	364.5	364.5	364.5	364.5	364.5	364.5	364.5	364.5	364.5	364.5
1182 Reservoirs	384.0	384.0	384.0	384.0	384.0	384.0	384.0	384.0	384.0	384.0
Core 548 - 5 and 10 MG	537.9	537.9	537.9	537.9	537.9	535.7	535.7	535.7	535.7	535.7
Horn Rapids	606.4	606.4	606.4	606.4	606.4	597.5	597.5	597.5	597.5	597.5
Tapteal I	650.4	650.4	650.4	650.4	650.4	644.6	644.6	644.6	644.6	644.6
Tapteal II	791.4	791.4	791.4	791.4	791.4	781.8	781.8	781.8	781.8	781.8
Country Ridge	785.4	785.4	785.4	785.4	785.4	776.4	776.4	776.4	776.4	776.4
Westcliffe	892.4	892.4	892.4	892.4	892.4	882.8	882.8	882.8	882.8	882.8
Badger South	1,036.9	1,036.9	1,036.9	1,037.4	1,036.3	1,033.0	1,033.0	1,033.0	1,033.5	1,032.4
Meadow Hills	1,195.9	1,195.9	1,195.9	1,195.9	1,195.9	1,189.0	1,189.0	1,189.0	1,189.0	1,189.0
Future Tapteal IV	---	---	---	---	1,070.0	---	---	---	---	1,050.0
Pumping Facilities Status										
Columbia - 1100B	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
WTP High Service Pumps	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Wellsian Way - 5	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Wellsian Way - 14	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
N. Richland Wellfield	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
1182 BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Horn Rapids BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Badger Mt. 1 BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Badger Mt. 2 BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Badger Mt. South BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Tapteal II BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Keene Rd. BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Westcliffe BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Meadow Hills BPS	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Future Tapteal IV BPS	---	---	---	---	ON	---	---	---	---	ON
Pressure Reducing Valves Hydraulic Grade Level (HGL) Setpoint (feet)[1]										
Future Tapteal IV PRV from Tapteal V (CIP WM6)	---	1,053	1,053	1,053	1,053	---	1,053	1,053	1,053	1,053
Future High Meadows St and Leslie Rd PRV (CIP PZ3)	---	647	647	647	647	---	647	647	647	647
Future Core Y PRV (CIP PZ4)	---	---	553	553	553	---	---	553	553	553
Future Badger Mt. South Subarea PRVs	---	---	941	941	941	---	---	941	941	941
Intertie Status										
BMID - Tapteal IV	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Kennewick - Gage Blvd	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Kennewick - Tapteal Drive	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Tri-Cities Estates Water District	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
KID - Lorayne J Water System	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
West Richland - Intertie BPS	2,500 gpm	2,500 gpm	2,500 gpm	2,500 gpm	2,500 gpm	2,500 gpm	2,500 gpm	2,500 gpm	2,500 gpm	2,500 gpm

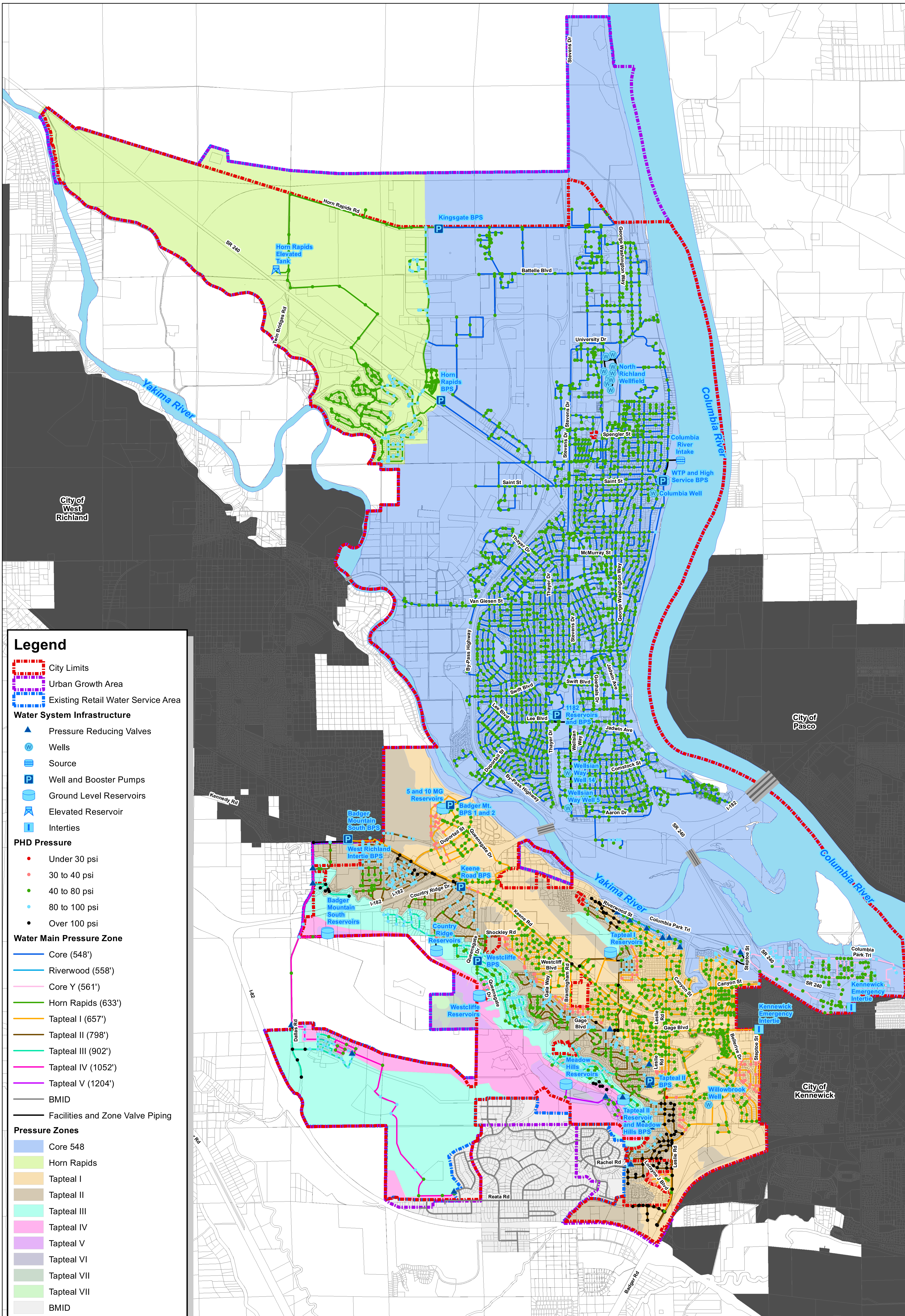
(1) All existing PRVs not specifically shown in this table were operated at the pressure setpoints provided by the City in 2015. A copy of these PRV setpoints is shown in **Appendix J**.
NOTE: All elevations and hydraulic grades are shown based on NAVD 88.

Separate fire flow analyses were performed on the system to size distribution system improvements and calculate fire flow availability. The hydraulic model for the fire flow analyses contained settings that correspond to MDD events. All sources of supply that are currently available to the system during a peak period were operating at their normal pumping rates with the largest pump at each facility offline. Reservoir levels were modeled to reflect full utilization of operational, equalizing, and fire flow storage based on the maximum planning-level fire flow requirement. Each pressure zone was modeled with the largest pump off during the fire flow analyses, consistent with WAC 246-293-660. **Table 3-21** summarizes the operational conditions for the fire flow analyses of the existing and future systems.

Hydraulic Analyses Results

Several hydraulic analyses were performed to determine the system's capability to meet the pressure and flow requirements identified in **Chapter 7** and contained in WAC 246-290-230. The first set of analyses was performed to determine the pressures throughout the system under existing (i.e., 2014) PHD conditions. Subsequent analyses were performed to determine the pressures throughout the system under future 2021, 2025, 2027, and 2036 PHD conditions. The results of these analyses were used to identify locations of low and high pressures. To satisfy the minimum pressure requirements, the pressure at all water service locations must be at least 30 psi during these demand conditions. In addition, the system should not have widespread areas with high pressures, generally considered to be more than 100 psi.

A summary of the low and high pressure areas identified from the results of the analyses is contained in **Table 3-22**. Multiple pressure zones have areas with both low and high pressures during existing PHD conditions. One location has inadequate pressure during PHD conditions (in the Tapteal I Zone near the intersection of Orchard Way and Greenview Drive), and there are multiple locations with pressures barely meeting the pressure requirements, as evidenced by the numerous locations with pressures between 30 and 32 psi in **Table 3-22**. **Figure 3-1** presents the pressures at each junction in the City's hydraulic model during existing PHD conditions. Pressure zone improvements have been proposed for low pressure areas identified in **Table 3-22**. All water mains with pressures greater than 100 psi, as identified from the analyses, were generally located along pressure zone boundaries. Water services in these areas, as with any future services, are required to be equipped with pressure regulators, installed and maintained by individual water service customers, to limit the maximum pressure to 80 psi for water provided to customers. The existing high pressures in the distribution system are within the pressure rating of the water system materials; therefore, no changes or improvements are proposed to reduce the pressures in these areas.



\\RH2\DFS\RICHLAND\DATA\RIC\715-107\GIS\MAPS\FIG3-1.MXD BY: RWITHERS PLOT DATE: MAR 20, 2017 COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON SOUTH FIPS 4602 FEET

NORTH

1 inch = 2,500 feet

0 1,250 2,500 5,000 Feet

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

Figure 3-1
Existing Water System PHD Pressures
City of Richland
2017 Comprehensive Water System Plan

Vicinity Map

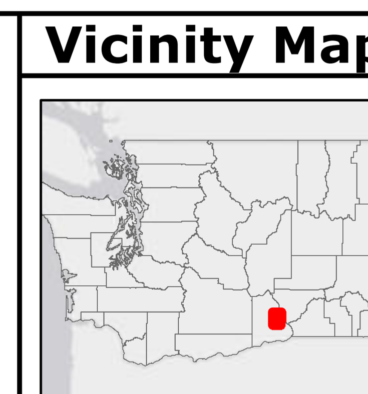


Table 3-22
Pressure Analysis Summary

Land Use	Approximate Location	Existing Pressure Zone	Node Number	Pressure (psi)				
				Existing System	6-year w/ Imprvmnts	10-year w/ Imprvmnts	12-year w/ Imprvmnts	21-year w/ Imprvmnts
Low Pressure Areas								
Low Density Residential	Water main in easement west of Leslie Rd, between Andrea Ln and Rachel Rd	Tapteal I	J-45-R	32	37	36	36	35
Low Density Residential	Near intersection of Center Blvd and Mackenzie Ct, east of Leslie Rd	Tapteal I	JI-R-E-2231-R	33	37	37	37	36
Low Density Residential	Neighborhoods on either side of Leslie Rd, between Broadmoor St and Peach Tree Ln	Tapteal I	JI-R-E-Q-80-R	34	38	38	38	37
Low Density Residential	Neighborhood near intersection of Mark Ct and Margaret St	Tapteal I	JI-C-E-Q-75-R	33	36	35	35	35
Low Density Residential	Neighborhood near intersection of Brantingham Rd and Oahu St	Tapteal I	J-1051-R	31	32	32	32	31
Low Density Residential	Near Intersection of Orchard Way and Greenview Drive	Tapteal I	JI-R-E-Q-130-R	25	76	75	74	81
Low Density Residential	Neighborhood near intersection of Purple Sage St and Azalea Ave	Tapteal I	J-1031-R	32	33	33	33	32
Low Density Residential	Apple Cider Ct dead end	Tapteal I	J-1258-R	30	32	31	31	31
Low Density Residential	Neighborhood near intersection of Chardonnay Dr and Riesling St	Tapteal I	J-1214-R	35	36	36	36	35
Commercial/ Industrial	Intersection of Kennedy Rd and Duportail St	Tapteal I	J-396-R	30	32	31	31	30
Commercial/ Industrial	Intersection of Queensgate Dr and Truman Ave	Tapteal I	JI-C-E-3049-R	35	36	36	36	35
Low Density Residential[1]	Near intersection of Summit St and Queensgate Dr	Tapteal III	J-1037-R	30	28	28	28	105
High Pressure Areas								
Low Density Residential	Neighborhood along Riverwood Street, between Rockwood Dr and Hillwood St	Tapteal II	JI-C-E-Q-251-R	145	140	140	139	140
Low Density Residential	Near intersection of Gage Blvd and Morency Dr	Tapteal III	J-81-R	95	93	93	93	93

(1) Approximately 15 single-family residential customers are currently supplied by the Westcliffe Reservoirs in the Tapteal III Zone. These customers will be converted to the Tapteal IV Zone following completion of CIP's WM6 and S1, which are currently scheduled to occur beyond the 10-year planning period. Prior to converting these customers to the Tapteal IV Zone, the City will monitor the pressures provided to these customers and will increase the operational range of the Westcliffe Reservoirs to ensure that a minimum of 30 psi is provided to these customers during PHD conditions.

The second set of analyses was performed to determine the capability of the existing water system to provide fire flow under MDD conditions. A separate fire flow analysis was performed for each node in the model to determine the available fire flow at a minimum residual pressure of 20 psi. More than 4,100 individual fire flow analyses were performed to comprehensively evaluate the water system. For each node analyzed, the resulting fire flow was compared to its planning-level fire flow requirement, which was assigned according to the land use classifications shown in **Table 3-1**. A summary of the results of the analyses at the buildings with the highest fire flow requirements is presented in **Table 3-23**. It is important to note that some of these buildings were constructed when standards were lower than today's standards, and the current fire flow standards listed might not be available through the existing water system. These facilities are typically grandfathered under the fire code, but do provide a reference point for system capacity needs.

Table 3-23
High Fire Flow Requirement Analysis Summary

Location	Junction No.	Pressure Zone	Fire Flow Requirement (gpm)	Existing Fire Flow Availability[1] (gpm)
Battelle (2400 Stevens Dr)	Battelle Stevens Dr.-R	Core 545	4,000	>5,000
Battelle (520 3rd St)	Battelle 3rd Street-R	Core 545	4,000	>5,000
Battelle (902 Battelle Blvd)	Battelle Battelle Blvd.-R	Core 545	4,000	>5,000
Fluor Hanford (3160 George Wash. Way)	J32 R-112-R	Core 545	4,000	4,000
Framatome/Areva (2101 Horn Rapids Rd)	Areva/Siemens 2-R	Core 545	4,000	4,300
Garlick Enterprises (2435 Garlick Blvd)	Garlick 1-R	Core 545	4,000	>5,000
Kadlec Hospital (888 Swift Blvd)	Kadlec hospital-R	Core 545	3,000	>5,000
Lamb-Weston (2013 Saint St)	Lamb-Weston3-R	Core 545	4,000	4,700
Penford Waterfront (216 1st St)	Penford Waterfront/1st-R	Core 545	4,000	3,500
School (100 Sprout)	School WSU 100 Sprout-R	Core 545	4,500	>5,000
School (1011 Northgate)	School 1011 Northgate-R	Core 545	4,500	>5,000
School (1250 Kensington)	School 1250 Kensington-R	Tapteal II	4,500	2,700
School (1515 Elementary)	School 1515 Elementary-R	Tapteal I	4,500	2,400
School (1525 Hunt)	School 1525 Hunt-R	Core 545	4,500	>5,000
School (1600 Gala)	J-1030-R	Tapteal I	4,500	2,100
School (1702 Van Giesen)	School 1702 Van Giesen-R	Core 545	4,500	>5,000
School (1704 Gray)	Schools 1704 Gray-R	Core 545	4,500	>5,000
School (1805 Lee)	School - 1805 Lee	Core 545	4,500	>5,000
School (450 Hanford St)	School 450 Hanford-R	Core 545	4,500	4,100
School (504 Wilson)	School 504 Wilson-R	Core 545	4,500	>5,000
School (518 Catskill)	School 518 Catskill-R	Core 545	4,500	>5,000
School (620 Thayer)	Schools 620 Thayer-R	Core 545	4,500	>5,000
School (930 Long)	School 930 Long-R	Core 545	4,500	>5,000
School (Cullum & Downing)	School 800 Downing-R	Core 545	4,500	>5,000

(1) Flows will require multiple hydrants flowing simultaneously. Most sites exceed 10 fps velocity.

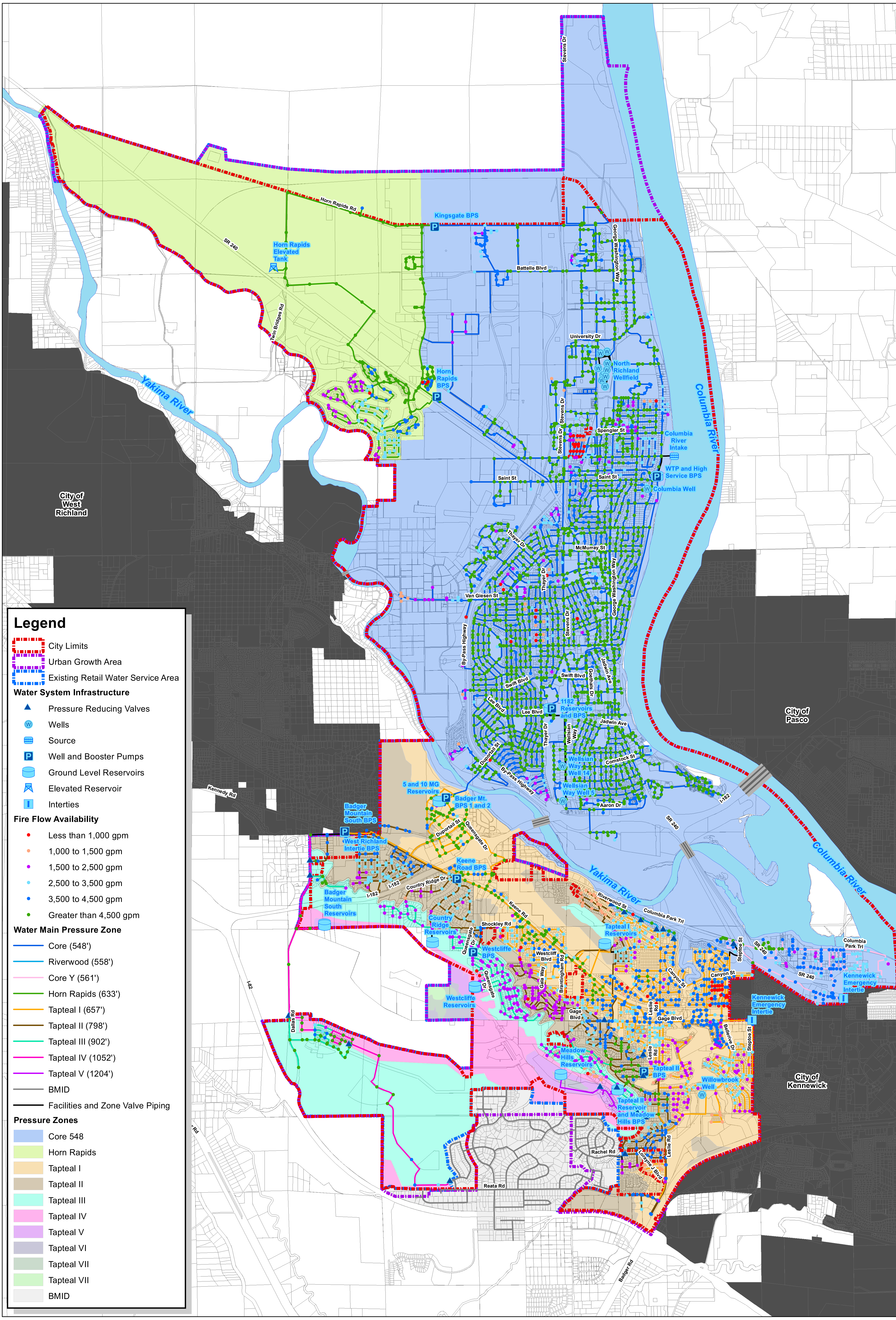
Figure 3-2 shows the existing fire flow availability at each junction in the City's hydraulic model. The fire flow availability at most junctions requires the velocity of water in transmission and distribution mains to exceed 10 fps during the fire event and, in some cases, approaches 20 fps. **Figure 3-3** shows the existing fire flow availability at each junction in the City's water system if the maximum velocity of water in the transmission and distribution mains is limited to 10 fps. The City does not have a maximum velocity constraint for emergency conditions. This evaluation is included only as a reference to show areas that could theoretically incur some physical damage if the pipes are in poor condition or insufficiently restrained when maximum fire flow is extracted. The sites that may have deficient fire flow in analyses without a velocity restriction are described below.

- Penford Waterfront – 216 1st Street

  There is 3,500 gpm available, limited by the residual pressure at the fire flow location. The location is served by a dead-end 8-inch-diameter asbestos cement water main. The fire flow availability at this facility is grandfathered, and no improvements are proposed as a result of the apparent fire flow deficiency. If the asbestos cement water main serving the location is replaced in the future, a 12-inch-diameter main is recommended to provide additional fire flow to the location.

- School – 1250 Kensington

  There is 2,800 gpm available, though the required fire flow is not known. The fire flow is constrained by maintaining 20 psi at the west end of Kensington Way. The school has an



\\RH2\DFS\RICHLAND\DATA\RIC\715-107\GIS\MAPS\FIG3-2.MXD BY: RWITHERS PLOT DATE: MAR 20, 2017 COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON SOUTH FIPS 4602 FEET

RH2

NORTH

1 inch = 2,500 feet

0 1,250 2,500 5,000 Feet

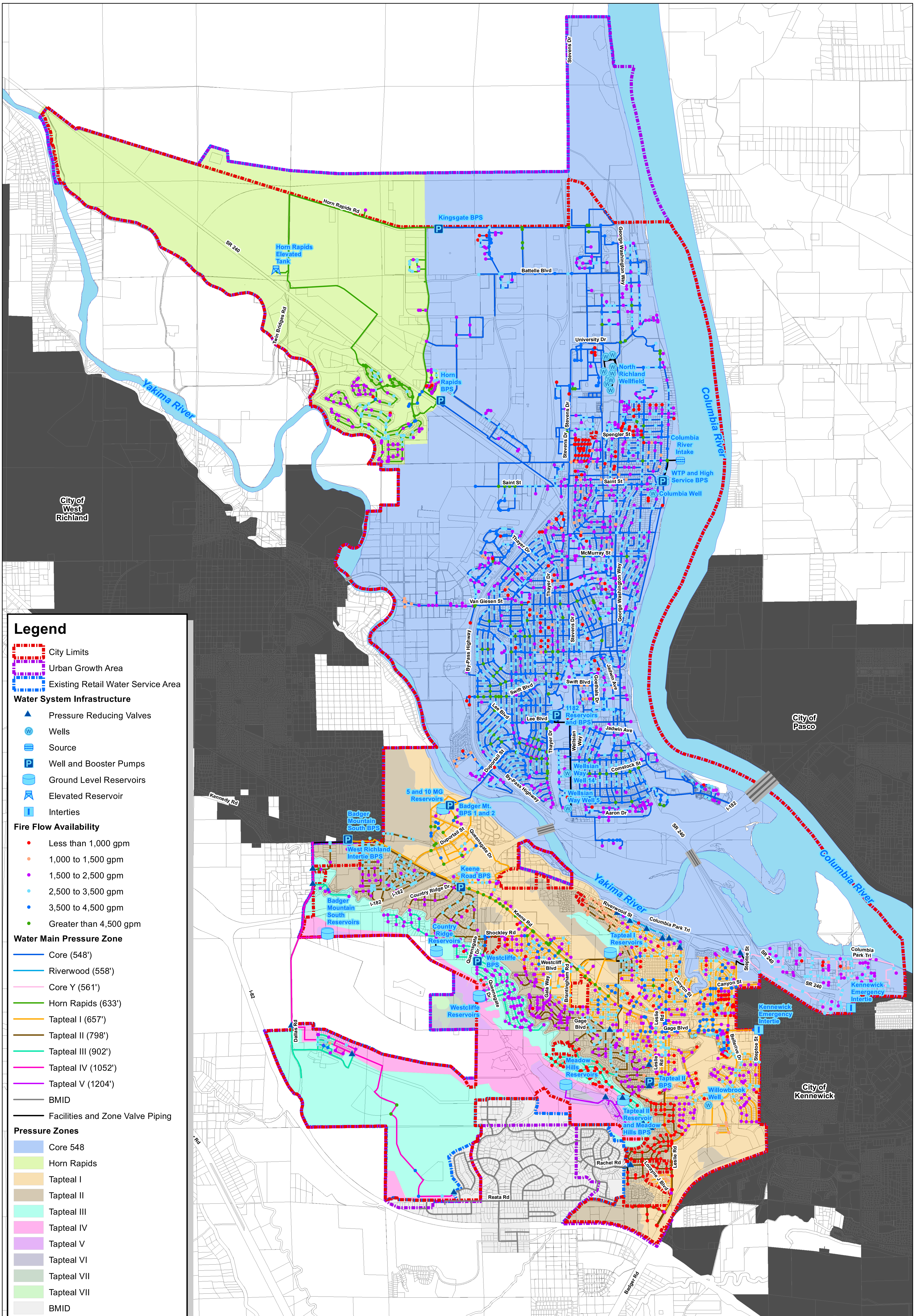
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

Richland Washington

Figure 3-2
Existing Water System
Fire Flow Availability without Velocity Constraints
City of Richland
2017 Comprehensive Water System Plan

Vicinity Map

Copyright: ©2013 Esri, DeLorme, NAVTEQ



\\RH2\DFS\RICHLAND\DATA\RIC\715-107\GIS\MAPS\FIG3-3.MXD BY: RWITHERS PLOT DATE: MAR 20, 2017 COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON SOUTH FIPS 4602 FEET

RH2

NORTH

1 inch = 2,500 feet

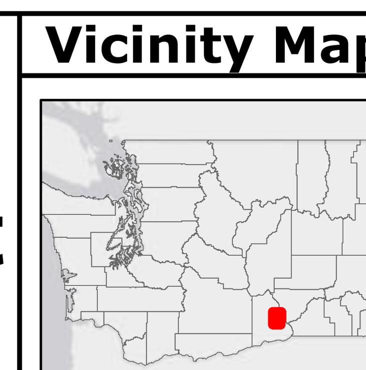
0 1,250 2,500 5,000 Feet

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

Richland Washington

Figure 3-3
Existing Water System
Fire Flow Availability with 10 fps Velocity Constraint
City of Richland
2017 Comprehensive Water System Plan

Vicinity Map



internal fire suppression system, and it is understood that the 2,800 gpm available in the water main fronting the school is adequate.

- School – 1515 Elementary

  There is 3,700 gpm available, though the required fire flow is not known. The fire flow is constrained by maintaining 20 psi at the pressure zone boundary between the Tapteal I and II Zones near the intersection of Orchard Way and Greenview Drive. It is understood that the school has an internal fire suppression system, and that the 3,700 gpm available in the water main fronting the school is adequate.

- School – 1600 Gala

  There is 3,000 gpm available, though the required fire flow is not known. The fire flow is constrained by maintaining 20 psi at the Tapteal I Zone boundary at the intersection of Orchard Way and Greenview Drive. It is understood that the school has an internal fire suppression system, and that the 3,000 gpm available in the water main fronting the school is adequate.

Only a few areas have less than 1,000 gpm fire flow for analyses without a velocity restriction. Most of these locations are on dead-end water mains served by small diameter (4-inch diameter or smaller) water mains that are grandfathered and do not require improvements. Areas without at least 1,000 gpm of fire flow availability that are served by looped water main or larger diameter dead-end main are described as follows, with proposed improvements to resolve the fire flow deficiencies, if applicable.

- Richland Mobile Homes – Southeast of Stevens Drive and Spengler Street

  The mobile homes are served by a dead-end 6-inch-diameter main extending from a single master meter on Stevens Drive, with numerous privately-owned hydrants located on 4-inch-diameter main within the property. This on-site water main constrains and limits fire flows to approximately 600 gpm at 20 psi. The area is grandfathered and no City-funded improvements are required.

- Single-family Residential – Tapteal I Zone – Orchard Way and Greenview Drive

  The single-family residential area located at the boundary between the Tapteal I and II Zones is located at high elevations and served by a dead-end 8-inch-diameter asbestos cement water main. The area has a normal static pressure of approximately 34 psi, and pressures are approximately 25 psi during existing PHD conditions. The elevation of the services in this area constrains and limits fire flow to approximately 675 gpm at 20 psi. Convert approximately 900 feet of 8- and 10-inch water main in Orchard Way from the Tapteal I Zone to the Tapteal II Zone to increase the fire flow availability in the area, and at multiple locations throughout the Tapteal I Zone as a result of the services in this area no longer approaching 20 psi during fire flow events. Construct approximately 200 linear feet of 8-inch-diameter main in Leslie Road from High Meadows Street to an existing Tapteal I Zone 8-inch-diameter main to provide looped supply to the Tapteal II Zone in this area.

Once the existing system deficiencies were identified, proposed water system improvements were included in the model, and pressure and fire flow analyses were performed throughout the system to demonstrate that the improvements will eliminate the deficiencies and meet the future flow and pressure requirements. Pressure analyses were performed under the projected 2021, 2025, 2027, and 2036 PHD conditions, and the results are provided in **Table 3-22**. Fire flow analyses were modeled under the projected 2021, 2025, 2027, and 2036 MDD conditions to ensure that the proposed improvements are sized sufficiently to meet future needs. The proposed 2021 improvements were selected to resolve existing pressure deficiencies in the water system, as shown in **Table 3-22**, and increase the fire flow availability at the intersection of Orchard Way and Greenview Drive. The projected 2021 fire flow availability with these improvements is presented in **Figure 3-4**, the projected 2025 fire flow availability with these improvements is presented in **Figure 3-5**, and the projected 2027 fire flow availability with these improvements is presented in **Figure 3-6**.

Distribution and Transmission System Deficiencies

Core 548 Zone

The majority of the system supply comes from the WTP and is transmitted to the south through a 36-inch concrete main and to the north through a 30-inch cast iron and concrete main. Common design practice is to limit velocity in transmission mains to 5.0 fps or less, unless water hammer analysis and mitigation is provided. The City does not currently have any water hammer protection devices on these transmission mains. At 5.0 fps, the maximum flow through the 30-inch and 36-inch mains are 11,000 gpm (15.8 MGD) and 15,800 gpm (22.7 MGD), respectively. The current treatment plant capacity is 36 MGD, which is limited by the treatment equipment. During existing peak hour demands, velocities in the 30- and 36-inch-diameter mains are approximately 4.3 and 4.1 fps, respectively.

As demands increase, the velocity in these mains is expected to increase and approach 5.0 fps. A water hammer analysis is recommended for each of the mains to identify the surge events that can be expected in the mains and the need for surge protection devices.

The WTP and NRW are supplied from the river intake structure through a 36-inch concrete cylinder main. The operators manage flow through this main by regularly adjusting pump operation to maximize the treatment system efficiency. Records show the highest average flow through the main was approximately 22,000 gpm (31 MGD) or 7 fps. However, this is a low lift system that discharges into an open flume. Significant water hammer events are not expected with this system configuration; therefore, higher velocities can likely be tolerated.

No other mains 20 inches in diameter and larger were found to exceed 5.0 fps during the conditions modeled in this evaluation.

There is only a single 36-inch-diameter main across the Yakima River. Loss of this main would disconnect the Core 548 Zone from its main storage, and south Richland from its main supply, leaving only two small wells for supply. Construction of additional transmission across the Yakima River for reliability has been discussed for many years, and is proposed in **Chapter 8**. **Table 3-24** shows the total system supply requirements, which are also presented in **Table 3-3**, and subtracts the Core 548 and Horn Rapids MDD to calculate the supply requirement across the Yakima River. Based on these calculations, a minimum of 11,945 gpm is required to be conveyed across the Yakima River in the 21-year (2036) planning period.

\\RH2\DFS\RICHLAND\DATA\RIC\715-107\GIS\MAPS\FIG3-4.MXD BY: RWITHERS PLOT DATE: MAR 20, 2017 COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON SOUTH FIPS 4602 FEET

RH2

NORTH

1 inch = 2,500 feet

0 1,250 2,500 5,000 Feet

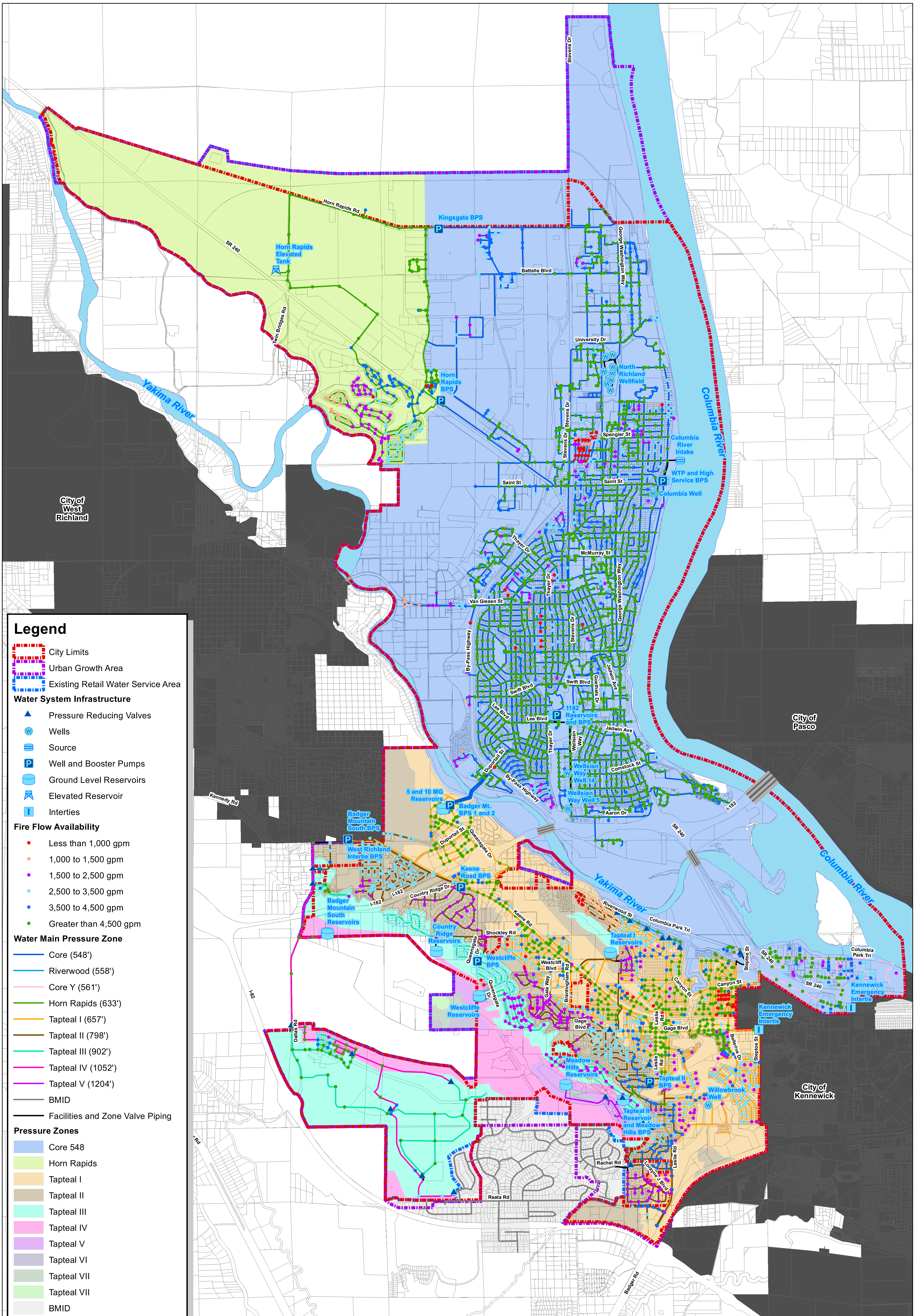
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

Richland Washington

Figure 3-4
Future 6-Year (2021) Water System Fire Flow Availability without Velocity Constraints
City of Richland
2017 Comprehensive Water System Plan

Vicinity Map

Copyright: ©2013 Esri, DeLorme, NAVTEQ



\\RH2\DFS\RICHLAND\DATA\RIC\715-107\GIS\MAPS\FIG3-5.MXD BY: RWITHERS PLOT DATE: MAR 20, 2017 COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON SOUTH FIPS 4602 FEET

RH2

NORTH

1 inch = 2,500 feet

0 1,250 2,500 5,000 Feet

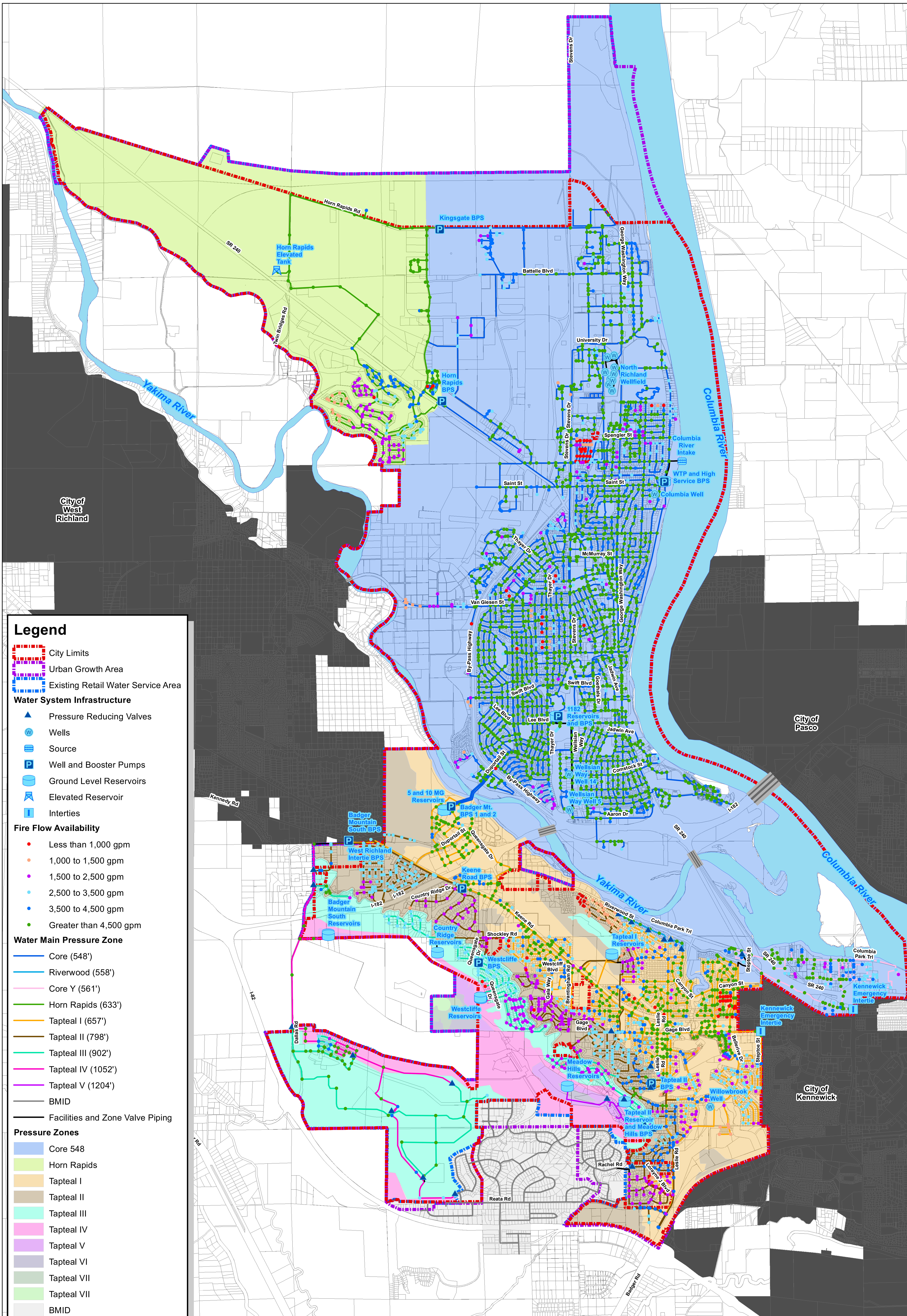
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

Richland Washington

Figure 3-5
Future 10-Year (2025) Water System
Fire Flow Availability without Velocity Constraints
City of Richland
2017 Comprehensive Water System Plan

Vicinity Map

Copyright: ©2013 Esri, DeLorme, NAVTEQ



\\RH2\DFS\RICHLAND\DATA\RIC\715-107\GIS\MAPS\FIG3-6.MXD BY: RWITHERS PLOT DATE: MAR 20, 2017 COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON SOUTH FIPS 4602 FEET

RH2 NORTH

1 inch = 2,500 feet

0 1,250 2,500 5,000 Feet

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

Richland Washington

Figure 3-6
Future 12-Year (2027) Water System Fire Flow Availability without Velocity Constraints

City of Richland
2017 Comprehensive Water System Plan

Vicinity Map

Table 3-24
Yakima River Crossing Minimum Supply Requirements

Description	Existing 2015	Future Projections 2021 (+6 yrs)	2025 (+10 yrs)	2027 (+12 yrs)	2036 (+21 yrs)
Required Supply (gpm)					
Total System Supply Requirement	27,444	31,640	33,445	34,348	38,540
Core 548 Supply Requirement	18,338	20,858	21,922	22,458	24,908
Horn Rapids Supply Requirement	326	845	1,067	1,178	1,687
River Crossing Supply Req't without S. Richland Well	**8,779**	**9,937**	**10,456**	**10,712**	**11,945**

The City is planning to install transmission mains on a future Yakima River bridge to provide a more reliable supply route across the Columbia River, and abandoning the existing 36-inch-diameter main as part of the project. Numerous transmission main configurations can meet the projected 21-year (2036) river crossing supply requirements, as well as the supply requirements beyond the planning periods analyzed in this WSP. A summary of transmission main configurations that meet the maximum river crossing supply requirements is shown in **Table 3-25**. The minimum river crossing supply requirements, assumed to be equivalent to average winter demands, are also shown in **Table 3-25**.

Table 3-25
Yakima River Crossing Transmission Main Capacity Summary

River Crossing Configuration	River Crossing Capacity at 5 fps (gpm)	Maximum Demands: 2036 (21-year) River Crossing Supply Req't (gpm)	Maximum Demands: Velocity in Each River Crossing Main (fps)	Minimum Demands: Existing River Crossing Supply Req't (gpm)	Minimum Demands: Velocity in Each River Crossing Main (fps)
Without S. Richland Well					
One 36-inch Main	16,000	11,945	3.8	1,510	0.48
Two 24-inch Mains	14,000	11,945	4.2	1,510	0.54
Three 24-inch Mains	21,000	11,945	2.8	1,510	0.36
Two 30-inch Mains	22,000	11,945	2.7	1,510	0.34

The Yakima River crossing supply requirements presented in **Tables 3-24** and **3-25** are based on the City's demand projections presented in **Chapter 2**, without additional capacity required to be conveyed to the City of West Richland via the Intertie BPS. The City anticipates that if additional supply is requested by the City of West Richland, it will be provided via a future Van Giesen Street intertie to provide West Richland a second connection to the City's water system, and to minimize the volume of water required to be conveyed across the Yakima River and pumped into the City's Tapteal I Zone.

Tapteal I Zone

Transmission through the Tapteal I Zone, and in fact all of south Richland, relies on a single 24-inch main in Keene Road. Supply to the east side of the Tapteal I Zone is currently supplemented by supply through the Newhaven PRV, and will be supplemented by the proposed PRV near the intersection of Leslie Road and High Meadows Street within the 6-year planning period (identified as CIP PZ2 in **Chapter 8**). However, if the 24-inch main in Keene Road is out of service for an extended period of time and the Tapteal I Reservoir empties, the City cannot provide adequate service to the east side of the Tapteal I Zone. Constructing an 18-inch-diameter water main in

Columbia Park Trail will provide a redundant transmission main in the Tapteal I Zone to increase the reliability and operational flexibility within the zone.

The Richland Y area is currently served by a single PRV station. This is an area encompassing nearly 700 acres with commercial and residential development. A second PRV station is recommended for reliability. The PRV station could be constructed either adjacent to the existing station or remotely for improved redundancy. One possible location is along Steptoe Street between Canyon Street and Tapteal Drive. This would also require construction of 700 feet of main along Steptoe Street. A third option would be to install a new main on the east end, constructed along the Columbia Park Trail. For the purposes of the analyses within this WSP, the PRV station is assumed to be constructed along Steptoe Street between Canyon Street and Tapteal Drive.

Tapteal II Zone

The existing 16-inch Tapteal II main in south Leslie Road is fed by a single 12-inch asbestos concrete main from Center Boulevard north, which in turn is fed by a single 8-inch main discharging from the Tapteal II BPS. This transmission should be supplemented with a second 12-inch main or replaced with a 16-inch main near the Tapteal II BPS to increase the conveyance capacity in the area and reduce the volume of water required to be supplied from the Tapteal III Zone via the existing Meadow Hills Drive PRV. The set point of the Meadow Hills Drive PRV is recommended to be reduced to 25 psi following completion of this transmission main improvement.

An 8-inch-diameter main extension from the dead-end 8-inch main at the east end of Lariat Lane and extending south to Shockley Road would increase redundancy and water quality at minimal cost. This proposed improvement would remove the bottleneck along Appaloosa Way when the Keene Road BPS is operating.

Tapteal III Zone

The existing water system consists of two separate Tapteal III Zones; the easterly zone is served via PRV from the Tapteal V Zone. A 12-inch-diameter main is proposed to connect the two Tapteal III Zones, allowing the existing Westcliffe Reservoirs to provide gravity emergency supply to the eastern portion existing Tapteal III Zone, which is currently served by a PRV set at a higher hydraulic grade approximately 60 feet higher than the overflow elevation of the Westcliffe Reservoirs.

Tapteal IV Zone

The existing Tapteal IV Zone consists of a limited number of customers in the Badger Mountain South area served by a Tapteal IV Zone 20-inch-diameter main in Dallas Road on the west side of Badger Mountain. Significant growth is anticipated within the Tapteal IV Zone that will require supplemental supply around the east side of Badger Mountain. A Tapteal IV BPS is proposed to pump water from the Westcliffe Reservoirs through future Tapteal IV Zone transmission main around the east side of Badger Mountain to supply growth in the Badger Mountain South Subarea. A future Tapteal IV Reservoir is also proposed to provide operational flexibility within the future Tapteal IV Zone.

Portions of the Badger Mountain South Subarea are located at elevations that coincide with receiving water service from the Tapteal III Zone. Therefore, five Tapteal IV to Tapteal III PRVs are proposed within the Badger Mountain South Subarea to provide acceptable water service throughout the area.

Tapteal V Zone

The existing Tapteal V Zone consists of a limited number of customers along Falconcrest Loop and Falconcrest Lane. The future Tapteal V Zone will provide supplemental supply to the Badger Mountain South Subarea via PRVs to the Tapteal III and IV Zones.

Other Deficiencies

Approximately 44 percent of the water main in the City's system was constructed in the 1970s, and is approaching the average life expectancy of water mains installed at that time. Much of the older water main is either asbestos cement (AC) or steel, which comprise approximately 31 percent and 2 percent, respectively, of the water main in the City's system. These water mains may be in need of replacement. Most of the AC and steel water main is located in the older areas of the City.

The City is planning to replace deficient water mains in the future, as shown in the schedule of planned improvements in **Chapter 8**.

PHYSICAL SYSTEM CAPACITY

This section evaluates the capacity of the City's water system components (e.g., supply, storage, and transmission) to determine the maximum number of ERUs it can serve. Once determined, system capacity becomes useful in determining how much capacity is available in the water system to support new customers that apply for service. The system capacity information, together with the projected growth of the system expressed in ERUs, as presented in **Table 2-14** of **Chapter 2**, also provides the City with a schedule of when additional system capacity is needed.

ANALYSIS CRITERIA

The capacity of the City's system was determined from the limiting capacity of the water rights, supply, storage, and transmission facilities (i.e., the facility with the least capacity). The average annual-based source capacity analysis considered the physical capacity of the City's supply facilities, which was then compared to the system's ADD per ERU, including distribution system leakage (DSL).

The maximum day-based source capacity analysis also considered the physical capacity of the City's supply facilities, but compared the capacity to the system's MDD per ERU, including DSL.

The storage capacity analysis was based on the storage capacity for equalizing and standby storage and the computed storage requirement per ERU. Operational and fire flow storage capacity were excluded from the storage analysis because these components are not directly determined by water demand or ERUs. For the analyses, a reserve amount equivalent to the existing operational and fire flow storage requirements was deducted from the total available storage capacity to determine the storage capacity available for equalizing and standby storage since distribution system pressure limits do not restrict equalizing and standby storage. The storage capacity available for equalizing and standby storage was divided by the existing number of ERUs presented in **Chapter 2** to determine the storage requirement per ERU. The ERU-based demand data was derived from the ADD of the system and peaking factors from **Chapter 2**.

The transmission capacity analysis was based on the total capacity of the transmission system, with a maximum pipeline velocity of 8 fps for the PHD analysis and 10 fps for the MDD, plus fire flow analysis. The transmission system includes a 36-, 30-, and 10-inch-diameter water main extending from the WTP, a 20- and 24-inch-diameter water main extending from the NRW, and a 14- and

20-inch-diameter main extending from the 1182 BPS. The transmission capacity analysis considered the limiting supply requirement between the system's PHD and MDD plus the maximum fire flow requirement for the system. In both the existing and future analyses, PHD is the limiting supply requirement that was used to compare with the system's transmission capacity.

CAPACITY ANALYSIS RESULTS

A summary of the results of the existing system capacity analysis is shown in **Table 3-26**. The results of the existing system capacity analysis indicate that the limiting capacity of the system is the source capacity based on the MDD, which can support up to a maximum of approximately 30,599 ERUs. The existing water system has a surplus of approximately 8,283 ERUs. All other water system components have a higher capacity to support existing water system customers.

Table 3-26
Existing System Capacity Evaluation

Demands Per ERU Basis	
Average Day Demand Per ERU (gal/day)[1]	761
Maximum Day Demand Per ERU (gal/day)[1]	1,771
Peak Hour Demand Per ERU (gal/day)[1]	2,345
Water Rights Capacity - Annual Average Based	
Water Rights Capacity - Annual Average Based (gal/day)	31,199,479
Average Day Demand Per ERU (gal/day)	761
Water Rights Annual Average Based Source Capacity (ERUs)	**40,981**
Water Rights Capacity - Instantaneous Based	
Water Rights Capacity - Instantaneous Based (gal/day)	63,051,840
Maximum Day Demand Per ERU (gal/day)	1,771
Maximum Day Based Source Capacity (ERUs)	**35,605**
Source Capacity - Maximum Day Based	
Source Treatment Capacity - Maximum Day Based (gal/day)	54,187,200
Maximum Day Demand Per ERU (gal/day)	1,771
Maximum Day Based Source Treatment Capacity (ERUs)	**30,599**
Storage Capacity	
Maximum Equalizing & Standby Storage Capacity (gal)	13,747,947
Equalizing & Standby Storage Requirement per ERU (gal)	200
Maximum Storage Capacity (ERUs)	**68,740**
Transmission Capacity - PHD Based (8 fps)	
Transmission Capacity (gal/day)	109,080,700
Peak Hour Demand per ERU (gal/day)	2,345
Maximum Transmission Capacity (ERUs)	**46,526**
Transmission Capacity - MDD + Fire Flow Based (10 fps)	
Transmission Capacity (gal/day)	136,350,900
MDD + Maximum Fire Flow Requirement (gpm)	28,468
Maximum Day Demand per ERU (gal/day)	1,771
Maximum Transmission Capacity (ERUs)	**53,847**
Maximum System Capacity	
Based on Limiting Facility - Source Capacity	**30,599**
Unused Available System Capacity	
Maximum System Capacity (ERUs)	30,599
Existing (2015) ERUs	22,316
Unused Available System Capacity (ERUs)	**8,283**

(1) Includes DSL.

The results of the 2021 projected system capacity analysis, shown in **Table 3-27**, indicate that the system capacity will increase slightly based on the average demand per ERU used for the future demand projections being slightly less than the actual 2015 demand per ERU, as described in **Chapter 2**. The 6-, 10-, and 12-year projected system capacity is approximately 30,970 ERUs, based on the limiting component of the source capacity for each year. The system is projected to have a surplus system capacity of 4,362 ERUs in 2021.

The results of the 2025 projected system capacity analysis, shown in **Table 3-27**, indicate that the system capacity will still be limited by source capacity, with a surplus system capacity of approximately 2,581 ERUs.

The results of the 2027 projected system capacity analysis, shown in **Table 3-27**, indicate that the system capacity will still be limited by source capacity, with a surplus system capacity of approximately 1,680 ERUs.

Table 3-27
2021, 2025, and 2027 Projected System Capacity Evaluation

Description	2021 (+6 years)	2025 (+10 years)	2027 (+12 years)
Demands Per ERU Basis			
Average Day Demand Per ERU (gal/day)[1]	752	752	752
Maximum Day Demand Per ERU (gal/day)[1]	1,750	1,750	1,750
Peak Hour Demand Per ERU (gal/day)[1]	2,316	2,316	2,316
Water Rights Capacity - Annual Average Based			
Water Rights Capacity - Annual Average Based (gal/day)	31,199,479	31,199,479	31,199,479
Average Day Demand Per ERU (gal/day)	752	752	752
Water Rights Annual Average Based Source Capacity (ERUs)	**41,478**	**41,478**	**41,478**
Water Rights Capacity - Instantaneous Based			
Water Rights Capacity - Instantaneous Based (gal/day)	63,051,840	63,051,840	63,051,840
Maximum Day Demand Per ERU (gal/day)	1,750	1,750	1,750
Maximum Day Based Source Capacity (ERUs)	**36,037**	**36,037**	**36,037**
Source Capacity - Maximum Day Based			
Source Treatment Capacity - Maximum Day Based (gal/day)	54,187,200	54,187,200	54,187,200
Maximum Day Demand Per ERU (gal/day)	1,750	1,750	1,750
Maximum Day Based Source Treatment Capacity (ERUs)	**30,970**	**30,970**	**30,970**
Storage Capacity			
Maximum Equalizing & Standby Storage Capacity (gal)	13,747,947	13,747,947	13,747,947
Equalizing & Standby Storage Requirement per ERU (gal)	225	260	304
Maximum Storage Capacity (ERUs)	**61,098**	**52,973**	**45,200**
Transmission Capacity - PHD Based (8 fps)			
Transmission Capacity (gal/day)	109,080,700	109,080,700	109,080,700
Peak Hour Demand per ERU (gal/day)	2,316	2,316	2,316
Maximum Transmission Capacity (ERUs)	**47,090**	**47,090**	**47,090**
Transmission Capacity - MDD + Fire Flow Based (10 fps)			
Transmission Capacity (gal/day)	136,350,900	136,350,900	136,350,900
MDD + Maximum Fire Flow Requirement (gpm)	33,440	35,217	36,106
Maximum Day Demand per ERU (gal/day)	1,750	1,750	1,750
Maximum Transmission Capacity (ERUs)	**50,408**	**48,946**	**48,214**
Maximum System Capacity			
Based on Limiting Facility - Source Capacity	**30,970**	**30,970**	**30,970**
Unused Available System Capacity			
Maximum System Capacity (ERUs)	30,970	30,970	30,970
Projected ERUs	26,608	28,389	29,291
Unused Available System Capacity (ERUs)	**4,362**	**2,581**	**1,680**

(1) Includes DSL.

WATER QUALITY ANALYSIS

DRINKING WATER REGULATIONS

Overview

The quality of drinking water in the United States is regulated by the U.S. Environmental Protection Agency (EPA). Under provisions of the Safe Drinking Water Act (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 drinking water regulations. For the State of Washington to maintain primacy (delegated authority to implement requirements) under the SDWA, the state must adopt drinking water regulations that are at least as stringent as the federal regulations. In meeting these requirements, the state, in cooperation with the DOH, has published drinking water regulations that are contained in Chapter 246-290 WAC.

Existing Regulations

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

In response to the 1986 SDWA Amendments, the EPA established six rules, known as the Phase I Rule, Phase II and IIb Rules, Phase V Rule, Surface Water Treatment Rule (SWTR), Total Coliform Rule, and Lead and Copper Rule. The EPA regulates most chemical contaminants through the Phase I, II, IIb, and V Rules. The City's active sources are affected by many of these rules.

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

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

- Organic Chemicals – Animal or plant produced substances containing carbon and other elements such as hydrogen and oxygen.

- Synthetic Organic Chemicals (SOCs) – Man-made organic substances including herbicides, pesticides, and various industrial chemicals and solvents.
- Volatile Organic Compounds (VOCs) – Chemicals, as liquids, that evaporate easily into the air.
- Inorganic Chemicals (IOCs) – Chemicals of mineral origin that are naturally occurring elements. These include metals such as lead and cadmium.

Phase I Rule

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

Phase II and IIb Rules

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

Phase V Rule

The Phase V Rule was published in the Federal Register on July 17, 1992, and became effective on January 17, 1994. This rule set standards for 23 additional contaminants, of which 18 are organic chemicals (mostly pesticides and herbicides), and 5 are IOCs (such as cyanide). The City currently complies with all contaminant monitoring requirements under this rule.

Surface Water Treatment Rule

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

Interim Enhanced Surface Water Treatment Rule

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

Long Term 1 Enhanced Surface Water Treatment Rule

This is the follow-up rule to the IESWTR and became effective in December of 1998. The final Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) was published on January 14, 2002, and became effective February 13, 2002. The rule addresses water systems using surface water or GWI sources serving fewer than 10,000 people. The rule extends protections against *Cryptosporidium* for smaller water systems. The City currently filters and chlorinates the Columbia River source and disinfects all groundwater sources, and therefore complies with the requirements of this rule.

Revised Total Coliform Rule

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

On February 13, 2013, the EPA published revisions to the rule in the Federal Register, which sets an MCL for *Escherichia Coli (E. Coli)*, and specifies the frequency and timing of coliform testing based on population served, public water system type, and source water type. Water systems that are vulnerable to microbial contamination must conduct an assessment of their system and fix any sanitary defects.

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

The rule established the health goals for total coliform and *E. Coli* at zero. To comply with the legal limit, systems may not find coliform in more than 5 percent of the samples taken each month. Based on the 2015 water service area population of 58,723, the City must take 60 samples per month (WAC 246-290-300). If four samples are found to contain coliform, the City would have exceeded the legal limit, triggering the follow-up sampling requirements. A copy of the City's Water Quality

Monitoring Plan, including the coliform monitoring program, is contained in **Appendix K** of this WSP.

Lead and Copper Rule

The Lead and Copper Rule was published in the Federal Register on June 7, 1991, and became effective on December 7, 1992. On January 12, 2000, the EPA published some minor revisions to the rule in the Federal Register, which primarily improved the rule's implementation. On June 29, 2004, additional minor revisions and clarification of several requirements of the Lead and Copper Rule were published by the EPA. The rule identifies "action levels" for both lead and copper. An action level is different than a MCL in that a MCL is a legal limit for a contaminant, and an action level is a trigger for additional prevention or removal steps. The action level for lead is greater than 0.015 milligrams per Liter (mg/L). The action level for copper is greater than 1.3 mg/L. If the 90th percentile concentration of either lead or copper from the group of samples exceeds these action levels, a corrosion control study must be undertaken to evaluate strategies and make recommendations for reducing the lead or copper concentration below the action levels. The rule requires systems that exceed the lead level to educate the affected public about reducing its lead intake. Systems that continue to exceed the lead action level after implementing corrosion control and source water treatment may be required to replace piping in the system that contains the source of lead. Corrosion control is typically accomplished by increasing the pH of the water to make it less corrosive, which reduces its ability to breakdown water pipes and absorb lead or copper.

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

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

Radionuclides Rule

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

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

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

Watershed Control Program

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

A watershed control program is a proactive and ongoing effort of a water purveyor to exercise surveillance over the conditions and activities within the watershed affecting source water quality to protect the health of its customers, as outlined in WAC 246-290-668, Watershed Control. All federally defined Group A public water systems that use surface water or groundwater as their source are required to develop and implement a watershed control program. All required elements of a watershed control program must be documented and included in the purveyor's Water Comprehensive Plan (applicable to the City) or Small Water System Management Program (not applicable to the City) at least every 6 years. The City's Watershed Control Program is presented in **Chapter 5** of this WSP.

Wellhead Protection Program

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

A wellhead protection program is a proactive and ongoing effort of a water purveyor to protect the health of its customers by preventing contamination of the groundwater that it supplies as drinking water. All federally defined Group A public water systems that use groundwater as their source are required to develop and implement a wellhead protection program. All required elements of a local wellhead protection program must be documented and included in the Water System Plan. A copy of the City's Wellhead Protection Program is presented in **Chapter 5** of this WSP.

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 SDWA Amendments. All community water systems like the City were required to issue the first report to customers by October 19, 1999. The annual report must be updated and re-issued to all customers by July 1st of each year thereafter.

The CCR is a report on the quality of water that was delivered to the system during the previous calendar year. The 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 includes the source and type of the drinking water, type of treatment, contaminants that have been detected in the water, potential health effects of the contaminants, identification of the likely source of contamination, violations of monitoring and reporting, and variances or exemptions to the drinking water regulations. A copy of the City's most recent CCR is contained in **Appendix L**.

Stage 1 Disinfectants/Disinfection Byproducts Rule

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

The EPA proposed the Stage 1 Disinfectants/Disinfection Byproducts Rule (D/DBPR) on July 29, 1994. The final rule was published in the Federal Register on December 16, 1998, and became effective on February 16, 1999. The rule applies to the City and most other water systems, including systems serving fewer than 10,000 people that add a chemical disinfectant to the drinking water during any part of the treatment process. The rule reduced the MCL for total THM, which are a composite measure of four individual THM, from the previous interim level of 0.10 mg/L to 0.08 mg/L. The rule established MCLs and requires monitoring of three additional categories of DBPs (0.06 mg/L for five haloacetic acids (HAA5), 0.01 mg/L for bromate, and 1.0 mg/L for chlorite). The rule established maximum residual disinfectant levels for chlorine (4.0 mg/L), chloramines (4.0 mg/L), and chlorine dioxide (0.8 mg/L). The rule also requires systems using surface water or groundwater directly influenced by surface water to implement enhanced coagulation or softening to remove DBP precursors, unless alternative criteria are met. Compliance with this rule must have been satisfied by December 16, 2001 for large surface water systems (those serving over 10,000 people, i.e., the City), and by December 16, 2003 for smaller surface water systems and all groundwater systems. The City currently complies with all contaminant monitoring requirements under this rule.

Stage 2 Disinfectants/Disinfection Byproducts Rule

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

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

Additionally, the rule requires systems to document peak DBP levels and prepare an Initial Distribution System Evaluation (IDSE) to identify Stage 2 D/DBPR compliance monitoring sites. IDSEs require each water system to prepare a separate IDSE plan and report, with the exception of those systems who obtain a 40/30 Certification or a Very Small System Waiver. In order to qualify for the 40/30 Certification, all samples collected during Stage 1 monitoring must have TTHM and HAA5 levels less than or equal to 0.040 mg/L and 0.030 mg/L, respectively. The first stage of the IDSE schedule required systems serving 100,000 or more people to submit IDSE plans by October 1, 2006. Systems serving 50,000 to 99,999 people, such as the City, had to submit IDSE plans by April 1, 2007. The City currently complies with all contaminant monitoring requirements under this rule and has completed its IDSE plan, which is included in **Appendix M**.

Long Term 2 Enhanced Surface Water Treatment Rule

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

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

The LT2ESWTR also addresses systems with unfinished water storage facilities. Under this rule, systems must either cover their storage facilities or achieve inactivation and/or removal of 4-log virus, 3-log *Giardia lamblia* and 2-log *Cryptosporidium* on a state-approved schedule. Lastly, the rule extends the requirement of the disinfection profiles mandated under the LT1ESWTR to the proposed Stage 2 D/DBPR. The City currently filters and chlorinates the Columbia River source and chlorinates all groundwater sources, and therefore complies with the requirements of this rule.

Unregulated Contaminant Monitoring Regulation

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

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

Arsenic

The EPA established interim drinking water regulations for arsenic in 1976 under the SDWA. Arsenic is highly toxic, affects the skin and nervous system, and may cause cancer. The 1996 SDWA Amendments require the EPA to conduct research to assess health risks associated with exposure to low levels of arsenic. The EPA issued a proposed regulation on June 22, 2000, and allowed a 90-day public review period. The final rule, which was published in the Federal Register on January 22, 2001, was to become effective on March 23, 2001, except for certain amendments to several sections of the rule. However, on May 22, 2001, the EPA announced that it was delaying the effective date for the rule until February 22, 2002, to allow time to reassess the rule and afford the public a full opportunity to provide further input. On October 31, 2001, the EPA implemented the final rule.

The rule sets the MCLG of arsenic at zero and reduces the MCL from the current standard of 0.05 mg/L to 0.01 mg/L. Arsenic's monitoring requirements are consistent with the existing requirements for other inorganic contaminants. The City has complied with these monitoring requirements since the regulations were implemented.

Filter Backwash Recycling Rule

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

The rule requires filter backwash water be returned to a location that allows complete treatment. In addition, filtration systems must provide detailed information regarding the treatment and recycling process to the state. The regulation requires water systems to have complied with the rule starting December 8, 2003, if filter backwash water was recycled. The Columbia River Water Treatment Facility does not recycle backwash water; therefore, this rule does not apply.

Groundwater Rule

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

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

1. Periodic sanitary surveys of groundwater systems that require the evaluation of eight critical elements and the identification of significant deficiencies (such as a well located near a leaking septic system). States must complete the initial survey for most community water systems by December 31, 2012, and for community water systems with outstanding performance and all non-community water systems by December 31, 2014. DOH conducted its most recent sanitary survey of the City's water system on June 19, 2014, under the state's existing sanitary survey program.
2. Source water monitoring to test for the presence of *E. coli*, enterococci, or coliphage in the sample. There are two monitoring provisions.
    - Triggered monitoring for systems that do not already provide treatment that achieves at least 99.99 percent (4-log) inactivation or removal of viruses and that have a total coliform positive routine sample under the Total Coliform Rule sampling in the distribution system.
    - Assessment monitoring is a complement to triggered monitoring. A state has the option to require systems to conduct source water assessment monitoring at any time to help identify high risk systems.
3. Corrective actions required for any system with a significant deficiency or source water fecal contamination. The system must implement one or more of the following corrective action options: correct all significant deficiencies; eliminate the source of contamination; provide an alternate source of water; or provide treatment that reliably achieves 99.99 percent inactivation or removal of viruses.
4. Compliance monitoring to ensure that treatment technology installed to treat drinking water reliably achieves at least 99.99 percent inactivation or removal of viruses.

The compliance date for requirements of this rule other than the sanitary survey was December 1, 2009. The City's last sanitary survey was completed in June 2014, and no significant deficiencies were observed during the survey, which is included in **Appendix Z**. The City currently complies with all other requirements of the rule.

Future Regulations

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

Radon

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

Unregulated Contaminant Monitoring Regulation Revisions

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