Water System Plan Update

FINAL | MAY 2021

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City of Renton

WATER SYSTEM PLAN UPDATE

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CITY OF RENTON

WATER SYSTEM PLAN UPDATE
A COMPREHENSIVE WATER SYSTEM PLAN

PREPARED BY

City of Renton

with the assistance of
Carollo Engineers

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Abbreviations

AC	asbestos cement
ac-ft	acre-feet
ac-ft/yr	acre-feet per year
ADD	average day demand
AMI	Advanced Metering Infrastructure
AMP	Asset Management Program
APA	aquifer protection area
AWWA	American Water Works Association
bgs	below ground surface
BPS	booster pump station
Carollo	Carollo Engineers, Inc.
CCC	Cross Connection Control
CCF	hundred cubic feet
CCR	Consumer Confidence Report
CCTF	Corrosion Control Treatment Facility
CCTV	closed-circuit television
CDC	Centers for Disease Control and Prevention
CEMP	Comprehensive Emergency Management Plan
cf	cubic feet
CI	cast iron
CIP	Capital Improvement Plan
City	City of Renton
COP	copper
Council	Renton City Council
CPI-U	Consumer Price Index
CRWSD	Cedar River Water and Sewer District
CT	concentration times / contact time
CWA	Cascade Water Alliance
CY	calendar year
D	Distribution pipeline
D/DBPR	Disinfectants/Disinfection Byproducts Rules
DBCP	dibromochloropropane
DI	ductile iron
DNS	determination of non-significance
DOE	Washington State Department of Ecology
DOH	Washington State Department of Health
DSCR	debt service coverage ratio
DSL	distribution system leakage

DU	dwelling unit
EDB	ethylene dibromide
ENR	Engineering News Report
EPS	extended period simulation
ERU	Equivalent Residential Unit
FAZ	forecast analysis zone
FEMA	Federal Emergency Management Agency
fps	feet per second
FSS	Fire-suppression storage
ft	/foot/feet
ft/day	feet per day
FTE	full-time employee
G	General
GAC	granular activated carbon
gal	gallon
gal/ERU	gallons per Equivalent Residential Unit
GI	galvanized iron
GIS	geographic information system
gpd	gallons per day
gpd/ERU	gallons per day per Equivalent Residential Unit
gpd/ft	gallons per day per foot
gpm	gallons per minute
GMA	Growth Management Act
GS	galvanized steel
H2S	Hydrogen sulfide
HDPE	high-density polyethylene
HGL	hydraulic grade line
HMI	human machine interface
hp	horsepower
I-405	Interstate 405
ISO	Insurance Services Organization
kPa	kilopascal
kW	kilowatt
LCR	Lead and Copper Rule
LF	linear feet
MaP	Maximum Performance
MCL	maximum contaminant level
MDD	maximum day demand
MG	million gallons
mg/L	milligrams per liter

mg-min/L	milligram-minutes per liter
mgd	million gallons per day
mgd/ft	million gallons per day per foot
MHz	megahertz
MTU	master telemetry unit
MWL	Municipal Water Law
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
P	Annual Program
PAA	potential annexation areas
PACP	Pipeline Assessment and Certification Program
PAYGO	Pay-As-You-Go
PCB	polychlorinated biphenyl
PFAS	per- and polyfluoroalkyl substances
PHD	peak hour demand
Plan	Water System Plan
PLC	programmable logic controller
psi	pounds per square inch
PSRC	Puget Sound Regional Council
PRV	pressure-reducing valve
PVC	polyvinyl chloride
PWTF	Public Works Trust Fund
PZ	Pressure Zone
Qa	system-wide annual withdrawal
Qi	instantaneous flow
R	Regulatory
R&R	repair and replacement
RCW	Revised Codes of Washington
Renton RFA	Renton Regional Fire Authority
ROW	Right-of-way
RPBA	reduced pressure backflow assembly
RSA	retail service area
RTCR	Revised Total Coliform Rule
RTU	remote telemetry unit
RUL	remaining useful life
RWSA	retail water service area
SAM-GAP	Strategic Asset Management Gap
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act
sec	second

SEPA	State Environmental Policy Act
SFR	single family residential
Skyway	Skyway Water and Sewer District
SOC	synthetic organic chemical
Soos Creek	Soos Creek Water and Sewer District
SPU	Seattle Public Utilities
SRSS	Seattle Regional Supply System
SS	Standby Storage
SSA	Sole Source Aquifer
SSTL	stainless steel
ST	Storage
State	State of Washington
STL	steel
SWP	Saving Water Partnership
TDH	total dynamic head
UCMR3	Unregulated Contaminant Monitoring Rule 3
UCMR4	Unregulated Contaminant Monitoring Rule 4
UD	utility district
USEPA	United States Environmental Protection Agency
VOC	volatile organic chemical
WA-167	Washington highway 167
WAC	State of Washington Administrative Code
Water Utility	City of Renton Water Utility
WDM	Water Distribution Manager
WDS	Water Distribution Specialist
WFI	Water Facilities Inventory
WHPP	Wellhead Protection Program
WISHA	Washington Industrial Safety and Health Act of 1973
WLCAP	Water Loss Control Action Plan
WM	Water Main Replacement Annual Program
WTP	Water Treatment Plant
WTPO	Water Treatment Plant Operator
WUE	Water Use Efficiency
yr	year

EXECUTIVE SUMMARY

ES.1 Introduction

This Water System Plan (Plan) updates the City of Renton's (City) 2012 Water System Plan. It was developed collaboratively by City staff, Carollo Engineers, Inc. (Carollo), and Pacific Groundwater Group. This Plan documents the current status of the water system and evaluates future needs of the water utility. The data used for this Plan was current as of December 2017. The Plan was developed between 2018 and 2020 for approval in 2021. This Plan will be used as a guide in maintaining and improving the water system in the short-term over the next 10 years and also provides a planning framework for the 20-year, long-term planning horizon.

The purpose of this Plan is to document changes to the City's water system, identify required system modifications, and appropriately outline capital improvement projects to meet future water demands. Maintaining a current Plan is required to meet the regulations of the Washington State Department of Health (DOH) and the requirements of the Washington State Growth Management Act. This Plan complies with the requirements of DOH as set forth in the Washington Administrative Code (WAC) 246-290-100, Water System Plan.

This Plan contains timeframes, which are the intended framework for future funding decisions and within which future actions and decisions are intended to occur. However, these timeframes are estimates, and depending on factors involved in the processing of applications and project work, and availability of funding, the timing may change. The framework presented in this Plan does not represent actual commitments by the City.

Key points of the Plan including analysis results and recommendations are emphasized below, with more detail provided in the chapters.

ES.2 Existing Water System

The City owns and operates a multi-source municipal water system, which includes supply, treatment, storage, and distribution of potable water to residential, commercial, industrial, and wholesale customers. Service is provided to an area of approximately 17.25 square miles with 17,830 retail customers (service connections) and one wholesale customer, Skyway Water and Sewer District (Skyway), via a single metered connection.

The City's service area boundaries are shown on Figure ES.1. The retail service area (RSA) is the area that the City has a duty to serve within the 20-year planning horizon of this Plan.

Figure ES.2 presents the water facility locations. Water supply sources include five production wells (Downtown Wellfield) and one artesian spring (Springbrook Springs) that are used for primary supply. There are also three production wells (Maplewood Wellfield) that provide an alternate source of supply.

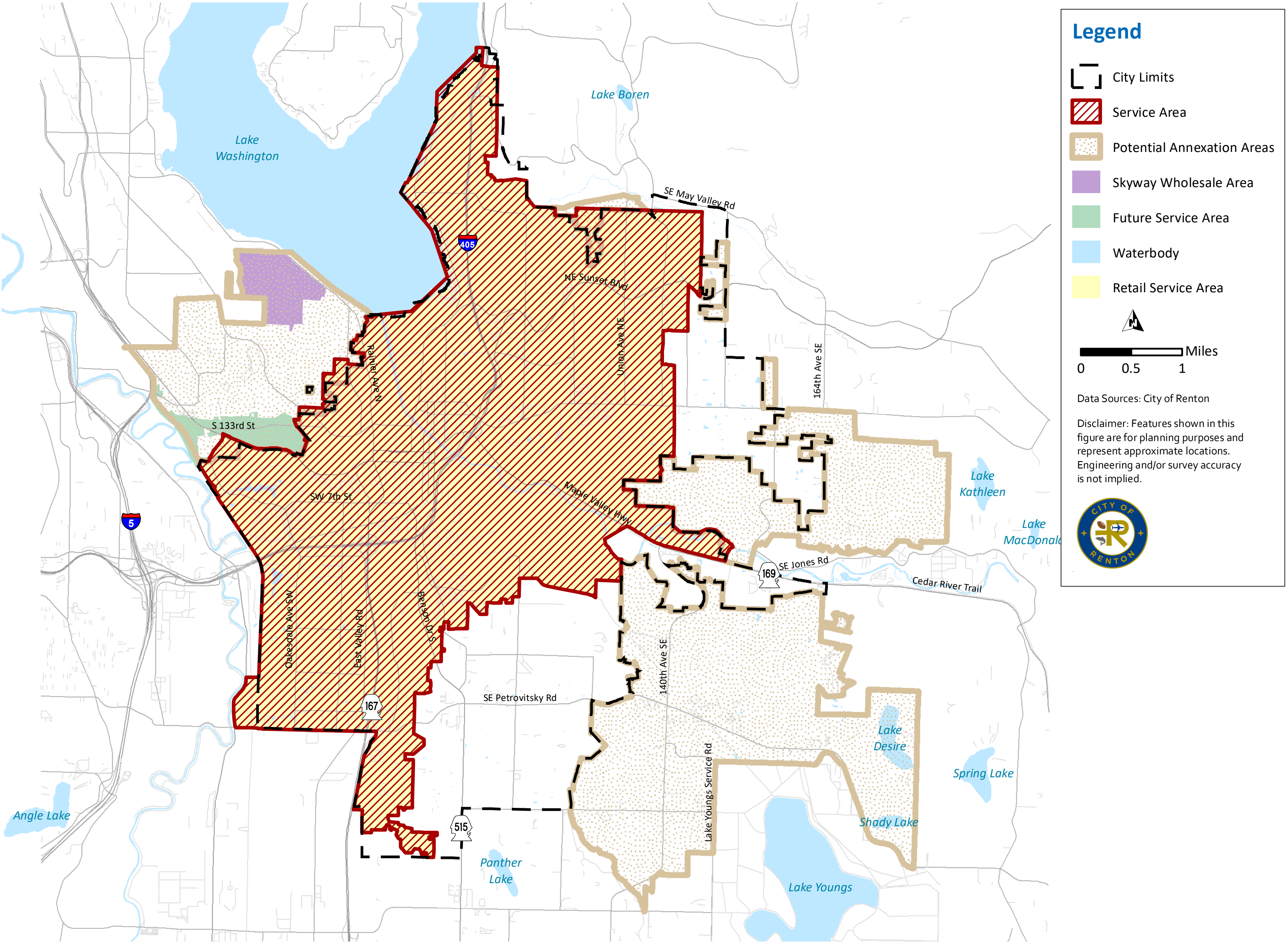
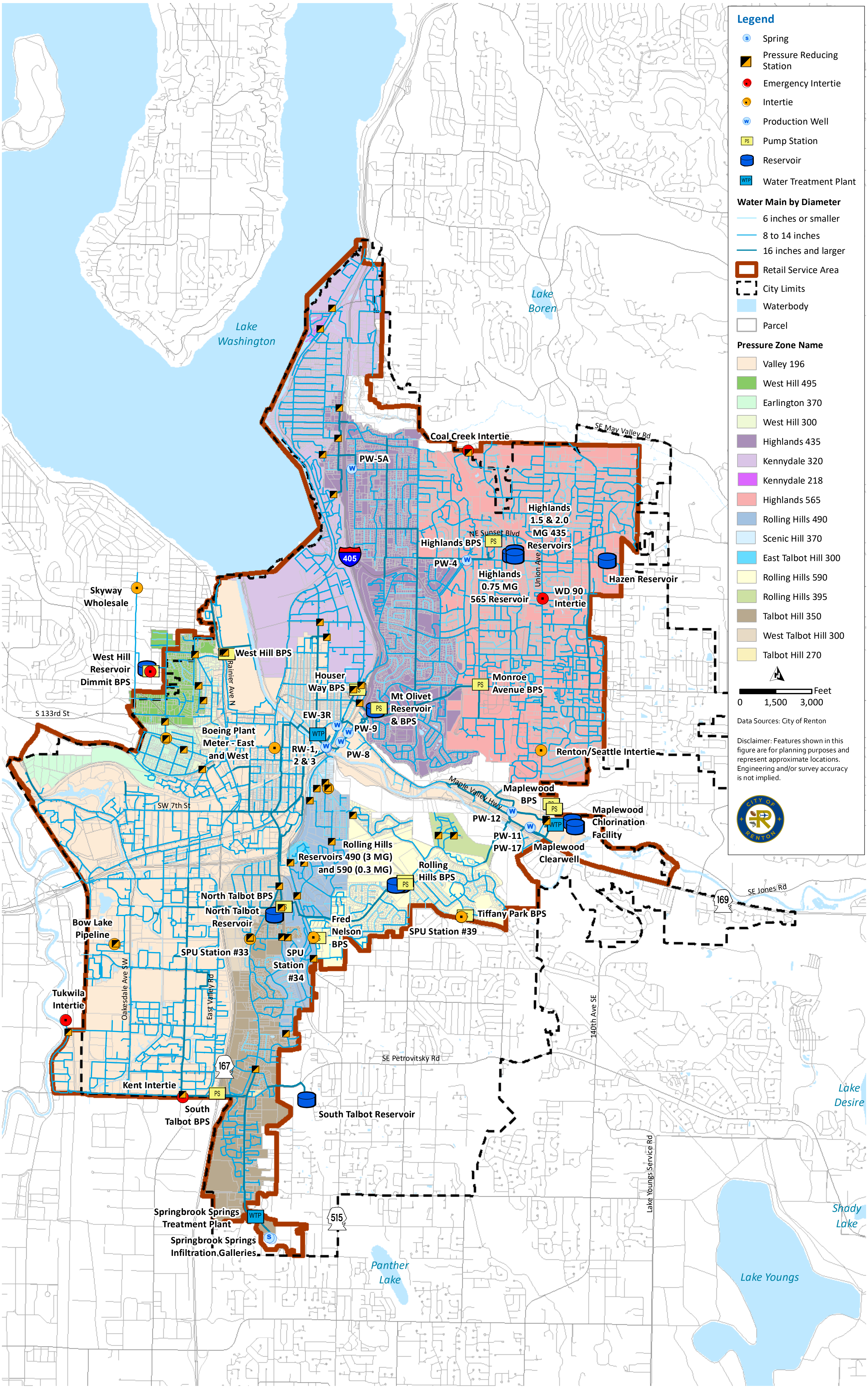


Figure ES.1 Service Area



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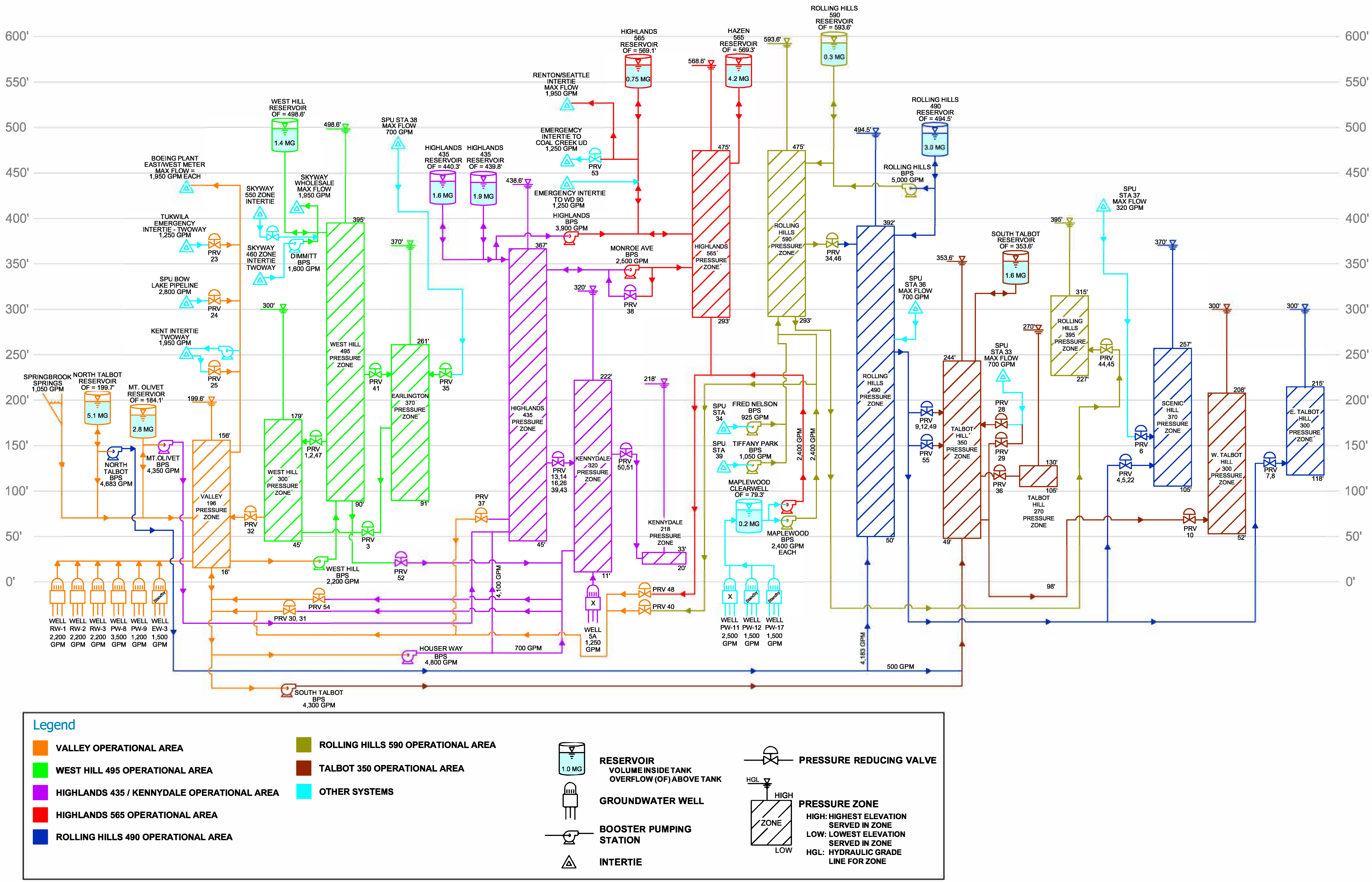
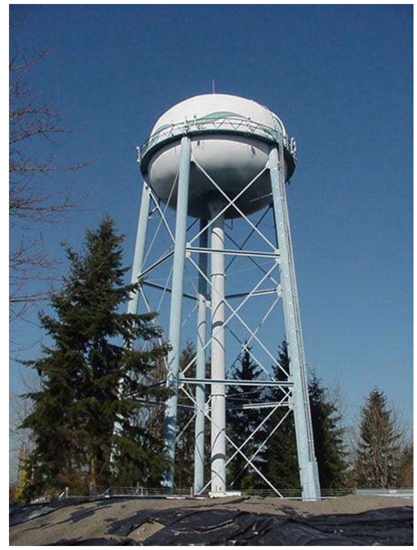


Figure ES.3 Hydraulic Profile Schematic

Mt. Olivet Booster Pump Station



Rolling Hills 590 Reservoir

The geography of the City requires the water system to have 16 distinct pressure zones (PZs). Figure ES.3 is a hydraulic profile of the system and shows how water moves from one zone to another. The zones are hydraulically interrelated by booster pump stations (BPSs) and pressure reducing valves (PRVs) that are located throughout the City. The Downtown Wells and Springbrook Springs supply water to the lowest pressure zone (Valley 196 PZ) and then the water is pumped up to the surrounding hills (West Hill, Highlands, Renton Hill, Talbot Hill, and Rolling Hills PZs). Water from the Maplewood Wells is pumped from a post-treatment clearwell into the Highlands and Rolling Hills PZs. Two pump stations, one pressure reducing station, and one metered connection can supply water to the Rolling Hills and Talbot Hill PZs from interties with the Seattle Public Utilities (SPU) Cedar River and Bow Lake transmission pipelines. Interties with the SPU Bow Lake transmission pipeline can also supply water to the Earlington 370 and Valley 196 PZs.

Currently, there are 10 reservoirs in the system, strategically located to provide adequate equalizing and fire flow reserves for all pressure zones. PRVs are used to supply lower pressure zones from higher pressure zones that contain water storage reservoirs.

ES.3 Demand Development

Projecting future water demand is a key part of the water system planning process. Demand projections are used to identify the system improvements required for supply, pumping, storage, and piping infrastructure. Three future water demand scenarios (Low, Medium, and High) were projected for the City using the following information:

- Historical production and consumption trends from 2008 to 2017.
- Puget Sound Regional Council (PSRC) demographic projections.
- Future predictions of the impacts placed on demands by factors such as water use efficiency (WUE), climate change, and the expected future consumption of the City's largest water consumers.

The Medium scenario's predictions most closely resemble the City's future demands, while the Low and High demand projection scenarios provide a range that the City's future water demands are expected to fall within. The High and Medium scenarios were used in the Chapter 6 supply analysis, which describes when the City must supplement its own supply with wholesale water purchased from SPU. The Medium scenario was used for the Chapter 7 system analysis, which determines future pumping, storage, and distribution system requirements.

Between 2008 and 2017, the City's average day demand (ADD) was approximately 7 million gallons per day (mgd). During that time, historical maximum day demands (MDD) were approximately 13 mgd. The City's typical Single-Family household consumes 159 gallons per day (gpd).

For demographic trends, PSRC predicts approximately 1 percent annual growth in the number of City households and 1.9 percent annual growth in the number of employees over the 20-year planning period. The same projections for each pressure zone were used to also predict the number of future water connections in the system.

For this analysis, water demand projections were developed in the following steps:

1. Increase historical water connection numbers for each pressure zone by the zone-specific residential and non-residential growth rates from the demographic analysis.
2. Convert connection projections into equivalent residential unit (ERU) projections using the historical ERUs per connection.
3. Convert ERU projections to ADD projections using demand projection parameters derived from historical data of the City's starting ERU value, distribution system leakage (DSL), Other Authorized Use, climate change impact, and Largest Consumer demand. City staff established unique demand projection parameters for Low, Medium, and High demand scenarios.
4. Apply the MDD to ADD peaking factor to convert ADD to MDD. Again, each demand scenario has a unique peaking factor selected by City staff.

Figure ES.4 also summarizes these steps.

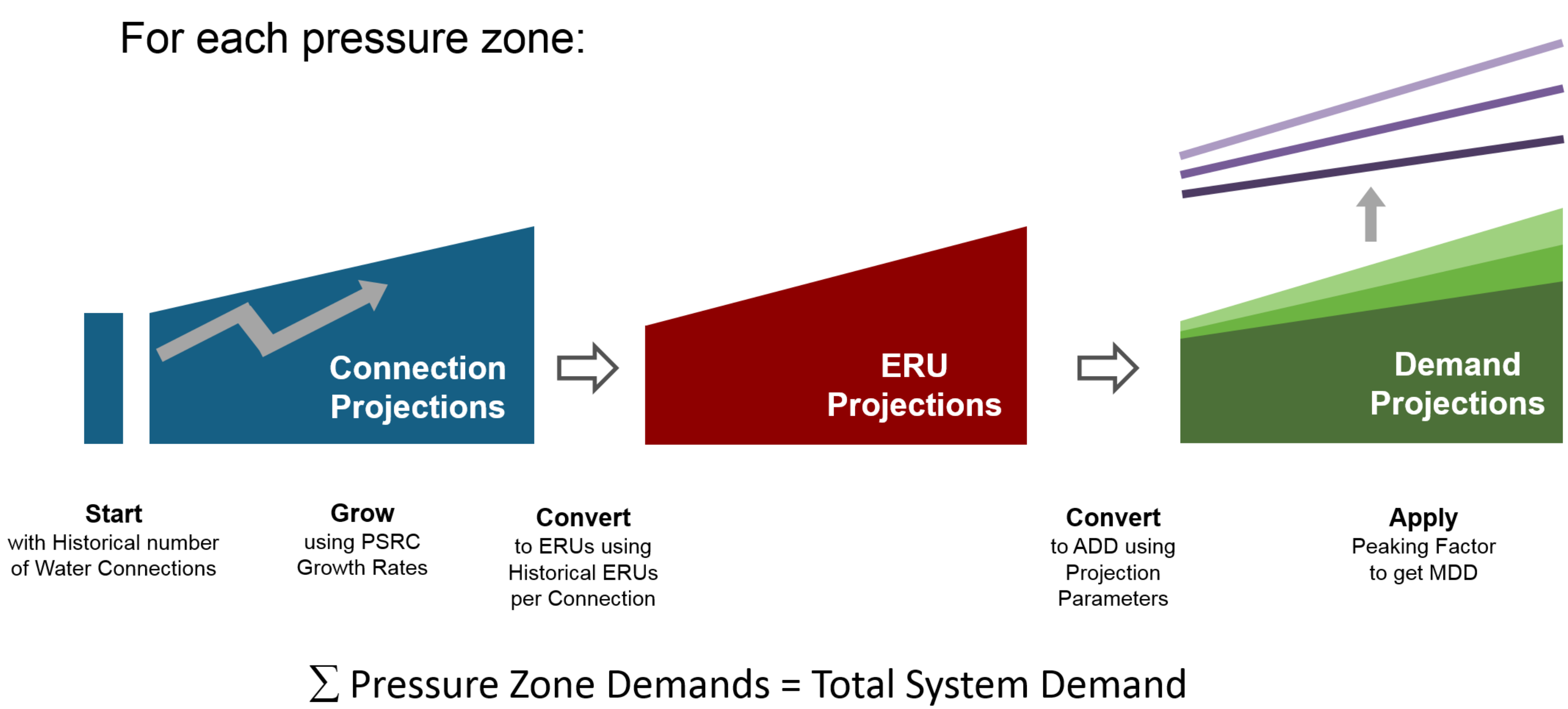


Figure ES.4 Demand Projection Methodology

To project the City's future ADD and MDD, several parameters were used:

- ERU value.
- DSL.
- Other authorized use.
- Climate change scenario.
- Largest Consumer demand.
- MDD to ADD peaking factor.

For each of the above parameters, the City used historical data to establish Low, Medium, and High values, which were used to develop each of the demand projection scenarios. This information, with the exception of Largest Consumer demands, is summarized in Table ES.1. The Largest Consumer demands that were incorporated into the demand projections are summarized in Table 3.16 of the Plan. The City's WUE program will also affect future demands. The City's three measurable WUE goals that were incorporated into the demand projections are presented in the following section, ES.4.2.

Table ES.1 Demand Projection Parameters

Demand Projection Scenario	Low		Medium		High	
	Value	Notes	Value	Notes	Value	Notes
ERU Value (gpd/ERU)	153	Historical Minimum	160	WUE Goal	173	Historical Max
Distribution System Leakage (Percent of Production)	10%	WUE Goal	12.5%	Historical Average	12.5%	Historical Average
Other Authorized Use (Percent of Production)	1.3%	Historical Average	1.8%	Historical Maximum	2.0%	
Climate Change Scenario	None		Warm		Warmest	
MDD/ADD Peaking Factor	1.7	Historical Minimum	1.8	Historical Average	2.0	WUE Goal

To calculate the ADD projections for each customer category, the ERU projections were multiplied by the ERU values in gpd/ERU unique to each demand projection scenario and customer category. To establish total ADD projections, non-revenue water consumption, including Other Authorized Use and DSL, was added using Low, Medium, and High assumptions. Finally, for each demand projection scenario, MDD projections were established by multiplying ADD projections by the appropriate MDD to ADD peaking factor.

Figure ES.5 shows a chart of the system-wide demand projections. Detailed projections can be found in Chapter 3 and Appendix H. The following summarizes the medium scenario projections.

The City's ADD is projected to increase from 7.7 mgd in 2019 to 8.9 mgd in 2029 to 9.8 mgd by 2039. By 2039, the MDD is projected to increase to 17.7 mgd. The analysis forecasts water system demands will increase 1.2 percent annually, which equates to a 27-percent increase over the next 20 years.

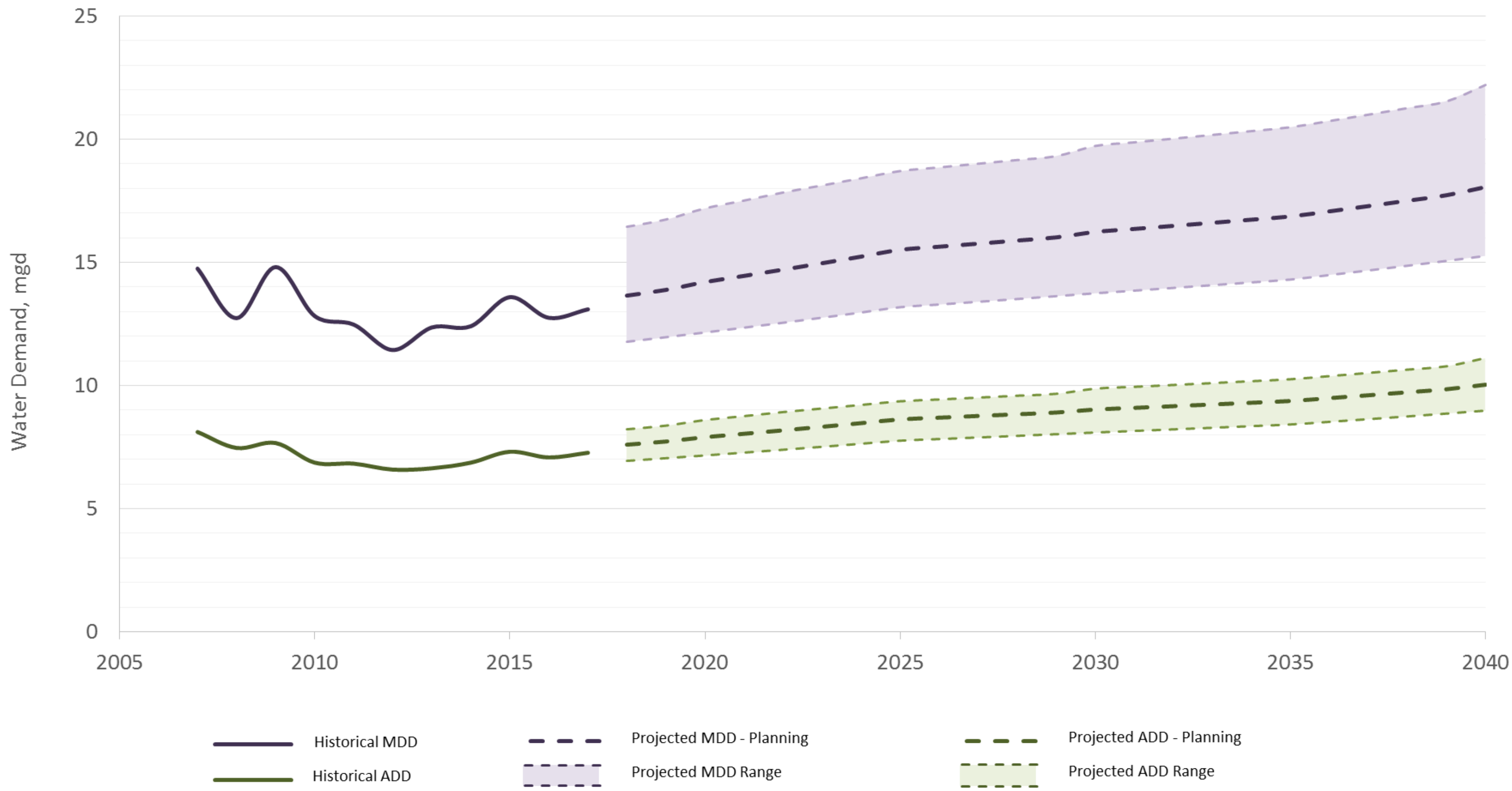


Figure ES.5 Projected Water Demands

ES.4 Water Use Efficiency and Conservation Plan

In 2003, the Washington State Legislature passed the Municipal Water Law (MWL) to address the increasing demand on Washington's water resources. As part of this law, the state implemented the WUE Rule, which requires all municipal water suppliers to use water more efficiently in exchange for guaranteed, flexible water rights to help meet future demands.

The City started a WUE program in 2007 to emphasize the importance of measuring water use and evaluating the rule's effectiveness. The intent was to minimize water withdrawals and use by implementing water-saving activities and adopting applicable policies, resolutions, ordinances, or bylaws.

While Table ES.2 summarizes the mandatory WUE measures, the City conducts many other conservation efforts as listed in Chapter 4.

Table ES.2 WUE Mandatory Measures

Must implement the following WUE measures:	Status
Install production (source) meters	Implemented
Install consumption (service) meters	Implemented
Perform meter calibration	Implemented / ongoing
Implement a WLCAP to control leakage if exceeds 10%	Implemented / ongoing
Educate customers about water efficiency at least once per year	Implemented /ongoing
Must evaluate or implement these WUE measures:	
Evaluate rates that encourage water demand efficiency	Implemented
Evaluate reclamation	Implemented

Note:
Abbreviation: WLCAP – Water Loss Control Action Plan.

The City's current conservation program was developed through a public process to support the City's WUE goals. The original objectives and goals are being carried forward to this Plan with the goal of encouraging residents to actively and instinctively conserve water.

ES.4.1 WUE Objectives

As part of the initial WUE compliance, the City reviewed its water system and water usage and developed four objectives for its WUE plan:

1. Identify and reduce sources of DSL.
2. Ensure efficient water supply for continued growth in the service area.
3. Reduce peak day and peak season demands.
4. Maintain the historically low levels of customer water usage.

ES.4.2 WUE Goals

The City has defined the following measurable goals:

1. Reduce DSL to 10 percent or less by 2022.
2. Limit the MDD to ADD peaking factor to less than 2.0.
3. Maintain an ERU value under 160 gpd/ERU.

As part of the Saving Water Partnership (SWP), the City also supports the regional 2019-2028 WUE goal to keep the total average annual retail water use of SWP members under 110 mgd through 2028 despite forecasted population growth by reducing per capita water use.

Based on the number of the City's connections, the WUE Rule requires the City to also evaluate or implement at least nine measures of its choice that support the proposed goals, in addition to the mandatory measures described above. The selected measures, described below, are conducted either by the City or by the SWP, on behalf of the City:

- Water Bill Consumption History.
- School Outreach.
- Utility Bill Inserts.
- Natural Yard Care Workshops.
- Advertising and Public Outreach.
- City Demonstration Garden.
- Indoor Water Conservation Giveaways.
- Hose Gaskets.
- Water Conservation Education Web Page.

The City's conservation strategy has been to focus on the residential consumer, for both indoor and outdoor consumption, a strategy that has proved successful by continued savings. Most recently, emphasis has been on reducing summer peak usage, which is now a WUE goal. To lower peak consumption, the City has instituted a third billing tier and has increased irrigation rates.

ES.5 Policies and Criteria

The City's Plan is based upon the following mission statement for all City utilities:

> "The City strives to protect the environment and empowers its citizens to be engaged in sustainability programs. The City manages its water system in a manner that ensures public health and safety, meets all regulatory requirements, and protects environmental resources." (Source: Renton Results – A Community Accountability Program)

The City is committed to providing customers high-quality drinking water that is reliable, affordable, and meets strict safety standards. We strive to serve as responsible community stewards by upholding the City's 2021-2026 Business Plan mission to provide a safe, healthy, and vibrant community by maintaining clean and sustainable drinking water services.

The Plan includes policies, effective practices, and goals over time to improve the operation and management of the City's water supply sources and water system toward sustainability, at a pace consistent with the current and future needs of the community. These goals have been applied to the planning process of the Water System Plan Update and will continued to be implemented in current and future programs and capital projects identified in the Plan.

The policies, design criteria, and standards used in the Plan are based on laws and policies that originate from the following sources, listed in descending order, from those with the broadest authority to those with the narrowest:

- Federal Regulations - Environmental Protection Agency (USEPA).

- State Regulations - Department of Health and Department of Ecology (DOE).
- King County Regulations.
- City of Renton Ordinances - City Council.
- City of Renton Administrative Policies - Mayor.
- City of Renton Comprehensive Plan.
- Department Policies - Public Works Department.
- Water System Plan Utility Policies - Utility Systems Division/ Water Utility Staff.

Law is set by the federal government through federal regulations, by the State of Washington (State) in the form of statutes: Revised Codes of Washington (RCW) and WAC, by King County in the form of policies, and by Renton City Council in the form of ordinances and resolutions. City policies are established in order to provide a vision or mission of the Water Utility and to provide a framework for the planning, design, operation, management, and maintenance of the water system. City policies cannot be less stringent or in conflict with adopted laws.

The City manages its water utility and water system in accordance with established federal and state regulations for public water systems. City policies and standards provide a consistent framework for the planning, design, construction, maintenance, operation, and service of the City's water system and water supply sources. The City has additional land use, development, and finance policies that specify additional requirements for new development or redevelopment projects that require water service for domestic, fire protection, and other uses.

The City's policies are grouped into the following major categories:

- Service Area.
- Water Supply Planning and Management.
- Water Main Extension and Service Ownership.
- System Reliability and Emergency Management Plan.
- Fire Protection.
- Financial.
- Facilities.
- Organization.

ES.6 Water Supply, Water Rights, and Water Quality

To meet water demands, the City has developed its own independent water supply sources as well as designed interties with adjacent purveyors to purchase wholesale water. The City's wells are generally in very good condition. The City has capital improvement and maintenance programs to upgrade and maintain its sources in good condition and to comply with water quality criteria.

ES.6.1 Water Rights

Independent water sources allow the City to maintain greater control over the management and costs of its water supply. Consistent with DOE's requirements for water rights, all of the City's water rights specify an instantaneous flow (Qi) and a maximum system-wide annual withdrawal (Qa). With its independent sources of supply, the City strives to protect public health, ensure adequate water supply to meet the requirements of its customers, and support the economic prosperity of the City. However, concern that growing water demands in the future may exceed the City's available water right withdrawals must be taken into consideration for system planning.

ES.6.2 Water Supply Evaluation

The City's supplies and pump stations were evaluated to ensure adequate capacity is available to serve future demands. For the evaluation, the City's water distribution system was divided such that the 16 pressure zones were condensed into 7 different operational areas, as shown on Figure ES.3. The City's criteria is to provide sufficient reliable sources / pumps that can provide the MDD for each operational area with the largest pump or source out of service.

The analysis found that each of the operational areas had sufficient source / pumping capacity to meet the projected demands through 2039. The City has sufficient supply to serve its customers with solely its own supplies, with the exception of the West Hill 495 Operational Area. The City needs to rely on its interties with SPU in the West Hill 495 Operational area to provide the MDD demands in the planning period.

The City has more than sufficient supplies to meet the system-wide MDD through 2039, as shown in Table ES.4. The City-owned supplies are sufficient to meet the system-wide MDD through 2029, with a small amount of SPU supply required by 2039.

Table ES.3 System-Wide Supply Comparison

			2019	2029	2039
		TOTAL MDD (gpm)	**9,646**	**11,125**	**12,306**
Source	Well	Status	Qi (gpm)		
Springbrook Springs		Active	1,050	1,050	1,050
Downtown Wellfield	Well RW-1	Active	2,200	2,200	2,200
Downtown Wellfield	Well RW-2	Active	2,200	2,200	2,200
Downtown Wellfield	Well RW-3	Active	2,200	2,200	2,200
Downtown Wellfield	Well PW-8	Active	3,500	3,500	3,500
Downtown Wellfield(1)	Well PW-9	Active	1,200	1,200	1,200
Well PW-5A	Well PW-5A	Backup	NA	NA	NA
Maplewood Wellfield	Well PW-11	Active	2,500	2,500	2,500
Maplewood Wellfield	Well PW-12	Active	500	500	500
Maplewood Wellfield	Well PW-17	Active	0	0	0
Downtown Wellfield	Well EW-3R	Emergency	NA	NA	NA
City Supply Total			**15,350**	**15,350**	**15,350**
SPU Supply Interties Total		Active	**7,195**	**7,195**	**7,195**
Total Reliable Capacity			**22,545**	**22,545**	**22,545**
Largest Pump/Supply Capacity	Well PW-8		3,500	3,500	3,500
Total Reliable Capacity with Largest Pump/Supply Capacity offline			**19,045**	**19,045**	**19,045**
SURPLUS/(DEFICIT)			**9,399**	**7,920**	**6,739**

Note:
(1) Reliable pump capacity for Well PW-9 is only 1,200 gpm.
Abbreviation: gpm – gallons per minute.

The City will pursue several different approaches to supplement its peak demand requirements (20-year and longer planning period). This includes expanded conservation efforts and strategies, additional storage, the purchase of wholesale water from SPU, perfecting additional Qi water rights (Maplewood Wells), and the possible use of other technologies such as reclaimed water and aquifer recharge.

The City actively participates with other water systems on regional planning, supply, and operating issues. For example, the City is a member of the East King County Regional Water Association and the Water Conservation Coalition of Puget Sound. Another example is the City's participation in the recent Puget Sound Regional Water Supply Outlook Study, which assessed the supply sources of the Central Puget Sound Region, explored ways that systems can support each other, and evaluated regional supply options to meet future needs. Under the City's new contract with SPU, the City will be participating in the Seattle Regional Supply System (SRSS) via its attendance and participation at SRSS Operating Board meetings.

ES.6.3 Water Quality

The City is defined as a Group A Community Public Water System. The City must comply with the drinking water standards of the federal Safe Drinking Water Act (SDWA) and DOH standards under WAC 246-290. The City's water quality is in compliance with all state and federal water quality and reporting requirements. All applicable drinking water quality regulations are described in detail in the Drinking Water Quality Monitoring Plan included as Appendix N.

The City maintains water quality within its system through the following approaches:

1. Routine system flushing within its distribution system in order to maintain satisfactory water quality.
2. A main replacement program to eliminate dead end mains and replace aging cast iron, asbestos cement, and steel pipes.
3. In-line chlorine and fluoride analyzers at all sources for continuous monitoring.
4. In-line pH meters at all sources in order to better manage pH and as a result reduce corrosion within the distribution system.
5. Cross-connection prevention.

It is recommended that the City take the following actions as part of its water quality programs:

- The City should continue to track proposed new water quality regulations being considered by the USEPA and DOH in order to plan for any impacts on its water system.
- The City should continue to implement its corrosion control treatment to minimize corrosion within the distribution system and private plumbing.

The City prepares an annual Water Quality Report (CCR) that documents regulated contaminants detected during monitoring to ensure consumers know what's in their drinking water. The City's Water Quality Monitoring Reports are electronically available at:

https://rentonwa.gov/city_hall/public_works/utility_systems/water_quality_report

ES.6.4 Wellhead Protection Program

The 1986 amendments to the federal SDWA mandated that every state develop a wellhead protection program (WHPP) to protect groundwaters that serve as drinking water sources for public water supplies. In 1994 DOH adopted WAC 246-290, which directed Group A public water systems using wells or springs to implement wellhead protection measures. The City prepared its

WHPP, which was approved by DOH in 1999. Updates to the City's WHPP were completed under this Plan and the changes to the WHPP are included as Appendix J.

Compliance with WHPP requirements is part of a broader City effort referred to as the "Aquifer Protection Program." The Aquifer Protection Program was established in 1988 when the Council designated Aquifer Protection Areas (APAs) with the intent of safeguarding the City's supply sources. The APAs that were initially delineated in 1988 were redefined during this WHPP update to be consistent with the capture zones, which were delineated using the City's Groundwater Model. As part of its Aquifer Protection Program, the City has enacted aquifer protection regulations within the APAs to protect the aquifers used as potable water supply sources from contamination by hazardous materials. The regulations include restrictions on hazardous material quantities, storage, and handling; land use restrictions; facility operating standards; construction activity standards; fill quality standards; and other measures intended to prevent contamination.

Other components of the Aquifer Protection Program include public education, aquifer water quality and level monitoring, coordination with emergency responders, and coordination with surrounding land use authorities on groundwater protection issues.

ES.7 System Analysis

The system analysis identified potential future system deficiencies in the City's water distribution and based on the analysis results, Carollo recommended improvements to the system. Carollo evaluated the capacity of the pipelines using the City's updated and calibrated hydraulic model. Evaluations of the remaining assets were conducted in Microsoft Excel.

The system analysis yielded a number of recommended improvements for the pump stations, reservoirs, pipelines, and pressure zones, which are summarized in Figures ES.6 and ES.7.

ES.7.1 Storage Analysis

The City's reservoir storage requirements depend on the water system's configuration, seasonal and daily variation in water-use patterns, and the reliability of various water system components. Water storage volumes are comprised of five components:

- Operational storage.
- Equalizing storage.
- Standby storage.
- Fire-suppression storage.
- Dead storage.

The operational areas were evaluated as separate systems to ensure that each has the required usable operational, equalizing, fire, and standby storage volume. Details are summarized in Chapter 7.

Storage deficits were identified in the following operational areas: the Valley, Highlands 565, West Hill 495, and Rolling Hills 590. The identified storage deficits can be mitigated by constructing additional storage or making changes to the operational strategy. In some cases, small improvements to the existing infrastructure, such as adding backup power to provide reliability, can better alleviate the storage deficiencies than adding storage.

All recommended projects are summarized below.

Valley Storage Recommendation

Although the Valley has sufficient storage at 20 pounds per square inch (psi), the area is deficient for all planning years in supplying operational and equalizing volumes at 30 psi to the customers located at the highest elevations within the operational area.

The City is connecting high-elevation residents within the Valley 196 PZ to higher pressure infrastructure. These improvements will then provide adequate operating pressures and fire flow pressures to these high-elevation residents.

Highlands 565 Storage Recommendation

The Highlands 565 Operational Area does not have sufficient storage for all planning years. However, excess storage located in the adjacent Highlands 445 Operational Area is sufficient to offset deficiencies in the Highlands 565 Operational Area.

A backup power generator is recommended at the Monroe Avenue BPS to allow storage to be provided from the Highlands 445 PZ to the Highlands 565 PZ, which will also improve pumping capacity in the long term. The City is already planning to add a generator at the Monroe BPS as part of constructing a new 6.3-million gallon (MG) reservoir in the Highlands 445 PZ.

West Hill 495 Storage Recommendation

The West Hill 495 Operational Area does not have sufficient storage through 2039. However, excess storage located in the Valley Operational Area is sufficient to offset deficiencies in the West Hill 495. The Valley Operational Area has 1.04 MG of excess storage available by 2039, which can be reliably pumped to the West Hill 495 Operational Area via the new West Hill BPS. The City is currently planning on expanding capacity of the West Hill PS and adding a generator at the West Hill BPS as part of the West Hill BPS Improvement Project.

Additionally, the City currently operates the tank with a 16 foot (ft) operational band, which equates to a 0.22-MG operational storage volume. It is recommended that the City update operational strategy and reduce the operational band thus decreasing the operational volume and mitigating deficiencies.

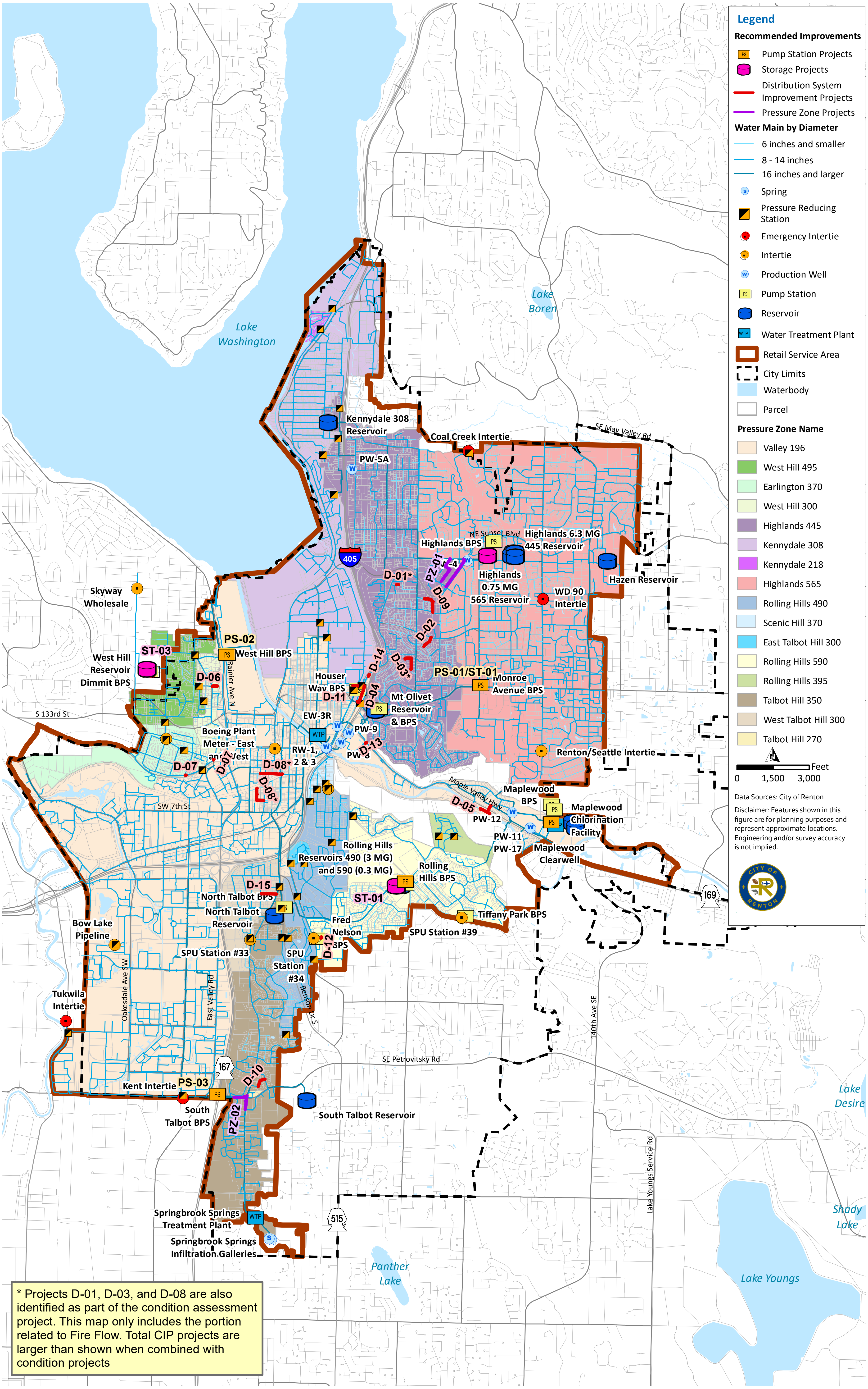


Figure ES.6 Recommended Improvement/Capacity Projects

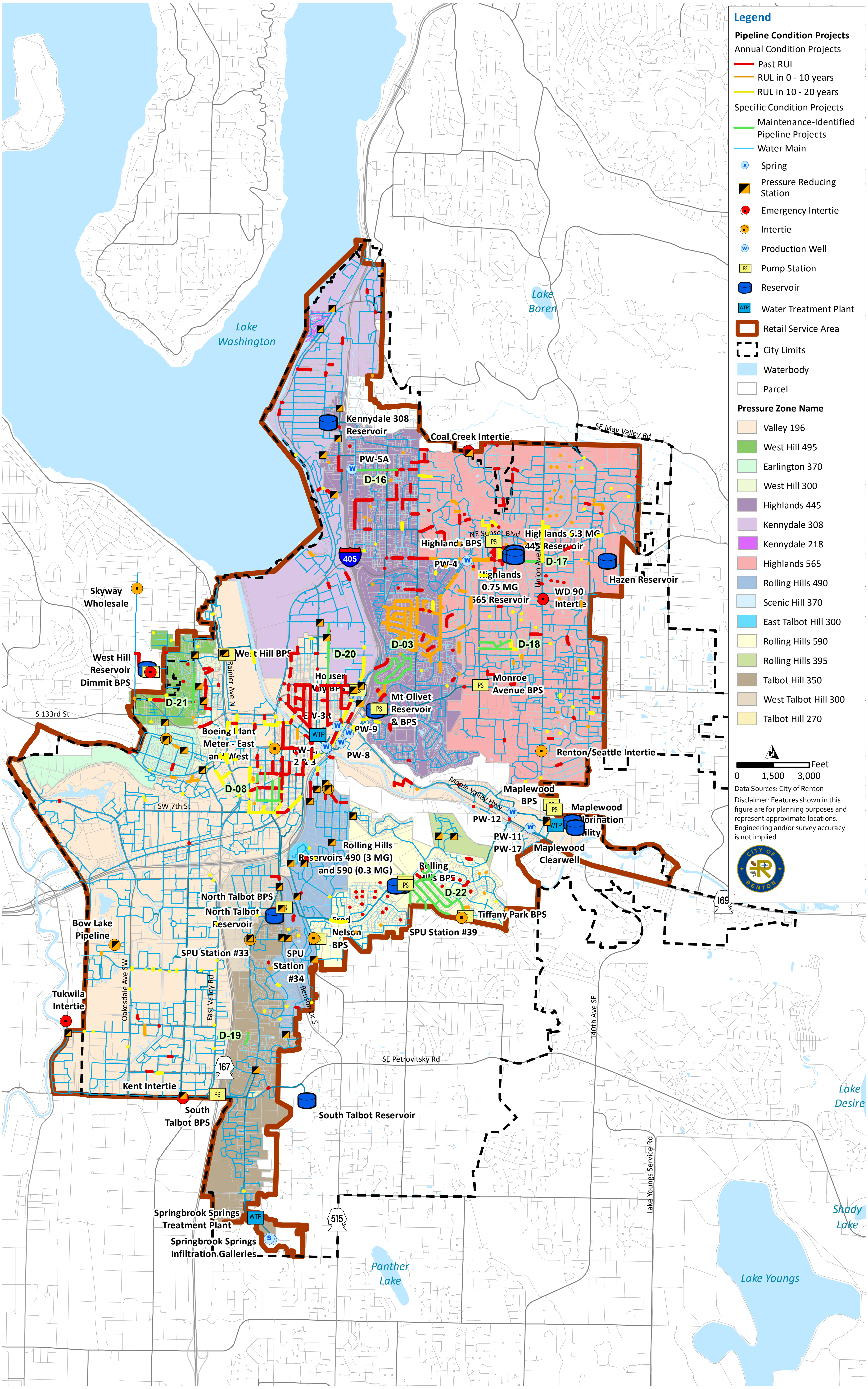


Figure ES.7 Recommended Pipeline Condition Projects

Rolling Hills 590 Recommendation

The Rolling Hills 590 Operational Area does not have sufficient storage for all planning years, being deficient by 0.95 MG by 2039. The City has a few options to mitigate this deficiency:

- Add backup power to the Maplewood BPS to increase pumping capacity from the Rolling Hills 490 PZ to the Rolling Hills 590 PZ, and add auto-start, auto-transfer, and backup power to the Rolling Hills BPS so that three pumps can be operated at the same time.
- Construct a new 1.5-MG standpipe for the Rolling Hills 590 Operational Area, replacing the existing 0.3-MG elevated tank.

ES.7.2 Distribution System Analysis

The calibrated InfoWater model of the City's distribution system was used to analyze the system for future planning years, and projected system demands were added for the 2019, 2029, and 2039 planning years. The hydraulic model was used to evaluate typical system conditions during diurnal operations and fire flow availability. Then, the model was updated and calibrated for both extended period simulation with temporary pressure loggers and steady state with hydrant flow tests.

Key parameters evaluated with the model were for the system pressure criteria during normal operations and fire flow testing of the system. During normal operations, the minimum pressure as set by the DOH during MDD and PHD was 30 psi at the service meter. The City's goal is to provide a maximum of 110 psi at the service meter.

Improvements include actions such as pipe upsizing, main looping, and modifying pressure zone boundaries. Each of the recommended improvements requires a further site-specific and project-level engineering analysis before implementation. Recommendations are summarized below by type of improvement.

Projects to Address Low Peak-Hour Pressure

Some low-pressure nodes (below 30 psi) exist adjacent to the Springbrook transmission line. The City has been working to remove connections to this line and relocate them onto an adjacent higher-pressure line.

Projects to Address Excessive Velocity

One 8-inch line located at the Maple Valley Highway on-ramp to Interstate 405 was found to exceed maximum velocity in the distribution system. This section of pipe is surrounded by 12-inch pipes and is recommended to also be upsized to 12-inch. Project D-13 will upsize 70 ft of 8-inch pipe to 12-inch pipe.

Improvements to Address Fire Flow in Non-Dead-End Areas

Deficiencies identified during the system analysis require improvements to address fire flow deficiencies. The projects include upsizing 4-inch and 6-inch pipes and changing hydrant lateral connections. Detailed information on each recommended pipe improvement can be found in Chapter 7, where individual projects may be referenced based on Project Identification. Once implemented, these projects will eliminate the identified deficiencies.

Dead-end Pipes in Non-Single Family Areas

The City has multiple older 4-inch, 6-inch, or 8-inch dead-end pipes in non-single family areas that do not have the capacity to provide the City's fire flow requirements of 3,000 gpm. It is recommended that the City evaluate each case individually to determine how fire flows can be provided to each customer.

In some cases, a customer may be protected by multiple hydrants on different water mains. As long as the total fire flow from the multiple hydrants meets the fire flow requirement, no improvements are necessary in these cases.

In other cases where only one water main serves the customer, looping may be required or the dead-end main may need to be upsized to 12-inch to meet the fire flow requirements.

Dead-End Pipes in Single Family Areas

The City also has multiple older 4-inch and 6-inch dead-end pipes in single family areas that do not have the capacity to provide the City's fire flow requirements of 1,000 gpm. It is recommended that the City evaluate each case individually to determine how fire flows can best be provided to each customer.

The City has been programmatically moving hydrants from the dead-end to the closest main with 1,000 gpm. It is recommended that the City continue with this approach.

ES.7.3 Pipeline Condition Evaluation

The pipe condition evaluation incorporates two types of data: remaining useful life (RUL) and maintenance-identified projects. The RUL analysis examined the pipe's material, installation year, and material's useful life to determine the year in which each pipe would reach its RUL. The pipes identified in this analysis serve as a starting point for the pipeline condition evaluation.

Additional pipeline condition projects have been identified by the City's Maintenance Department based on field observation and excessive maintenance. These projects, in addition to the RUL analysis projects, make up the pipeline condition evaluation. The length of time that a pipe is anticipated to remain functional is called useful life. Useful life depends largely on the pipe material but can also depend on soil conditions, water constituents, and methods of installation. When a pipe is in service beyond its useful life, the increasing costs of maintenance associated with a failing pipe typically warrant replacement. Figure ES.8 shows the total length of pipe reaching the end of its assumed useful life for each year for the next 100 years, starting in 2019. All pipes that have already exceeded their useful life are shown in the year 2019.

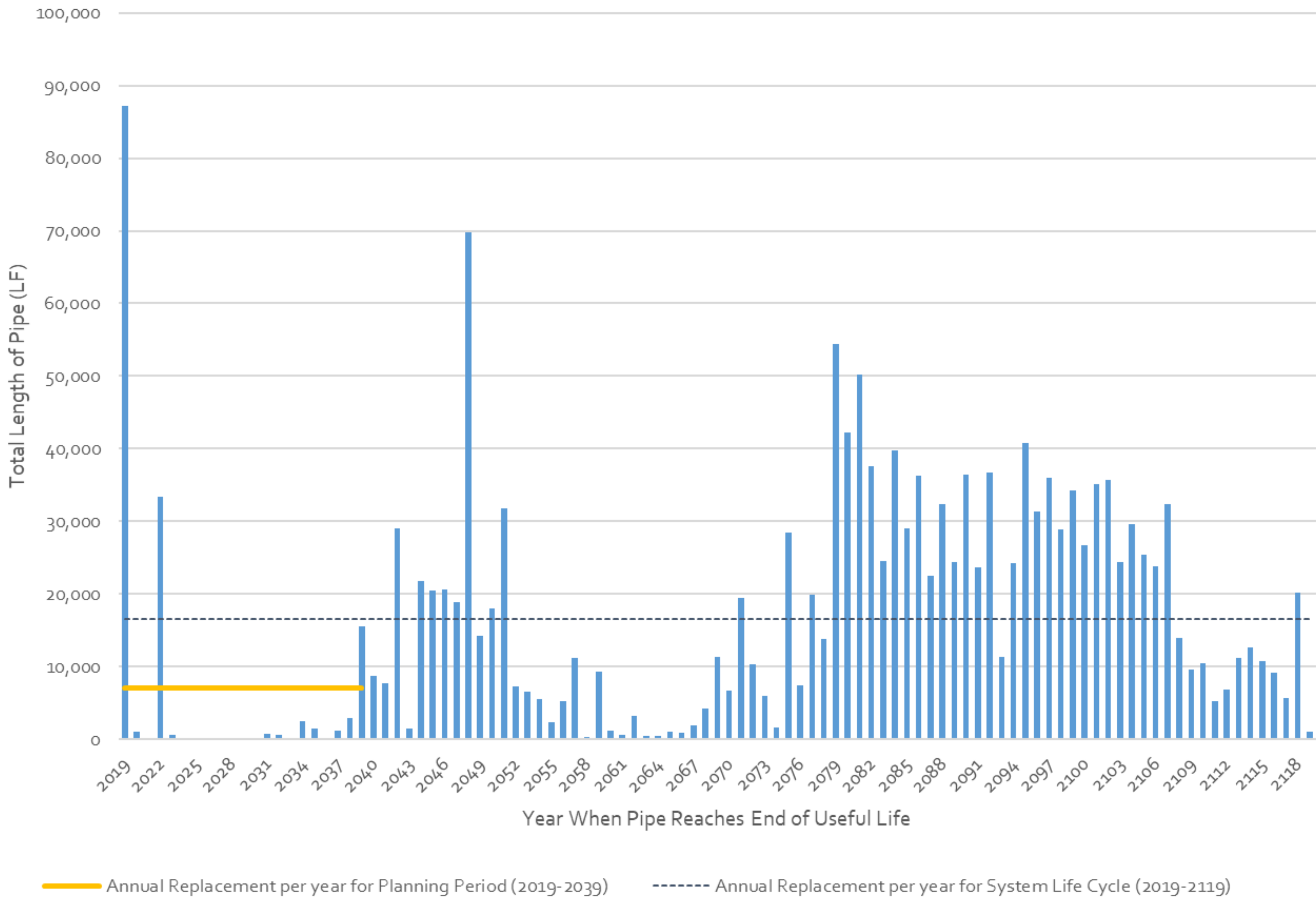


Figure ES.8 Pipes Reaching End of Useful Life

ES.8 Operations and Maintenance

The Water Maintenance Services Division maintains and operates the City's public water infrastructure. Normal, day-to-day operational monitoring including daily water quality checks ensure the integrity of the drinking water provided to customers. Other operations and maintenance (O&M) responsibilities and tasks include:

- Preventive Maintenance.
- Water Quality Monitoring.
- Emergency Response.
- Cross Connection Control.
- Capital Improvement Planning.
- O&M Budget Formulation.
- Response to Complaints.

Chapter 8 also reviews the water system's routine operation practices conducted by staff, performance evaluation, operations under abnormal conditions, and preventative maintenance program that manages the condition and operations of all the Water Utility's major assets.

ES.9 Capital Improvement Plan

The various projects recommended in the Plan were summarized in a comprehensive Capital Improvement Plan (CIP). With this CIP, the City will have a guideline to plan and budget for the water system over the next 20 years, as well as the recommended timing and cost estimates for each identified project. Project phasing is described as either short term (0 to 10 years, which corresponds to 2020-2029) or long term (10 to 20 years, which corresponds to 2030-2039).

The Plan's capital projects are categorized by the following infrastructure:

- Distribution pipeline (D).
- Pressure Zone (PZ).
- Storage Facilities (ST).
- Annual Repair and Replacement (R&R) Programs (P).
- Pump Station (PS).
- General and On-Going Capital Projects and Programs (G).
- Regulatory Compliance Programs (R).

As part of the planning and development of the capital improvement plan, the water utility will continue to consider programs and projects to support the City's business plan, vision and mission for economic growth, social equity, and environmental sustainability goals. The water utility will continue to implement capital improvement projects in a transparent manner, informed by system and community needs and the financial, environmental, and social costs and benefits, to provide long-term community value.

The City's Water Main Replacement Annual Program (WM) consist of the replacement of aging and undersized water mains throughout the water distribution and transmission system. The prioritization and selection of pipes are based on several factors including degree of fire flow deficiencies identified from the hydraulic model, frequency of leaks and breaks, remaining useful life of the pipes, and coordination with other City capital projects. This program reduces the likelihood of system failures, unplanned service interruptions, and claims for damages against the City. The following project categories identified in this Plan will be ultimately included in the City's WM Program:

- Distribution Pipeline Projects (D), which consist of sited specific projects to help mitigate deficiencies identified in Chapter 7, and sited maintenance main projects.
- Annual R&R Programs (P), which included non-sited pipelines. The City will prioritize every year based on the City's priorities and opportunities such as major roadways improvements and redevelopment areas.

Storage projects include construction of the new Kennydale and Highlands 445 reservoirs, and the recommendation of replacing the Rolling Hills 590 and Mt. Olivet reservoirs and a new Blackriver reservoir in the Valley 196 PZ. Pump station projects include improvements at the West Hill BPS, South Talbot BPS, Monroe BPS, and Mt. Olivet BPS.

Meanwhile, general projects (G) include studies and seismic-related projects for the distribution system, and on-going capital projects and programs, such as security improvements, or PRV rehabilitation. Finally, regulatory (R) projects represent general water quality compliance projects, water system plan updates, and the water conservation program.

Tables ES.4 and ES.5 summarize the CIP projects by project category and priority, respectively. Figures ES.9 and ES.10 summarize the percent of each project identified by project category and project phasing, respectively. Specific project details are provided at the end of the chapter in Chapter 9.

When considering CIP costs by project category as shown in Table ES.5 and Figure ES.9, the majority of CIP costs (47.3 percent) are accrued from programmatic projects. Distribution pipeline projects and general projects comprise the other high-cost categories and account for 17.3 percent and 10.4 percent of the CIP, respectively.

When considering CIP costs by priority as shown in Table ES.6 and Figure ES.10, approximately 63 percent of the CIP costs are annual programs. The total water CIP cost over the next 20 years is approximately $124 million, which equates to approximately $6 million per year for the planning period. Of the total cost, approximately $28 million is budgeted for the short term, approximately $18 million is budgeted for the long term, and approximately $79 million is budgeted for the annual category.

Table ES.4 CIP Summary by Project Category

Project Category	Annual Cost	Total Cost	Percentage
Distribution (D)	$ 1,075,550	$ 21,511,000	17.3%
Pressure Zone (PZ)	$ 21,250	$ 425,000	0.3%
Annual R&R Programs (P)	$ 2,937,600	$ 58,752,000	47.3%
Pump Station (PS)	$ 225,250	$ 4,505,000	3.6%
Storage (ST)	$ 869,750	$ 17,395,000	14.0%
General (G)	$ 645,000	$ 12,900,000	10.4%
Regulatory (R)	$ 440,000	$ 8,800,000	7.1%
Total Cost	**$ 6,214,400**	**$ 124,288,000**	**100%**

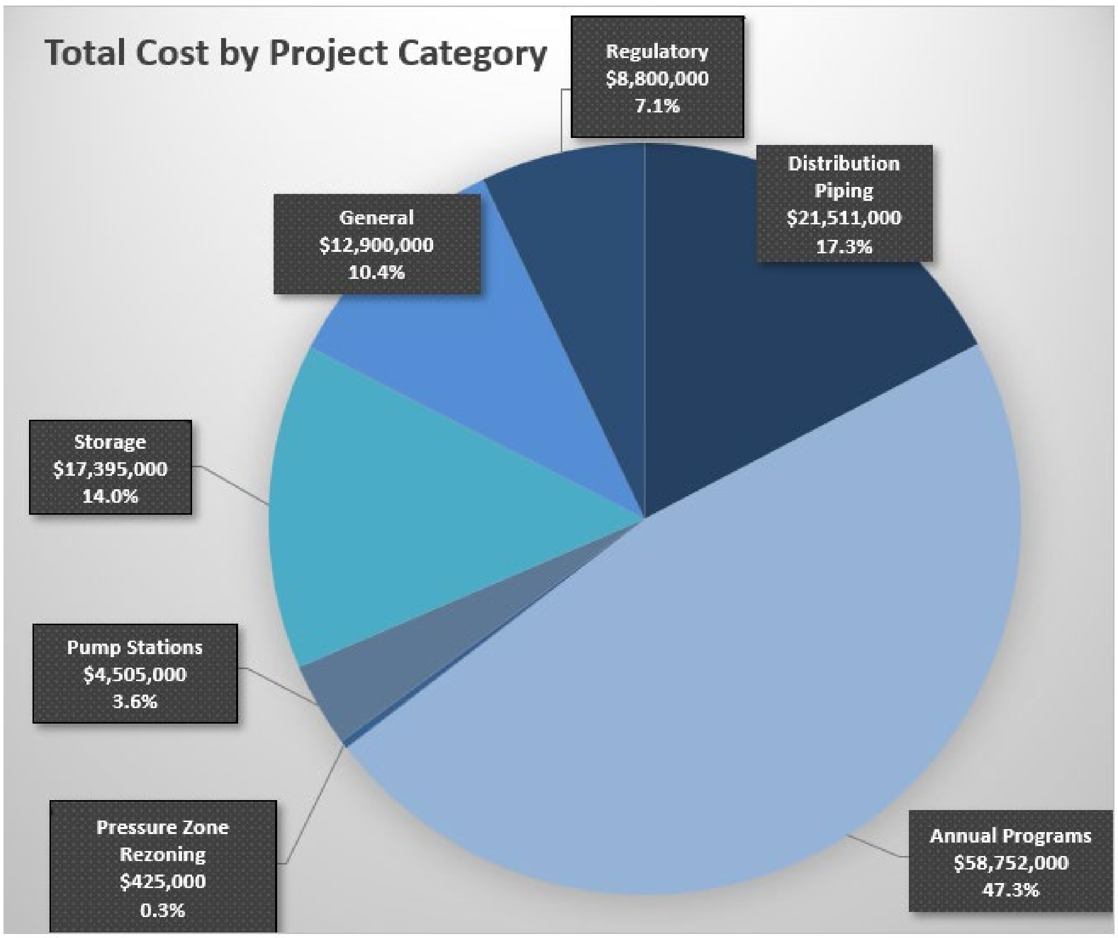


Figure ES.9 CIP Summary by Project Category

Table ES.5 CIP Summary by Project Priority

Project Priority	Total Cost	Percentage
0-10 years	$ 27,658,000	22.3%
10-20 years	$ 18,033,000	14.5%
Annual	$ 78,597,000	63.2%
Total Cost	**$ 124,288,000**	**100%**

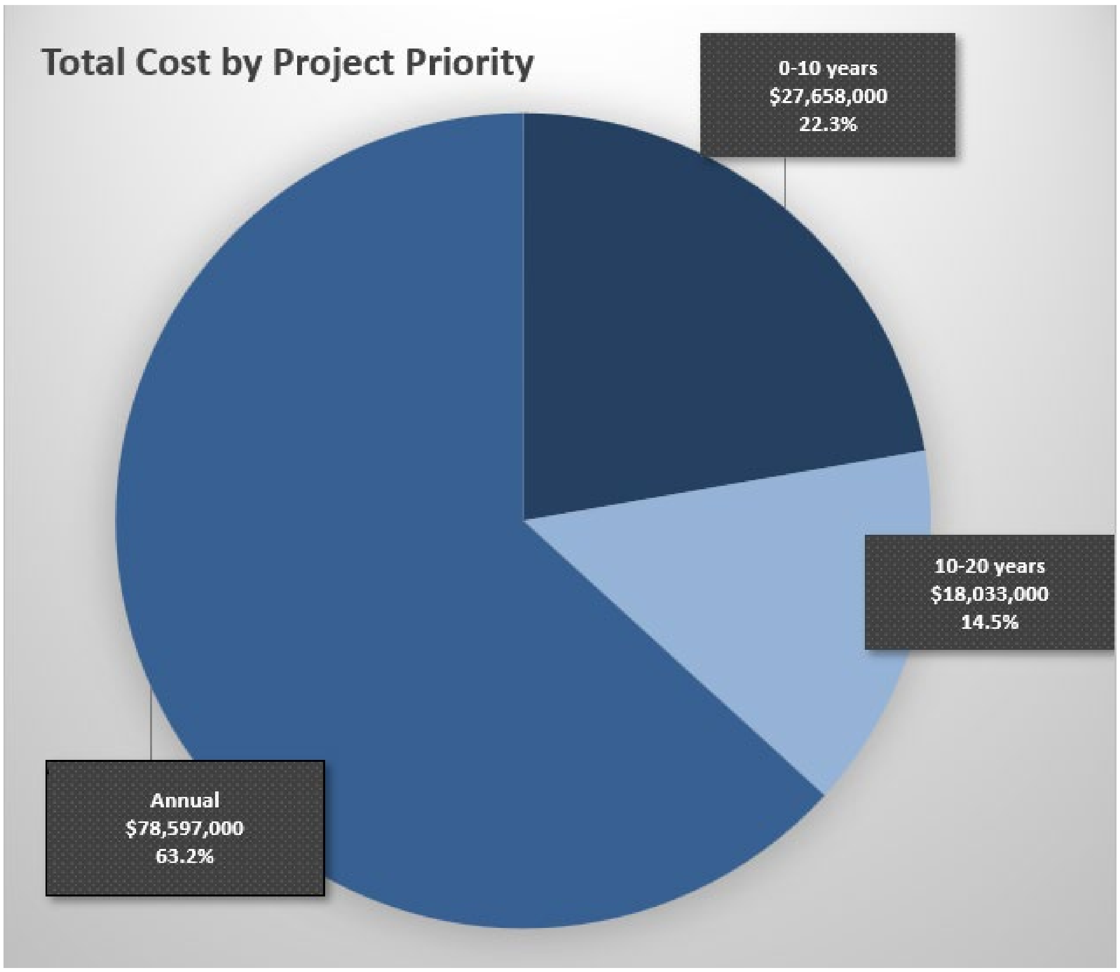


Figure ES.10 CIP Summary by Project Priority

Figure ES.11 illustrates the locations of the specific projects identified, while Figure ES.12 illustrates these projects phased between short and long terms. Distribution system improvements highlighted on Figure ES.11 includes both fire flow and velocity recommendations.

Figure ES.13 and Figure ES.14 illustrate the location of projects included in the programmatic CIP, which are not included in any of the specific projects. Figure ES.13 presents City's recommended program P-01, while Figure ES.14 presents City's recommended program P-03.

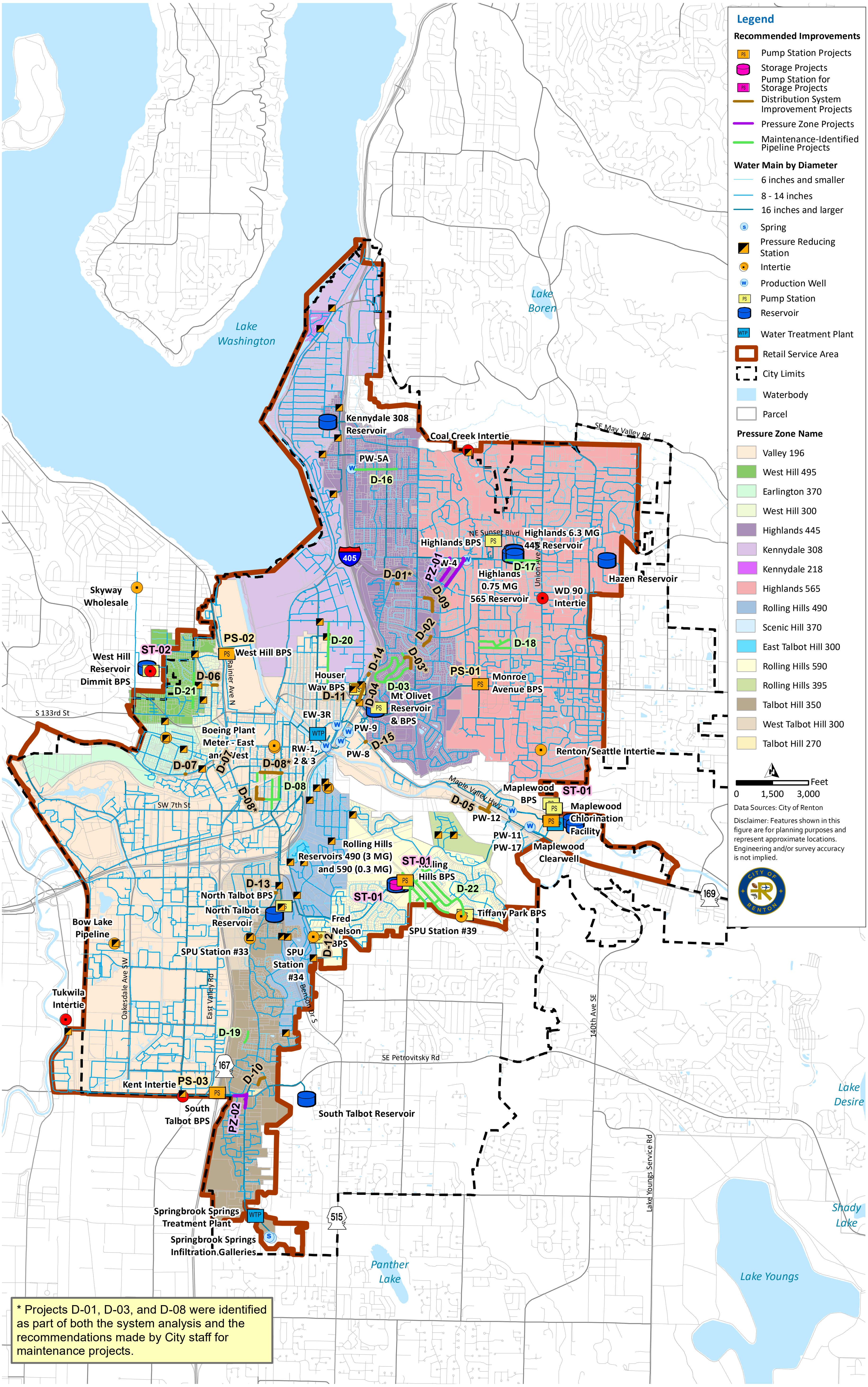
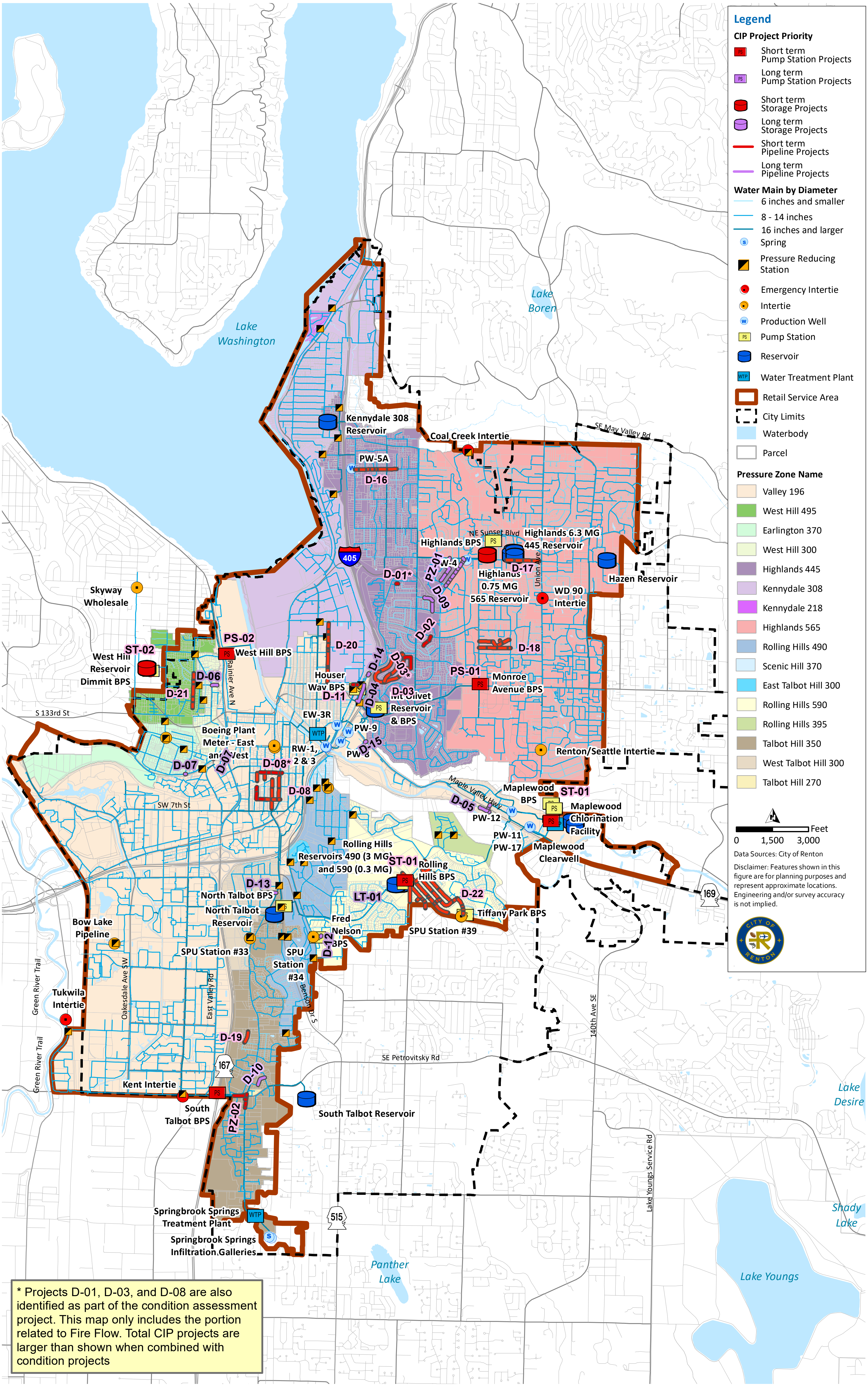


Figure ES.11 Recommended Specific CIP Projects



* Projects D-01, D-03, and D-08 are also identified as part of the condition assessment project. This map only includes the portion related to Fire Flow. Total CIP projects are larger than shown when combined with condition projects

Figure ES.12 CIP Specific Project Priority

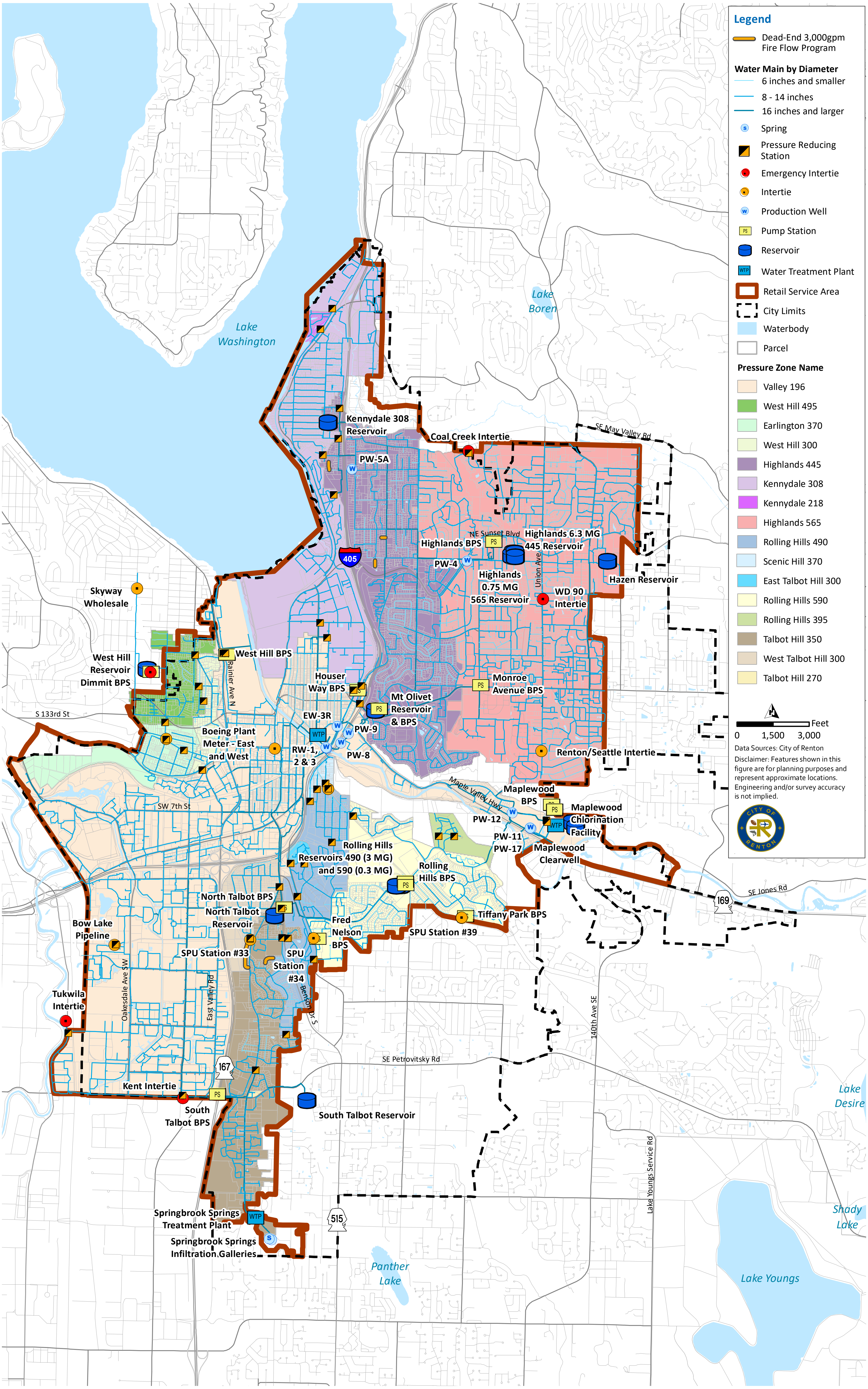


Figure ES.13 P-01: Dead-end 3,000 gpm Fire Flow Program

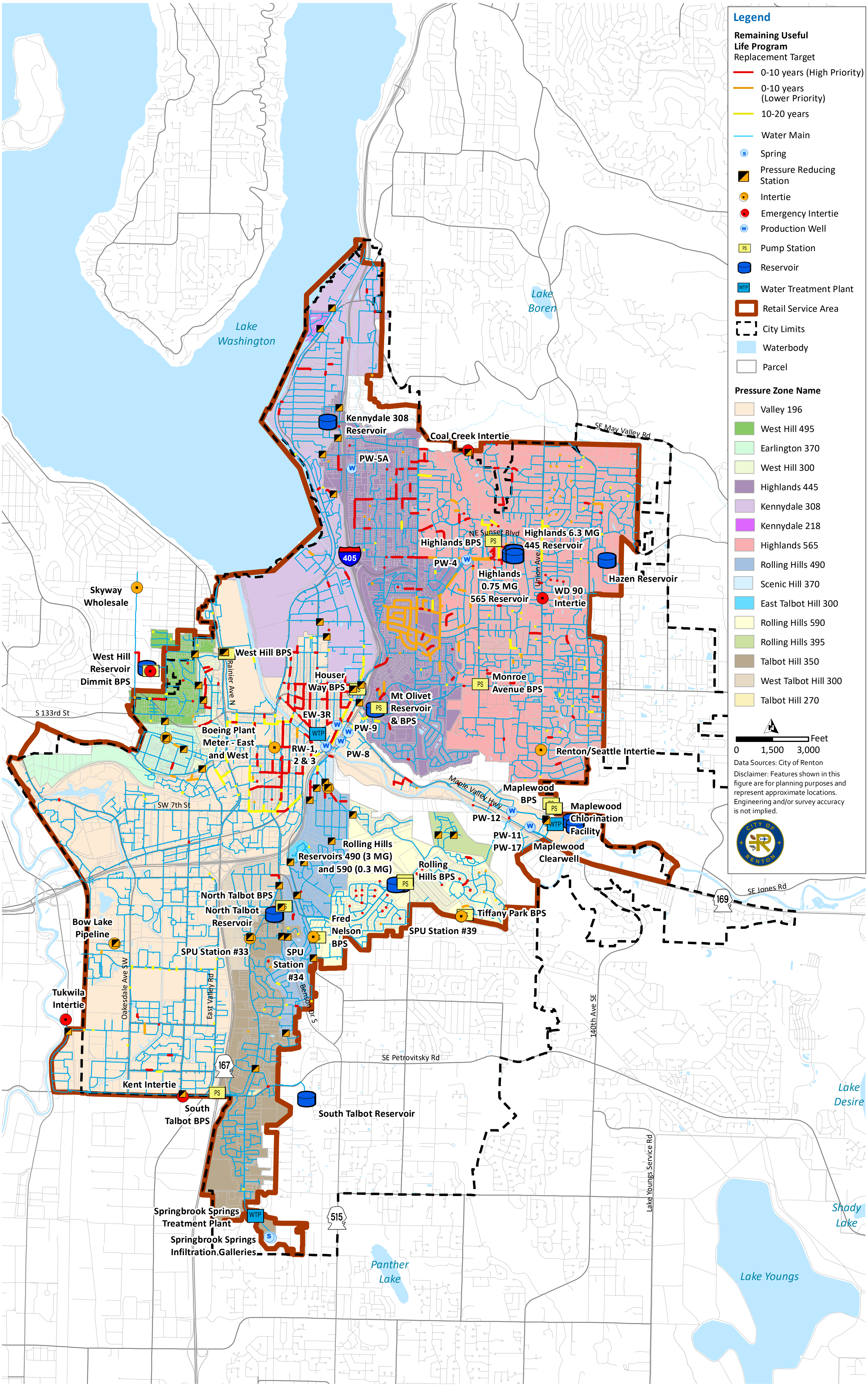


Figure ES.14 P-03: Remaining Useful Life

ES.10 Financial Program

The Water Utility's financial status was evaluated as part of the Plan, which provides a cursory evaluation of its ability to finance the necessary capital improvements identified in the CIP. The financial sufficiency evaluation developed for this Plan aims to determine whether existing and adopted rates are sufficient to cover the capital program developed as a part of Master Plan and, if not, the level of rate increases that would be required to do so. The evaluation relies on a revenue requirements analysis, which is used to test revenue sufficiency against expected revenue needs.

There are two tests used to define the annual revenues necessary to provide both sufficient (1) cash flow, and (2) debt coverage. These sufficiency tests are commonly used to determine the amount of annual revenue that must be generated from an agency's rates:

- **Cash Flow Sufficiency Test** defines the amount of annual revenue that a utility must generate in order to meet annual expenditure obligations. In the same lieu, the cash-flow test identifies projected cash requirements in each year. Cash requirements include O&M expenses, debt-service payments, policy-driven additions to working capital, miscellaneous capital outlays, and rate-funded capital expenditures. These expenses are compared to the total annual projected revenues, and shortfalls are used to calculate the needed rate increases. In this analysis, the cash flow test is the driver of the rate increase.
- **Debt-Coverage Test** refers to the collection of revenues to meet all operating expenses, debt service payments, and debt service obligations, such as debt service coverage ratio (DSCR). The debt-coverage test measures an agency's ability to meet policy-driven revenue obligations. Currently, the City holds three outstanding debt obligations and does not have any plans to issue additional debt to fund capital projects in the near future. Typical DSCRs range from 1.10x to 1.35x depending on an agency's financial situation and the type of debt being issued. For this analysis, the debt coverage test was set to meet a 1.25x DSCR based on the City's outstanding bond's requirements, meaning that the City must collect sufficient revenue through user rates to meet all on-going O&M expenses, as well as 1.25 times the total debt-service requirements due each year. The debt coverage test was sufficient in this analysis.

Financial projections from calendar year (CY) 2020 through CY 2029 were developed using the assumptions and inputs described in Chapter 10, as well as other inputs provided by the City or developed for the project. All three scenarios used the same assumptions for O&M costs, capital expenditures, and most offsetting revenues (all except interest earnings).

The financial forecast gives the City a snapshot of its current financial status. As numerous assumptions were made for analysis, projected results can vary from the actual data depending on factors such as actual customer use, demand projection, and growth. Therefore, this high-level projection should be later compared with actuals and adjusted accordingly.

Three funding strategy scenarios were developed to evaluate the 10-year CIP's impact on the Water Utility's financial status. Each scenario assumes a different amount of debt to fund the CIP projects. All scenarios include the expected debt issuance with the financing assumptions mentioned above:

- **Scenario 1, PAYGO (No Additional Debt)**: This scenario assumes that all 10-year CIP projects are funded by Pay-As-You-Go (PAYGO), using revenues from user rates and available reserves. The City has indicated that this is the preferred scenario as it hopes to no longer rely on debt as a means of controlling long-term expenses.
- **Scenario 2, Maximized Additional Debt**: This scenario maximizes the use of debt to mitigate rate increases in the short term. The first additional debt issuance would be needed in CY 2022 with debt proceeds needed every 3 years of the analysis.
- **Scenario 3, Moderate Additional Debt**: This scenario assumes that rate increases are front loaded in the first 5 years of the analysis, then additional debt issuances are used to smooth out peaks in CIP spending. The first additional debt issuance would be required in CY 2021 and another in CY 2025.

The Water Utility has indicated that Scenarios 1 or 3 are the preferred scenarios as they would decrease reliance on debt. Results for each scenario are summarized below:

Figure ES.15 compares each scenario's total capital funding sources from CY 2020 to CY 2029. As shown, Scenario 2 would require substantial use of debt to hold rate increases to 2 percent per year through CY 2025 and still implement the full 10-year CIP.

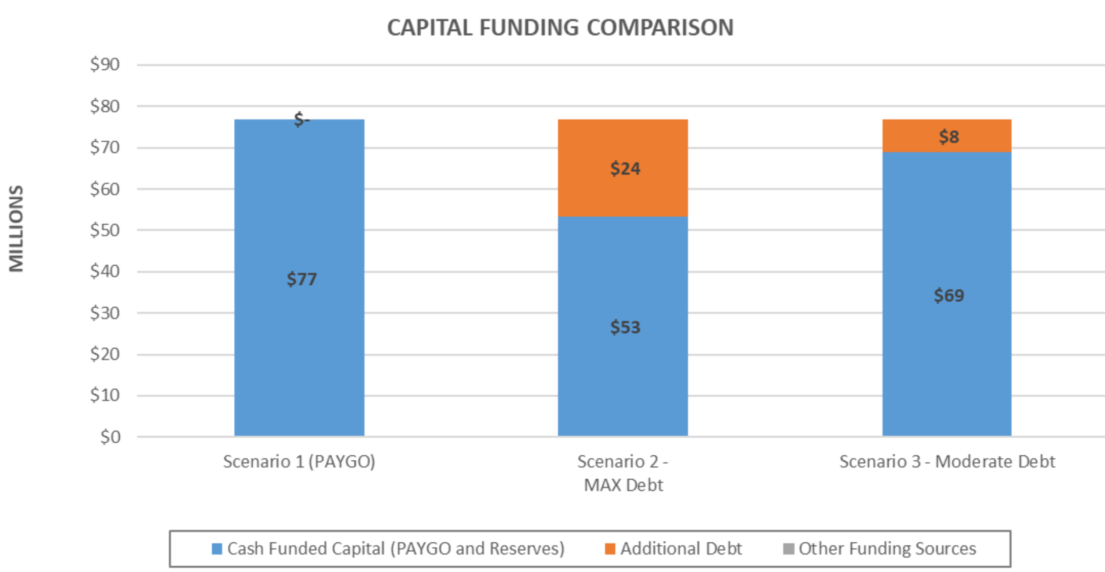


Figure ES.15 Capital Funding Comparison

Figure ES.16 compares the outstanding debt principal and projected interest payments that the water funds would hold after CY 2029 for each scenario. Under Scenario 2, the City would still need to pay off approximately $21.90 million in debt principal with almost $11 million in interest payments. This will lead to higher long-term costs and rate increases beyond CY 2029 as compared to what is demanded by the other scenarios. Furthermore, the City may not be able to issue debt at the frequency required for Scenario 2.

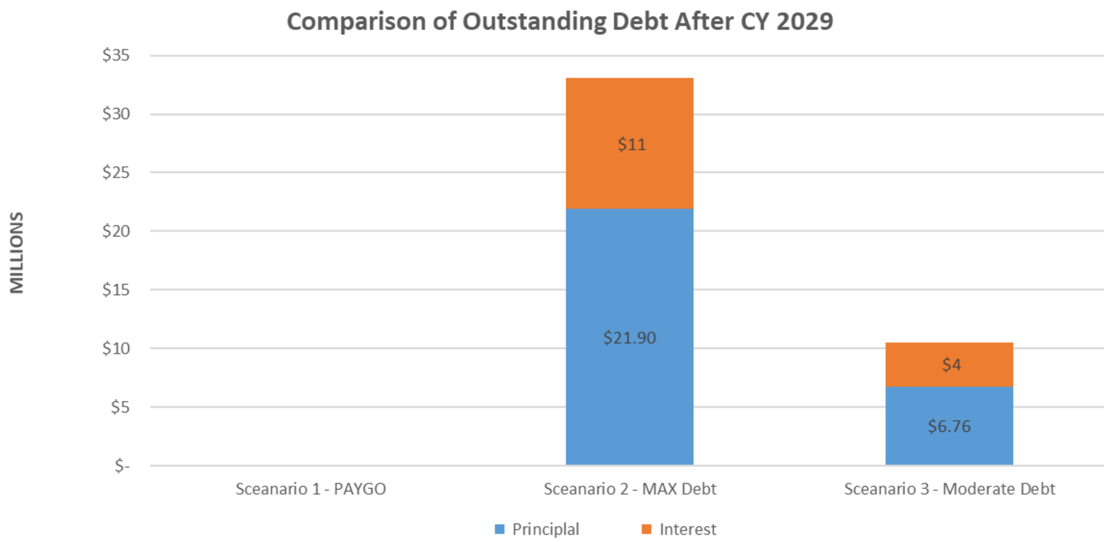


Figure ES.16 Comparison of Outstanding Debt After CY 2029

Figure ES.17 compares estimated single family residential (SFR) bills from CY 2020 to CY 2029 under each scenario. As shown, the long-term rate outlook for each scenario has the same general magnitude with estimated single-family charges ranging from about $61 to $68 per month by CY 2029. Increasing the amount of debt issued allows rate increases to be smoothed over time for a more gradual ramp-up to the ultimate rates.

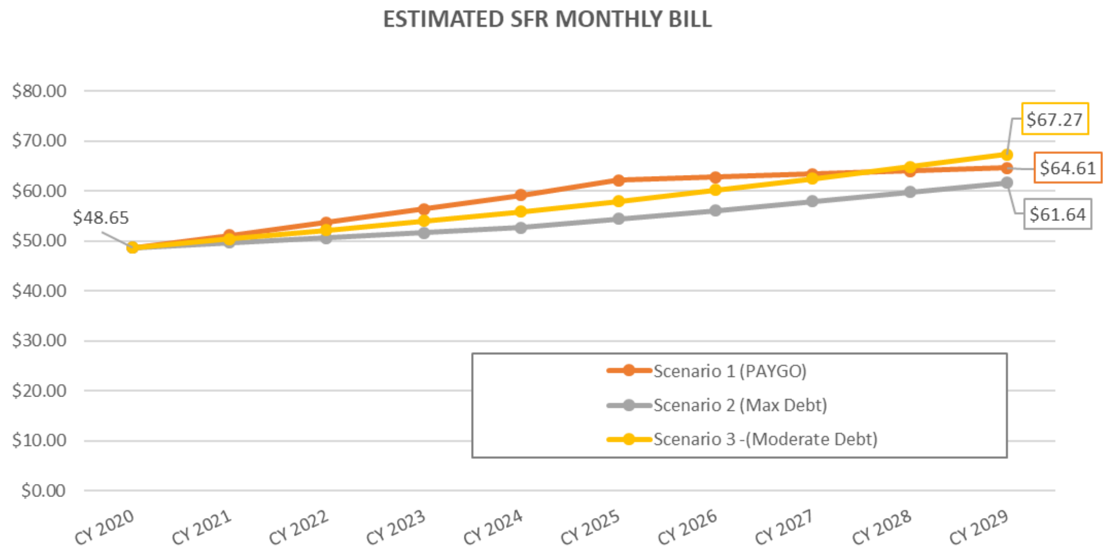


Figure ES.17 Estimated Single Family Residential Bill Comparison

These projections are intended to guide the financial planning of the City's Water Utility, not to serve as the basis for any implemented rate increases. As the City works with its rate consultant to complete a comprehensive rate study, more detailed short-term projections should be developed for the rate-study period.

Chapter 1
INTRODUCTION

1.1 Purpose

This Water System Plan (Plan) updates the City of Renton's (City) 2012 Water System Plan. It was developed collaboratively by City staff, Carollo Engineers, Inc. (Carollo), and Pacific Groundwater Group. This Plan documents the current status of the water system and evaluates future needs of the water utility. The data used for this Plan was current as of December 2017. The Plan was developed between 2018 and 2020 for approval in 2019. This Plan will be used as a guide in maintaining and improving the water system in the short-term over the next ten years and also provides a planning framework for the 20-year, long-term planning horizon.

The purpose of this Plan is to document changes to the City's water system, identify required system modifications, and appropriately outline capital improvement projects to meet future water demands. Maintaining a current Plan is required to meet the regulations of the Washington State Department of Health (DOH) and the requirements of the Washington State Growth Management Act. This Plan complies with the requirements of DOH as set forth in the Washington Administrative Code (WAC) 246-290-100, Water System Plan.

This Plan contains timeframes, which are the intended framework for future funding decisions and within which future actions and decisions are intended to occur. However, these timeframes are estimates, and depending on factors involved in the processing of applications and project work, and availability of funding, the timing may change. The framework presented in this Plan does not represent actual commitments by the City.

1.2 Authorization

Recognizing the importance of planning, developing, and financing water system facilities to provide reliable service for the existing customers and to serve anticipated growth, the City initiated the preparation of this Plan. In October 2017, the City selected the Carollo team to assist in the preparation of the updated Plan in accordance with applicable rules and regulations governing planning for water utility systems.

1.3 Objectives

This Plan has been prepared to serve as a guide for planning and designing future water system facilities and to assist the City in using its water resources in the most efficient manner possible. Identified in this Plan are system improvements intended to meet the expanding and changing needs of the City. Specific objectives of this Plan are addressed by individual chapters presented herein and include the following:

- Develop a document that can be updated periodically as additional information on the water system is obtained.
- Description of Existing System (Chapter 2): Document the existing water system supply, storage, and distribution facilities.

- Planning Data and Water Demand Forecast (Chapter 3): Identify and estimate the effect of future land uses and population trends on the water system. Document historical water use, and project future demands based on growth projections.
- Water Conservation Program (Chapter 4): Identify the role that water use efficiency will have in reducing future water requirements and how the City's water conservation program will be implemented.
- Water System Policies, Criteria, and Standards (Chapter 5): Establish clear policies and criteria relating to water service within the City's water system.
- Water Supply and Water Rights (Chapter 6): Document existing and potential future water supply and water rights and discuss existing and forthcoming regulatory requirements on the City water system.
- System Analysis (Chapter 7): Update the computerized model for analysis of the system. Assess the capability of the existing water system to meet existing and projected future demands, identify water system deficiencies.
- Operations Program (Chapter 8): Provide a comprehensive review of operations and maintenance of system facilities.
- Capital Improvement Plan (Chapter 9): Develop a program of capital improvements, including priorities for design and construction.
- Financial Program (Chapter 10): Develop a plan for financial backing of required system improvements.
- Prepare an environmental checklist for city council action on the proposed water system plan. The checklist is to be reviewed by the various City departments for a threshold determination.
- Prepare the Plan to comply with the requirements of the DOH.

1.4 Location

The City is located within King County at the southeastern end of Lake Washington. Interstate 405 (I-405) runs through the middle of the retail service area (RSA), from its western boundary, up through its northern boundary. The Cedar River divides the City's RSA between the north and south. The City's water system provides service to an area of approximately 17.25 square miles that is largely coincident with the city limits. The water distribution system serves the valley floor and parts of five surrounding hills: West Hill, the Highlands, Scenic Hill (also known as Renton Hill), Talbot Hill, and Rolling Hills. The City currently serves customers within an elevation range of 11 to 476 feet. This range creates a need for at least four separate pressure zones. However, physical barriers such as hills and valleys often prevent the extension of a pressure zone from one location to another. As a result of the City's topography and geography, the City has 16 hydraulically distinct pressure zones.

The City's RSA is bordered by nine adjacent water systems: the Skyway Water and Sewer District (Skyway), Seattle Public Utilities (SPU), the City of Tukwila, the City of Kent, the Soos Creek Water and Sewer District (Soos Creek), the Cedar River Water and Sewer District (CRWSD), King County Water District No. 90, the Coal Creek Utility District (UD), and the Wasmeta Park Water System. Figure 1.1 shows the City's neighboring water utilities, as well as the RSA boundary.

1.5 Ownership and Management

The City's water system is officially designated in the DOH records as City of Renton, system identification number 71850L. It is a municipal, Class A water system.

The City has a city council-mayoral form of government. Members of the council and the mayor are elected officials. The mayor is the head of the executive branch of the government and is the chief executive officer of the City government and as such has general supervision over the several departments of the City and over all its interests. Figure 1.2 shows the organization of the drinking water utility. With the exception of the billing function, the operation of the utility falls under the supervision of the administrator of the Planning/Building/Public Works Department, Mr. Martin Pastucha. Some of the City offices that provide support to the operation of the Drinking Water Utility are not shown on the organizational chart. For example, the Human Resources/Risk Management Department provides hiring, benefits, insurance, some types of training, and other support to the utility; the Information Services Division provides computer, networking and telecommunications support; and the City Attorney's Office provides legal support. Budgets are formulated by the departments and are presented by the mayor to the city council for approval. Expenditures for items in a council-approved budget are approved by the administrator, the mayor, or the council depending upon the amount of expenditure.

The main point of contact for the water system is as follows:

Name: George Stahl – Water Maintenance Manager
Phone: (425) 430-7400
Email: Gstahl@rentonwa.gov
Address: 3555 NE 2nd Street
Renton, WA 98056

1.6 System History

The City's municipal water service system was established in 1901. The municipality's source of water was first drawn from Renton Springs which was the primary source for this growing coal mine community but was eventually abandoned. A new source facility was constructed in 1924 at Springbrook Springs at the south end of the City. This artesian spring has since undergone several renovations and reconstruction phases while still providing water by gravity feed.

From the early 1940's to the 1990's, other groundwater sources were developed to augment capacity and to provide water supply reliability. These sources include six "Downtown" wells (RW-1, RW-2, RW-3, PW-8, PW-9, EW-3R) in the shallow Cedar River Delta Aquifer, three "Maplewood" wells (PW-11, PW-12, PW-17) in the deep Maplewood Aquifer, and one emergency well (PW-5A) in the Kennydale area.

In 2011, the City signed a 60-year water supply contract with SPU for the purchase of additional supply to meet the City's future growth demand and for peak demand periods.

A detailed history of the City's system is well documented in Chapter 2 of this Plan and in the previous water system plans prepared for the City by CH2M Hill in 1965, by RH2 Engineering in 1983, 1990, and 1998, by RW Beck in 2006, and by Carollo in 2012. The previous water system plans are available from the City upon request.

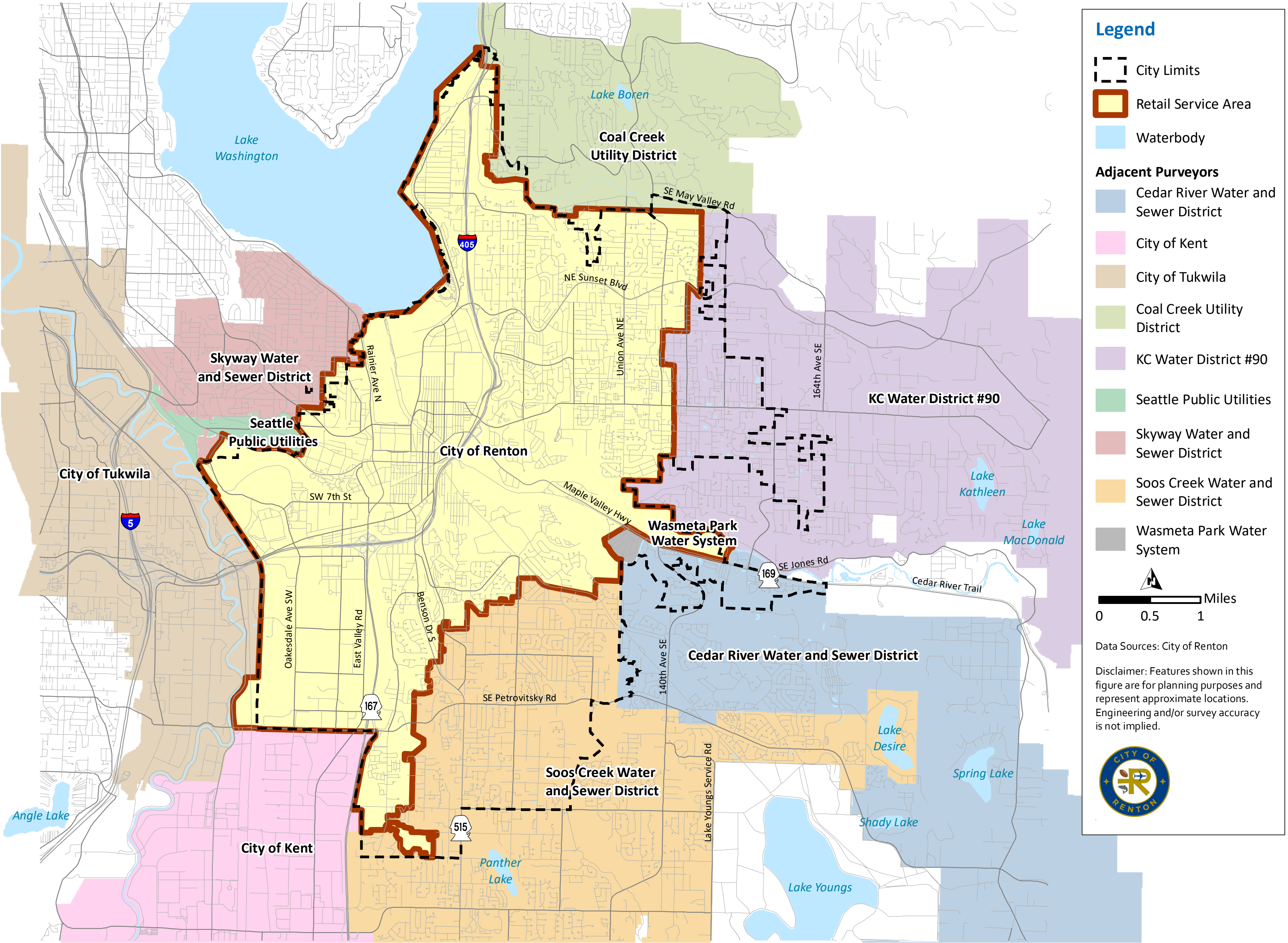


Figure 1.1 Adjacent Purveyors

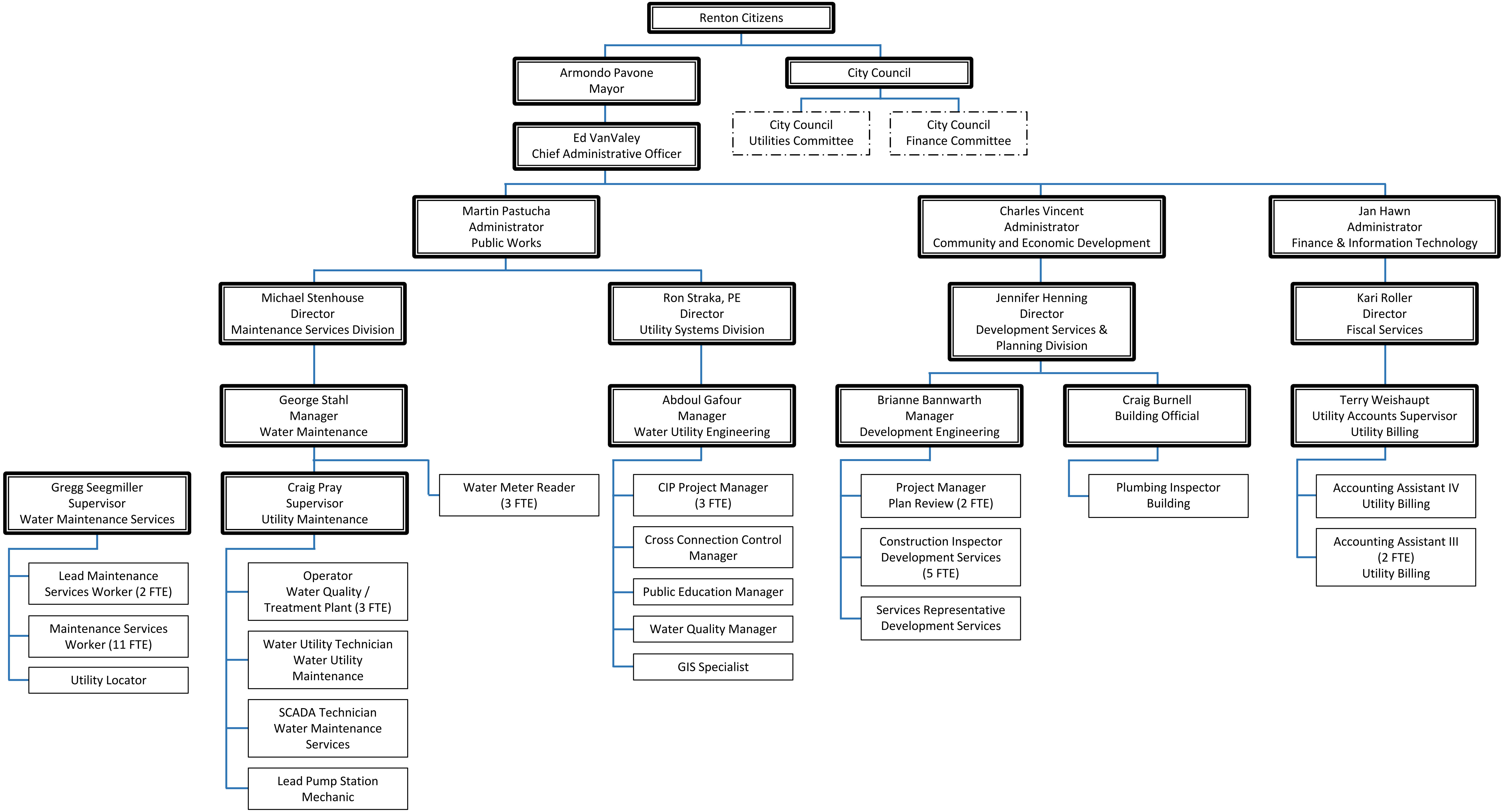


Figure 1.2 Drinking Water Utility Organization

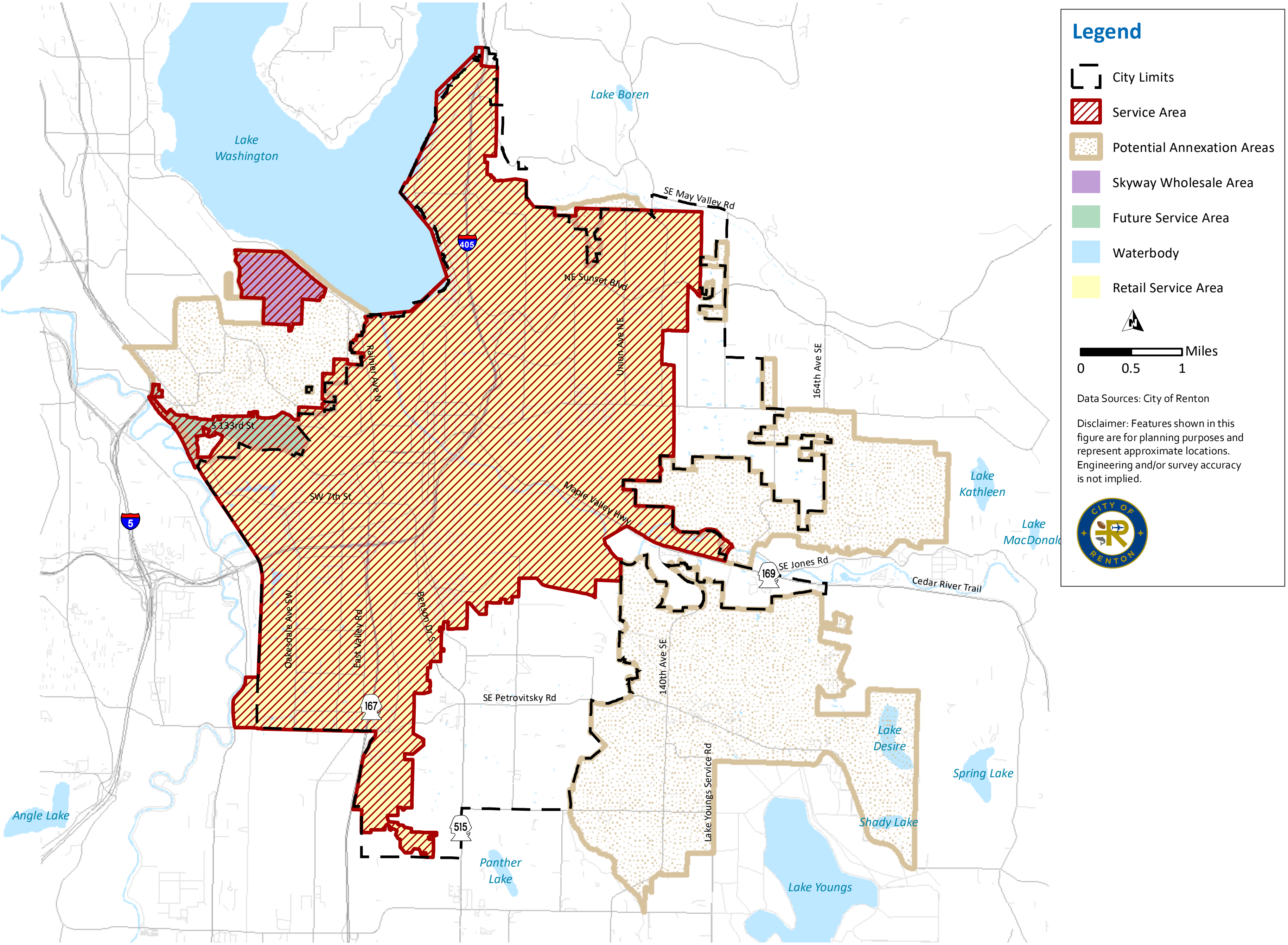


Figure 1.3 Service Area

1.7 Existing Service Area Characteristics

The City's service area boundaries are shown on Figure 1.3. The RSA is the area that the City has a duty to serve within the 20-year planning horizon of this Plan. The future service area is currently served by SPU but will likely be served by the City in the future. This area was originally defined in the Skyway Coordinated Water System Plan and is also described in service area agreement between the City and Skyway. The area would only become part of the water service area upon annexation into the City. The City's service area includes the RSA, the future service area, and the portion of Skyway that is supplied by Renton wholesale water.

The City's RSA boundary and future service area were initially defined by the East King County Coordinated Water System Plan (Agreement CAG-075-89) and its update (CAG-97-100) and by the Skyway Coordinated Water System Plan (CAG-076-89). These boundaries were further refined by agreements with the adjacent water purveyors: Skyway (CAG-03-197), Soos Creek (CAG-91-083 and CAG-97-164), and CRWSD (CAG-99-014). It is unlikely that the City's RSA will change very much in the future because of the geography of the surrounding areas and the fact that all of the surrounding areas are currently served by other water purveyors.

However, the City is considering small revisions to the boundary lines with both Soos Creek and CRWSD to better align with service in developments to City customers. These changes will be coordinated, reviewed, and mutually agreed upon with the adjacent purveyor in the future. Figures 1.4 and 1.5 illustrate these two areas.

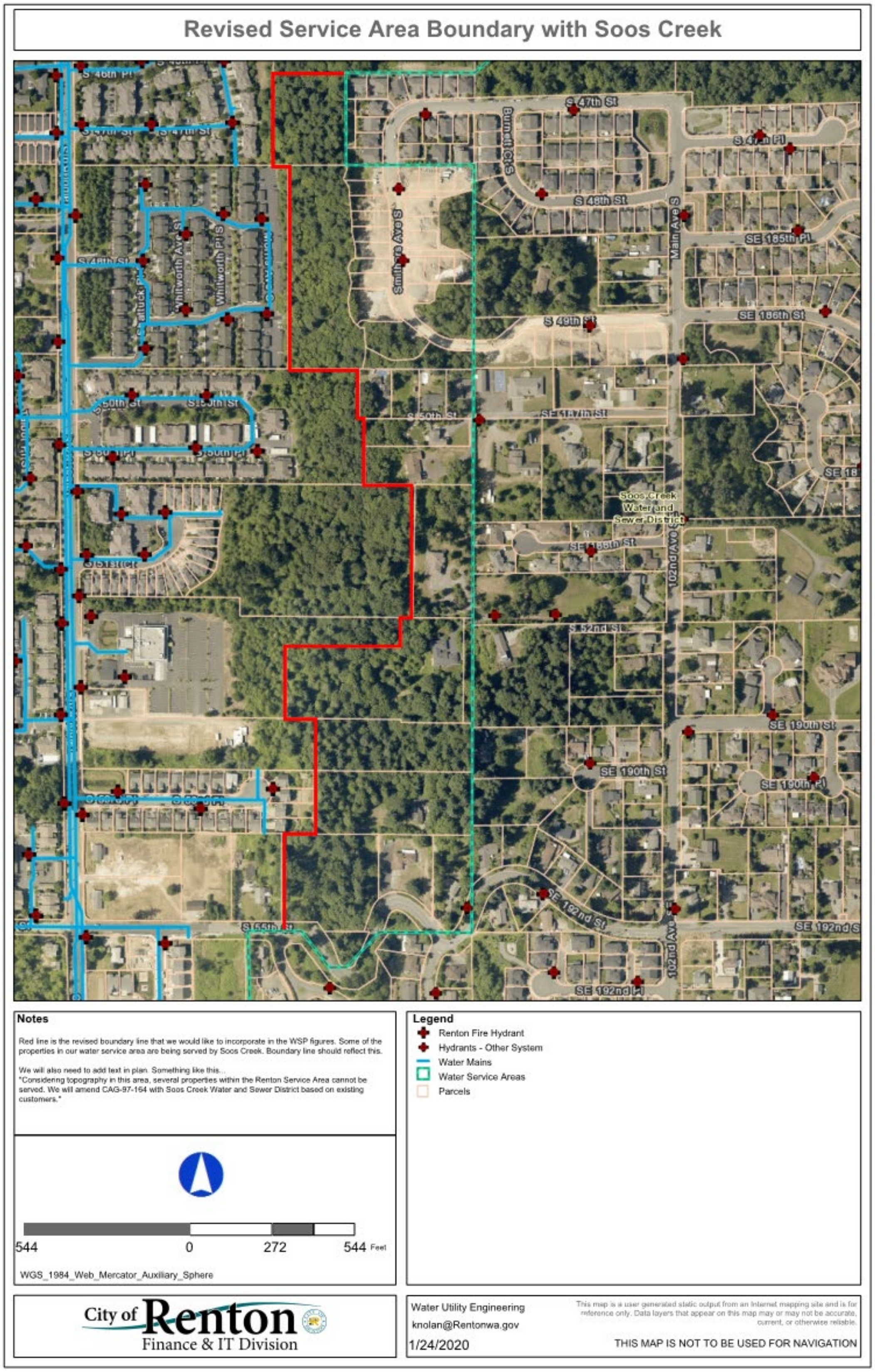


Figure 1.4 Revised Service Area Boundary with Soos Creek

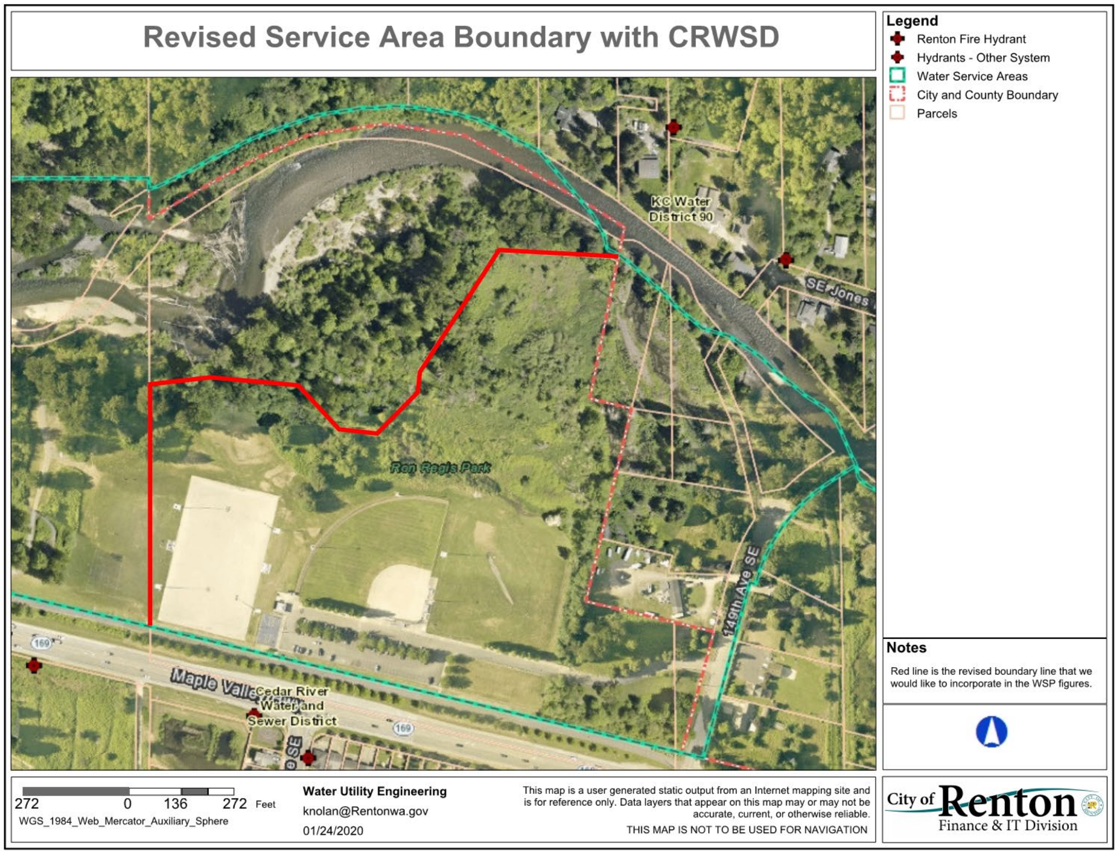


Figure 1.5 Revised Service Area Boundary with CRWSD

1.8 Service Area Agreements

Copies of current service area agreements are included in Appendix D. The following is a list of the service area agreements that the City has with adjacent purveyors:

- CAG-03-197 – Agreement between the City of Renton and the Skyway Water and Sewer District for the Establishment of Water and Sewer Service Boundaries, December 31, 2003.
- CAG-11-093 – Partial Requirements Contract for the Supply of Water to City of Renton, March 18, 2011.
- City of Seattle Ordinance 119202, October 22, 1998:
  - Interlocal Agreement between the City of Seattle and the City of Renton for use of certain Renton right-of-way by Seattle and use of certain Seattle owned property by Renton, November 9, 1998.
  - Water Purveyor Contract between the City of Seattle and the City of Renton for the Sale of Wholesale Water by Seattle to Renton, November 1, 1998.
  - Lease Agreement No. 327-815 (18-23-5 SE) between the City of Seattle and the City of Renton, November 9, 1998.
  - Agreement for the Transfer of Water Service and Provision of Primary Fire Service between the City of Seattle and the City of Renton, November 9, 1998.
- City of Renton Ordinance 1544, Granting Franchise to City of Seattle for 36-inch supply line in 132nd Avenue SE, May 1, 1956.

- CAG-02-123 – Agreement for the Sale of Water in an Emergency by the City of Renton to the City of Renton, November 30, 2002.
- CAG-99-014 – Agreement between the City of Renton and the CRWSD for the Establishment of Service Boundaries, February 8, 1999.
- CAG-97-100 – Agreement for Establishing Utility Service Boundaries as Identified by the East King County Coordinated Water System Plan, June 12, 1997.
- CAG-075-89 – Agreement for Establishing Utility Service Boundaries as Identified by the East King County Coordinated Water System Plan, October 18, 1989.
- CAG-076-89 – Agreement for Establishing Water Service Boundaries as Identified by the Skyway Coordinated Water System Plan, October 18, 1989.
- CAG-97-164 – City of Renton and Soos Creek Water and Sewer District Interlocal Agreement for the Establishment of Service Boundaries, October 10, 1997.
- CAG-91-083 – City of Renton and Soos Creek Water and Sewer District Agreement for the Transfer of Facilities and for the Establishment of Service Boundaries, August 6, 1991.
- CAG-93-097 – City of Renton and Bryn Mawr – Lakeridge Water and Sewer District Contract for Water Supply and Joint Storage and Transmission, January 1, 1993 (now part of Skyway Water and Sewer District).
- CAG-95-034 – Agreement for the Emergency Sale of Water between the City of Renton and the City of Tukwila, March 21, 1995.
- CAG-95-071 – Agreement for the Emergency Sale of Water between the City of Renton and the City of Kent, May 17, 1995.

1.9 Environmental Assessment

A State Environmental Policy Act (SEPA) Checklist and determination of non-significance (DNS) has been prepared for this Plan. The City anticipates this Plan does not have probable significant adverse impacts on the environment in accordance with the DNS under WAC 197-11-340(2). Many of the projects proposed within the Plan will require subsequent project specific environmental review and SEPA checklists as part of their preliminary and final design process. The SEPA Checklist and DNS are included in Appendix A.

1.10 Approval Process

This Plan is required to meet state, county, and local requirements. It complies with the requirements of the DOH as set forth in WAC 246-290-100. The City will submit this Plan to the DOH, the Washington State Department of Ecology (DOE), King County, adjacent utilities, and local governments as part of the Agency Review process. See Appendix B for the Comment Letters. The Adopting Resolution will be included in Appendix C, upon Plan approval by the city council.

1.11 Related Plans

The following plans are related to the City's Water System Plan:

- City of Renton Water System Plan (2012).
- City of Renton Long-Range Wastewater Management Plan (2010).
- City of Renton Comprehensive Plan (2015).
- City of Renton Water Use Efficiency Plan (2008).

- King County Comprehensive Plan (2017).
- East King County Coordinated Water System Plan (1996).
- Skyway Coordinated Water System Plan (1989).
- Skyway Water and Sewer District Comprehensive Plan (2013).
- SPU Water Shortage Contingency Plan (2019).
- SPU Water System Plan (2019).

The City is not aware of any inconsistencies between this Plan and the plans listed above.

1.12 Acknowledgements

Carollo and Pacific Groundwater Group, wish to acknowledge and thank the following individuals for their efforts and assistance in completing this Plan:

- Martin Pastucha, Public Works Administrator.
- Gregg Zimmerman, former Public Works Administrator
- Ron Straka, Utility Systems Director.
- Abdoul Gafour, Water Utility Engineering Manager.
- George Stahl, Water Maintenance Manager.
- Craig Pray, Water Utility Maintenance Supervisor.
- Katie Nolan, Water Utility Engineer.
- Mike Mitchell, Water Utility Engineer.
- Lauren Imhoff, Water Utility Program Specialist.
- Emina Sulych, GIS Specialist.
- Mick Holte, Cross-Connection Specialist.
- Greg Durbin, Water Quality Treatment Plan Operator.
- Lys Hornsby, former Utility Systems Director.
- Andrew Weygandt, former Water Utility Engineer.
- J.D. Wilson, former Water Utility/GIS Engineer.

Chapter 2

EXISTING SYSTEM

2.1 System Overview

The City of Renton (City) owns and operates a multi-source municipal water system, which includes supply, treatment, storage, and distribution of potable water to residential, commercial, industrial, and wholesale customers. Service is provided to an area of approximately 17.25 square miles with 17,830 retail customers (service connections) and one wholesale customer, Skyway Water and Sewer District, via a single metered connection. The City's Water Facilities Inventory (WFI) is located in Appendix E.

Figure 2.1 presents the water facility locations. Water supply sources include five production wells (RW-1, RW-2, RW-3, PW-8, and PW-9) and one artesian spring (Springbrook Springs) that are used for primary supply. Springbrook Springs is located at the south end of the service area. The wells are located in Liberty Park and Cedar River Park, and pump from a relatively shallow aquifer (Cedar Valley Aquifer). One emergency well (EW-3R) pumps from the same aquifer but is only available as a backup source of supply. These six wells are referred to as the "Downtown Wells". There are also three production wells (PW-11, PW-12, and PW-17) located east of the downtown area at the Maplewood Golf Course that provide an alternate source of supply in the event of the contamination of the Downtown Wells. A secondary purpose of the Maplewood Wellfield is to provide additional instantaneous flow (Qi) during high demand periods. The permits for the Maplewood Wells set the system-wide annual withdrawal (Qa) to no more than the existing certificated Qa of 14,809.5 acre-feet (i.e., the Maplewood annual water rights are non-additive). The Maplewood wells pump from a deep aquifer (Maplewood Aquifer). A single emergency well (PW-5A) is located at the north end of the service area. Well 4 is currently inactive, as is Well PW-5A which is only used as backup due to water quality issues. These sources authorize total primary water right allocations in the amount of 1,670 gallons per minute (gpm) and 2,593.5 acre-feet per year (ac-ft/yr), which is being exercised through the use of supplemental sources.

The City is a wholesale customer of Seattle Public Utilities (SPU). The City has seven metered interties with the SPU transmission mains, which are available to serve wholesale water to the City's distribution system. The City also has two metered interties with SPU to serve water directly to the Renton Boeing Plant. The City currently only buys wholesale water from SPU to sell to Boeing, but the City has a long-term supply contract for backup supply and future water demands. The City has three emergency supply interties with neighboring water systems.

All of the water the City produces comes from a well or spring. Because of this supply configuration, the City's water system is maintenance-intensive, with facilities for pumping, water quality control, and emergency power generation.

Areas within the City's Retail Service Area (RSA) may have similar elevations but cannot be served as part of the same pressure zone due to the geography. For instance, the pressure zones in the Highlands area have not been extended across Maple Valley into the Renton Scenic Hill or Talbot Hill areas, even though the elevations served on these two hills are similar. The Cedar River Valley provides a physical barrier that has precluded joining hydraulically similar pressure zones. As a result of these physical barriers and the elevation range served, 16 pressure zones are necessary to serve the City's customers within acceptable pressure ranges.

Figure 2.1 illustrates how water moves horizontally through the distribution system. Figure 2.2 is a hydraulic profile of the system and shows how water moves vertically from one pressure zone to another. All of the pressure zones are hydraulically interrelated with the lowest pressure zone located in the valley floor. It is desirable to have two or more connections (or supply points) within each pressure zone to allow water to move upward to a higher-pressure zone or downward to a lower pressure zone. This maximizes system reliability by providing multiple routes to move water between pressure zones.

Pumping between pressure zones is accomplished by 12 booster pump stations (BPS) that are located throughout the City. The Downtown Wells and Springbrook Springs supply water to the lowest pressure zone (Valley 196 Pressure Zone [PZ]) and then the water is pumped up to the West Hill, Highlands, Renton Hill, Talbot Hill, and Rolling Hills PZs. Water from the Maplewood Wells is pumped from a post-treatment clearwell into the Highlands and Rolling Hills PZs. Water from Well PW-5A is also pumped into the Highlands 435 PZ. Two pump stations, one pressure reducing station, and one metered connection can supply water to the Rolling Hills and Talbot Hill PZs from interties with the SPU Cedar River and Bow Lake transmission pipelines. Interties with the SPU Bow Lake transmission pipeline can also supply water to the Earlington 370 and Valley 196 PZs.

Currently there are 10 reservoirs in the system, strategically located to provide adequate equalizing and fire flow reserves for all pressure zones. Pressure Reducing Valves (PRVs) are used to supply lower pressure zones from higher pressure zones that contain water storage reservoirs.

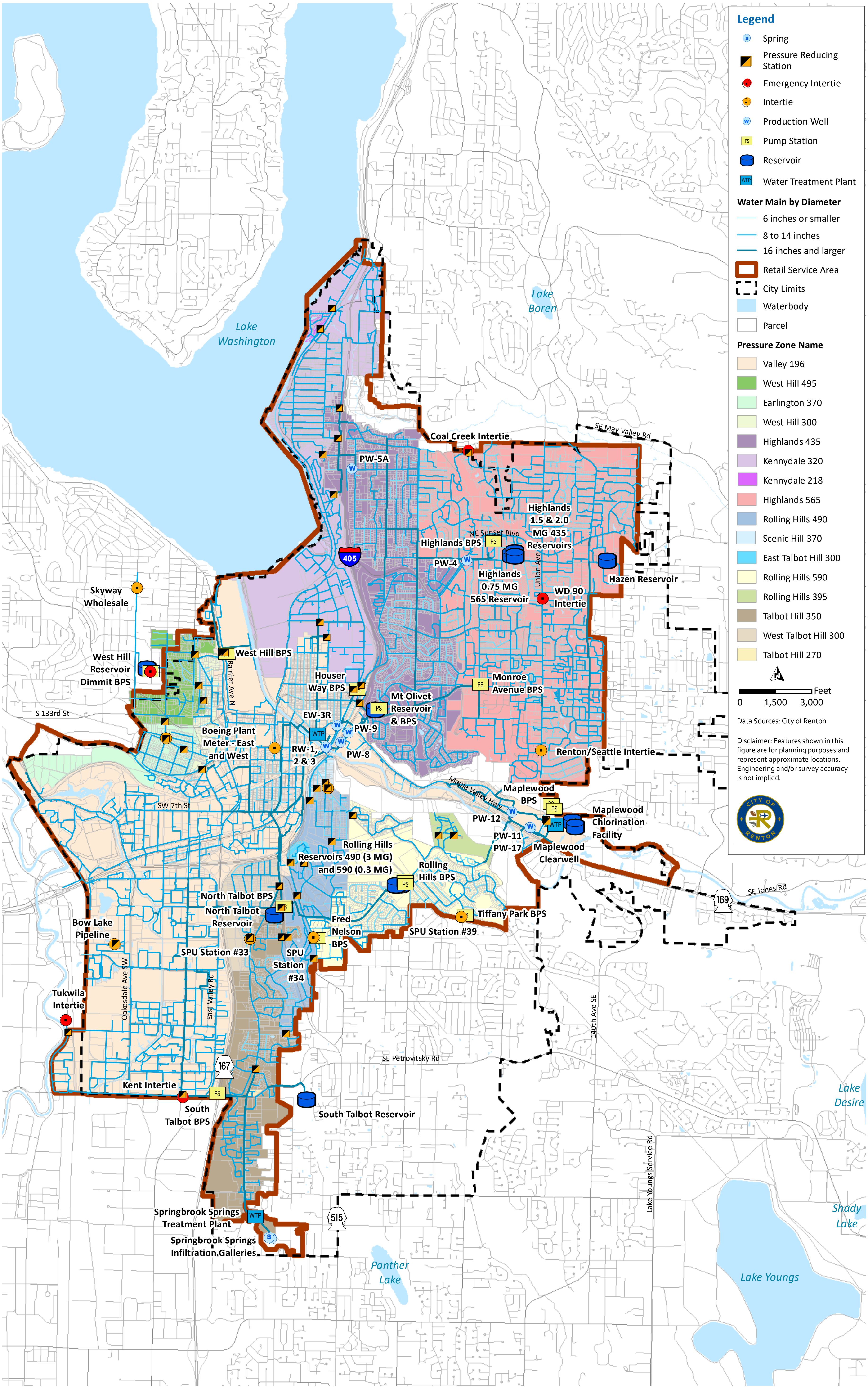


Figure 2.1 Water Facility Locations

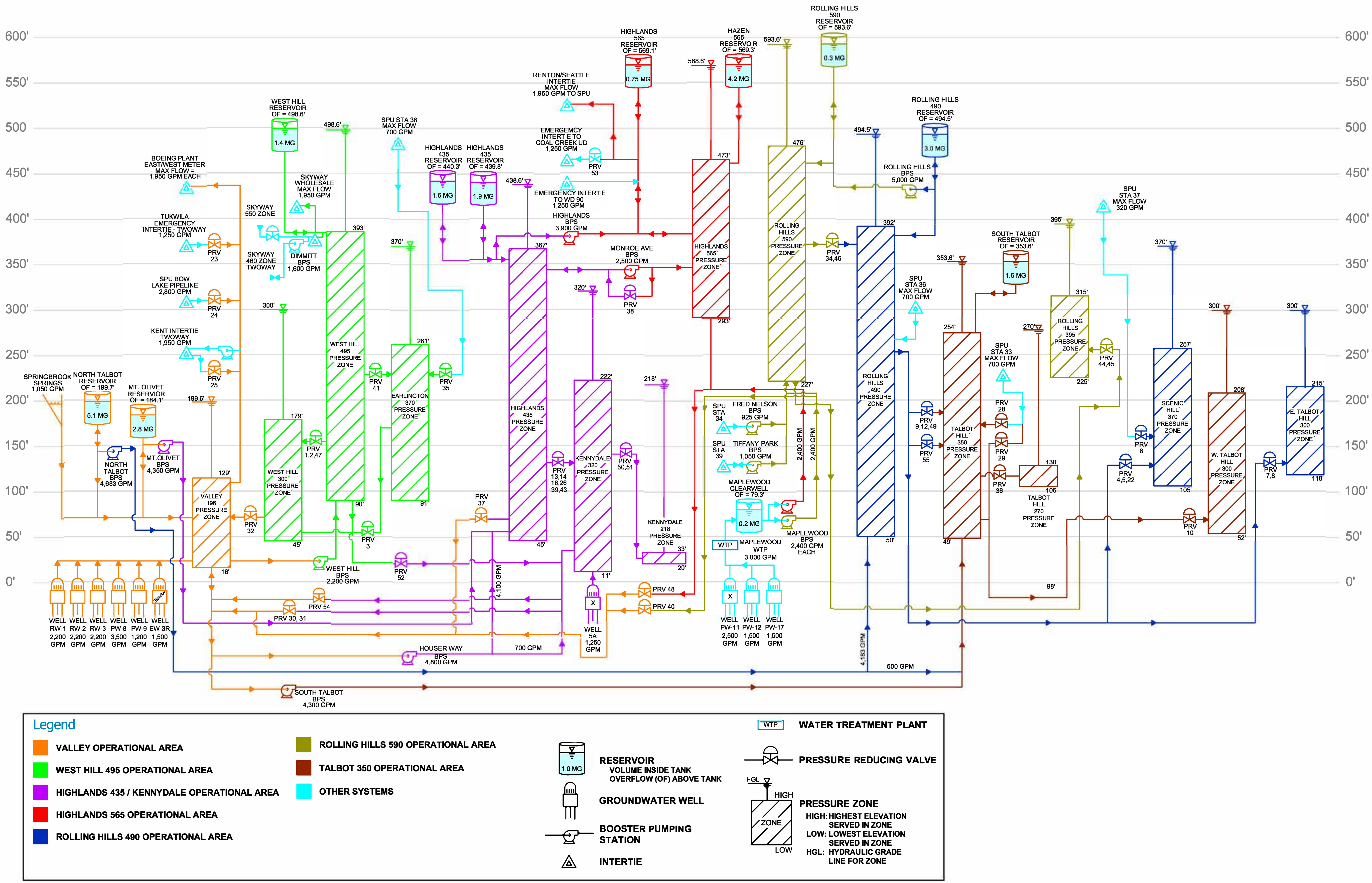


Figure 2.2 Hydraulic Profile Schematic

2.2 Water System Description

Several changes to the City's water system have occurred since the completion of the 2012 Water System Plan Update. A description of each facility and any major changes are summarized in the following sections.

2.2.1 Pressure Zones

As described above, the geography of the City requires the water system to have 16 distinct pressure zones. The hydraulic profile shown in Figure 2.2 shows how the pressure zones are interrelated and demonstrates how water can move through the system between pressure zones. All pressure zones are served directly or indirectly from the City's active wells and Springbrook Springs. The Downtown Wells (RW-1, RW-2, RW-3, PW-8, and PW-9) and Springbrook Springs directly supply the Valley 196 PZ. The Maplewood Wells (PW-11, PW-12, and PW-17) supply the Highlands 565 PZ and Rolling Hills 590 PZ.

Although the system has 16 distinct pressure zones, not all of the pressure zones have separate storage or supply facilities. Some pressure zones are supplied exclusively by pressure reducing stations from an upper pressure zone.

It is impractical to plan facilities and improvements for all of these pressure zones individually; therefore, the water system has been divided into seven operating areas. Each operating area is either a single pressure zone or a combination of pressure zones with similar operating characteristics. For instance, a lower pressure zone that is supplied exclusively by PRVs from an upper pressure zone would be combined with the upper pressure zone to form an operating area. For the majority of this Plan, the pressure zones are organized into the seven operating areas as indicated in Table 2.1.

Table 2.1 Pressure Zones by Geographical Area

Pressure Zone	Area Served	Operating Area	HGL (ft)	Maximum Elevation Within PZ (ft)	Minimum Elevation Within PZ (ft)	Minimum Served Static Pressure (psi)	Maximum Served Static Pressure (psi)
KD218	Kennydale	Highlands 435	218	33	20	80	86
KD320	Kennydale	Highlands 435	320	222	11	42	134
HLD435	Highlands	Highlands 435	439	367	45	31	170
HLD565	Highlands	Highlands 565	569	473	293	42	119
ETH300	East Talbot Hill	Rolling Hills 490	300	215	118	37	79
WTH300	West Talbot Hill	Talbot Hill 350	300	208	52	40	107
TH270	Talbot Hill	Talbot Hill 350	270	130	105	61	71
TH350	Talbot Hill	Talbot Hill 350	354	254	49	47	132
SH370	Scenic Hill	Rolling Hills 490	370	257	105	49	115
RH395	Rolling Hills	Rolling Hills 590	395	315	225	35	74
RH590	Rolling Hills	Rolling Hills 590	594	476	227	51	159
RH490	Rolling Hills	Rolling Hills 490	495	392	50	44	192
VLY196	Valley Floor	Valley	200	129	16	29	79
EARL370	Earlington	West Hill 495	370	261	91	47	121
WH300	West Hill	West Hill 495	300	179	45	52	110
WH495	West Hill	West Hill 495	499	393	90	45	177

Note:
Abbreviations: HGL – hydraulic grade line; ft – feet; psi - pounds per square inch.

2.2.2 Source of Supply

The City produces water from production wells and an artesian spring. Each of the supply sources is described in the sections below. Table 2.2 lists the active supply sources and the rated capacity of each. The table does not include inactive sources or interties. All of the City's interties, regular and emergency supply, are summarized in Table 2.3.

2.2.2.1 Springbrook Springs (Department of Health [DOH] Source S05)

Located at the south end of the City, Springbrook Springs is an artesian spring that supplies approximately 15 to 20 percent of the City’s drinking water. Springbrook Springs was first used in 1909. The infiltration galleries were upgraded and a sanitary seal was added to each in 1976 (project number W-0422). Chlorination was added in 1976 (W-0423). The chlorination building is located approximately 300 yards from the infiltration galleries and is adjacent to the transmission main. Fluoridation was added in 1986 (W-0851) via an addition to the chlorination building. Corrosion control treatment was added in 1999 (W-2238) and a sodium hydroxide storage building was constructed as part of this project.

The City has ownership of a significant amount of property that forms a watershed directly surrounding Springbrook Springs. A chain link fence was erected around the property to restrict activities and access to the watershed. The last segment of chain link fence was installed in 2002 (W-2980).

Springbrook Springs provides direct service to the Valley 196 PZ. In 2010, a motorized valve was added to the treatment facility to stop the flow of water when the chlorine residual drops below a safe level. The power source is a 20-kilowatt (kW) generator (propane fuel source). The generator is auto-start and the transfer from commercial power to electric generator power is automatic. Currently, flow control is via a manually set gate valve (throttling valve).

In 2013, a chlorine line was added at Springbrook Springs to provide primary disinfection. The dosing pipeline was installed adjacent to the Transmission Main and taps into the existing main at a manhole (new chlorine injection point). The manhole is about 770 ft upstream of the chlorination building and 1,195 ft upstream of the connection point for first service. This manhole serves as the chlorine injection point such that the minimum required chlorine contact time is achieved before the supply enters the distribution system (W-3648). Concentration of free chlorine times Contact Time (CT) of 11 milligram-minutes per liter (mg-min/L) is achieved for the Springbrook Spring’s supply. A chlorine analyzer was installed as part of Project W-3648, which provides continuous chlorine concentration monitoring.

Table 2.2 Active Supply Sources

Name	WFI Source Number	Water Right Status	Aquifer	Water Right Qi (gpm)	Maximum Pumping Capacity (gpm)	Maximum Physical Capacity with Installed Equipment		Standby Power
						(gpm)	(mgd)	
Springbrook	S05	Certificate	N/A	1,050	N/A	1,050	1.51	Auto Start / Auto Transfer
Well RW-1	S10	Certificate	Cedar Valley	2,200	2,200	2,200	3.17	Auto Start /Auto Transfer
Well RW-2	S10	Certificate	Cedar Valley	2,200	2,200	2,200	3.17	Auto Start /Auto Transfer
Well RW-3	S10	Certificate	Cedar Valley	2,200	2,200	2,200	3.17	Auto Start / Auto Transfer
Well PW-8	S20	Certificate	Cedar Valley	3,500	3,500	3,500	5.04	Trailer-in / Manual
Well PW-9	S20	Certificate	Cedar Valley	1,300	1,200	1,200	1.73	Trailer-in / Manual
Well PW-11	S13	Permit	Maplewood	2,500	2,500			None
Well PW-12(1)	S13	Permit	Maplewood	1,600	1,500	3,000	4.32	Trailer-in / Manual
Well PW-17(1)	S13	Permit	Maplewood	1,500	1,500			Trailer-in / Manual
Well EW-3R(2)	S16	None	Cedar Valley	1,500	1,600	1,500	2.16	Trailer-in / Manual

Notes:
(1) Standby power can serve either PW-12 or PW-17, not both.
(2) Emergency use only, when RW-1, RW-2, RW-3, PW-8, or PW-9 is out of service.
Abbreviation: mgd - million gallons per day.

2.2.2.2 Wells 1, 2, and 3 (DOH Source S10 – Wellfield)

Wells PW-1 and PW-2 were originally drilled in 1942 in Liberty Park adjacent to Houser Way North and the Cedar River. The wells were replaced by Wells RW-1 (DOH Source S01) and RW-2 (DOH Source S02) in 1988 (W-0880). Well PW-3 was originally drilled in 1959 and the wellhead constructed in 1962 (W-0119) in Liberty Park near the intersection of Houser Way North and Bronson Way North. Well RW-3 (DOH Source S03) replaced Well PW-3 (W-0880) but was co-located in the wellhouse with RW-1 and RW-2. Project W-0880 also included both chlorination and fluoridation. Corrosion control treatment was added in 1999 (W-2238).

A manual transfer switch with Kirk-Key safety system was added in 1999 to allow the wellhouse to be powered by a City-owned portable generator (W-2784). In 2007, an emergency electrical power generation facility was constructed at the Mt. Olivet Reservoir site to provide backup power for the Mt. Olivet BPS and Wells RW-1, RW-2, and RW-3 (W-3239). A power transmission line was installed from the new power facility to an automatic transfer switch located at the transformer adjacent to the wellhouse. The portable generator and manual transfer switch configuration remains as a secondary backup. The automatic transfer switch, which was originally installed in 1988 (W-0880), was rebuilt in 2010.

Primary disinfection was added to the three wells in 2003 using a loop of large diameter pipe (CT Pipe 1) in Liberty Park. The chlorine contact pipeline provides 4-log inactivation of viruses prior to discharge into the distribution system (W-2893). The three sources share a common tap for source water samples, which are collected after treatment but before entry into the distribution system. A continuous chlorine concentration monitoring and control system was installed and integrated with the City's existing telemetry system as part of Project W-2893. Each well is individually metered and is controlled by the water level elevation in the North Talbot Reservoir. Additionally, in 2010 the backpressure control valves were converted to flow control valves to prevent the flow rate from exceeding the water right Qi. The meters are located inside the wellhouse. The roof of the wellhouse was replaced in 2016.The wells pump into the Valley 196 PZ.

2.2.2.3 Wells 8 and 9 (DOH Source S20 – Wellfield)

Well PW-8 (DOH Source S07) was initially drilled in 1968 and the wellhead constructed in 1969 (W-0310). Project W-0310 also included chlorination. Well PW-9 (DOH Source S09) was drilled in 1984 (W-0665) and the wellhead constructed in 1985 (W-0718). Project W-0718 included adding chlorination and stubbing out a 3.5-inch electrical conduit from the main panel to the west side of the building for a future emergency power feed (refer to WTR-13-0035, Emergency Power System Study 1989). The wellhouses are located in Cedar River Park adjacent to Interstate 405. Fluoridation was added in 1986 (W-0851). Corrosion control treatment was added in 1999 (W 2238). The electrical system for Well PW-8 was rehabilitated in 1990 (W-1020). The rehabilitation project included adding an automatic transfer switch and stubbing out a 4-inch electrical conduit from the main panel to the west side of the building for a future emergency power feed (refer to WTR-13-0035, Emergency Power System Study, 1989).

Primary disinfection was added in 2013 (W-3582). The project included combining and routing the Well PW-8 discharge line and Well PW-9 discharge line through a loop of large diameter pipe in Cedar River Park to provide 4-log inactivation of viruses prior to discharge into the distribution system. The two sources share a common tap for source water samples, which are collected after treatment but before entry into the distribution system. A chlorine analyzer was installed as part of Project W-3582 to provide continuous chlorine concentration monitoring. Both wells are individually metered and controlled by the water level elevation in the North Talbot Reservoir. Each meter is located in a vault adjacent to the wellhouse. The wells pump water to the Valley 196 PZ.

2.2.2.4 Emergency Well 3R (DOH Source S16)

Emergency Well EW-3R was drilled in 1999 (W-2315) and the wellhead constructed in 2003 (W-2915). This well replaced EW-3, which was located at the original Well PW-3 wellhouse in Liberty Park near the intersection of Houser Way North and Bronson Way North. Project W-2315 included chlorination, fluoridation, and treatment for corrosion control. The project also included switchgear and a receptacle to feed power from a portable generator set. Primary disinfection was added to the emergency well in 2013 using a loop of large diameter pipe (CT Pipe 2) installed at the north end of Liberty Park (W-3582). The chlorine contact pipeline provides 4-log inactivation of viruses prior to discharge into the distribution system. This is a metered source and is controlled by the water level elevation in the North Talbot Reservoir. The meter is located inside the wellhouse. The well pumps into the Valley 196 PZ.

Well EW-3R

2.2.2.5 Well 5 (DOH Source S04)

Well PW-5A was drilled in 1988 (CAG-070-86) and the wellhead constructed in 1991 (W-0888). Well PW-5A is currently inactive due to water quality issues. The wellhouse is located on the northwest corner of Jones Avenue NE and NE 24th Street. Well PW-5A replaced Well PW-5 (formerly Kennydale Well No. 1), which had severe sanding problems and could not be successfully redeveloped. The original Well PW-5 was drilled in 1953. Project W-0888 included both chlorination and fluoridation as well as the addition of a switchgear and a receptacle to feed power from a portable generator set. Treatment for corrosion control is not necessary, as the pH of the raw water is about 8.0. This source can be used for emergency supply but has taste and odor problems. The raw water, similar to the Maplewood Wellfield, contains hydrogen sulfide, iron, manganese, and ammonia. At some time in the future, additional treatment will be added to address these problems. This is a metered source which is controlled by the water level elevation in the Highlands 435 Reservoirs. The meter is located in a vault, which is approximately 45 ft to the east of the wellhouse. The well pumps into the Highlands 435 PZ.

2.2.2.6 Wells 11, 12, and 17 (DOH Source S13 – Wellfield)

Located at the Maplewood Golf Course on Maple Valley Highway, the Maplewood Wellfield consists of three wells: PW-11 (DOH Source S11), PW-12 (DOH Source S15), and PW-17 (DOH Source S12). Wells PW-11 and PW-17 were drilled in 1989 (CAG-88-030) and the wellheads constructed in 1991 (W-0850 and W-1027). Well PW-12 was drilled in 1994 (WTR-13-042) and the wellhead constructed in 1998 (W-2279).

Treatment for these wells is provided at the Maplewood Treatment and BPS Facility, which was constructed in 1995 (W-1052). The raw water contains hydrogen sulfide, ammonia, manganese, and a small amount of iron. The original strategy for treating the water was to remove hydrogen sulfide using aeration and to keep the manganese in solution using ortho-polyphosphate (sequestering) as well as chlorinating and fluoridating the water. Treatment for corrosion control is not necessary, as the pH of the raw water is about 8.0. The presence of ammonia was discovered after the plant went online. The sequestering did not work and the water utility received numerous complaints regarding staining, taste, and odor. The method used for secondary disinfection was changed from chlorination to chloramination, which limited the areas in which the water could be used in the distribution system due to problems with mixing the Maplewood water with the chlorine-treated water from the other sources.

In January 2002, the City shut the wellfield down and began design and construction efforts to replace the treatment method. A treatment pilot plant study was conducted in June and July of 2001. The resulting design consisted of:

1. Converting hydrogen sulfide to sulfate by adding oxygen from air and reacting on granular activated carbon (GAC) filters.
2. Removing manganese with green sand filters.
3. Converting ammonia to nitrogen gas by adding chlorine and reacting in a contact basin.

Construction (W-2953) of a new treatment building began in October 2003 and the treatment plant was put into operation in September 2006. The project included changing the method of chlorination from chlorine gas to sodium hypochlorite liquid. Fluoridation is accomplished by using the existing plant. The project also included a manual switchgear with Kirk-Key safety system to allow powering one 1,500-gpm production well, one 1,550-gpm low-lift pump, and one 1,550-gpm high-lift pump and associated treatment equipment with a City-owned portable generator.

In 2015, equipment access improvements were made to the Maplewood Water Treatment Plant including installation of access platforms around the GAC contactors and green sand filter vessels. Ventilation improvements were also made to the facility (W-3610).

Each well is individually metered. The meters are located in the new treatment building. Flow from each well is kept below the proposed Qi water right by using flow control valves. The wells are controlled by either the elevation in the Highlands 565 Reservoir or the Rolling Hills 590 and 490 Reservoirs (see discussion of Rolling Hills BPS – in particular the back-pressure sustaining valves regulating the flow between the 490 and 590 PZs). The treated water is pumped to the clearwell located at the existing Maplewood Treatment and BPS facility. After at least 3 to 4 hours of contact time, the water is pumped to either the Highlands 565 PZ or the Rolling Hills 590 PZ.

2.2.2.7 Well 4 (DOH Source S06)

Well 4 was drilled in 1942 for the Northwest Water Company. The well was removed in 1962. The City has an active water right of 170-gpm for the well (GWC 884-D). Well 4 is currently inactive, as is Well PW-5A which is only used as backup due to water quality issues.

2.2.2.8 Seattle Interties (DOH Source S08)

Currently there are 10 interties with SPU. Two of the interties are used to supply water to the Boeing Renton Plant via two 10-inch mains. Prior to 2001, Seattle sold this water directly to Boeing. In 2001, in accordance with a revised franchise agreement between Seattle and Renton, the metering points for the two 10-inch service lines were moved closer to the SPU Cedar River Pipelines (W-2890), and the City began purchasing the water wholesale from Seattle and selling to Boeing.

One of the ten interties was originally constructed as a retail supply point for Seattle to provide water to the Longacres Racetrack site. In 1994, the connection was upgraded (W-2071) and is currently used as a backup fire flow supply for the Boeing Longacres site. This is an 8-inch connection to the 60-inch SPU Bow Lake transmission main at PRV Station 24. This intertie was modified in 2010 (W-3553) with a flow control valve so that it can be used to provide wholesale water to the City's system in the future. Bow Lake intertie is available for summer peaking.

Six other interties are currently available for summer peaking supply. These are SPU Station Nos. 33, 34, 36, 37, 38, and 39 and are further described in Table 2.3. Project W-3553 involved upgrading SPU stations 34 and 39 with flow meters and pressure gauges, as well as the Bow Lake Intertie. The remaining intertie is configured for supplying water to the SPU Mercer Island Pipeline.

2.2.2.9 Emergency Supply Sources

The City maintains several emergency supply sources: one emergency well, EW-3R, and three emergency interties (PRV #23, PRV #25, and Dimmit BPS). Copies of all of the City's intertie and emergency supply agreements are included in Appendix D.

Table 2.3 All Interties of All Types

Name	Meter Size (inches)	Location	Other System	Flow Direction	Maximum Flow Rate (gpm)	PZ Served	Type of Service Supply/Emergency
Supply Interties with SPU							
PRV 28 SPU Sta. #33	6	Shattuck Ave S & S 23rd St	Seattle	To Renton	700	TH350, WTH300	Summer Peaking Supply
Fred Nelson SPU Sta. #34	8	Benson Rd S & S 26th St Fred Nelson BPS	Seattle	To Renton	925	RH590	Summer Peaking Supply
SPU Sta. #36	6	Jones Ave S & S 7th St	Seattle	To Renton	700	RH490	Summer Peaking Supply
PRV 6 SPU Sta. #37	3 / 5	Beacon Way, near Renton Ave S	Seattle	To Renton	320	SH370	Currently closed and out of service
PRV 35 SPU Sta. #38	6	S 134th St & Thomas Ave S	Seattle	To Renton	700	EARL370	Summer Peaking Supply
Tiffany Park SPU Sta. #39	10 / 8	Kirkland Ave SE & SE 158th St, Tiffany BPS	Seattle	Two-way	1,050	RH590	Summer Peaking Supply
PRV 24 Bow Lake Pipeline(1)	8	1901 Oakesdale Ave SW (1,250 ft south)	Seattle	To Renton	2,800	VLY196	Summer Peaking Supply
Renton / Seattle	10	Union Ave SE & SE 2nd Pl	Seattle	To Seattle	1,950	From HLD565	Supply to SPU Mercer Island Pipeline
Boeing Plant Meter - East	10	Logan Ave S & S 2nd St	Seattle	To Boeing Plant	1,950	From SPU	Supply to Boeing
Boeing Plant Meter - West	10	Logan Ave S & S 2nd St	Seattle	To Boeing Plant	1,950	From SPU	Supply to Boeing
Intertie with Skyway Water & Sewer District							
Skyway Wholesale	10	80th Ave S & S 116th St	Skyway	To Skyway	1,950	From WH495	Supply to Skyway
Emergency Interties							
PRV 53 Coal Creek UD	8	2610 Lynnwood Ave NE	Coal Creek UD	To Coal Creek UD	1,250	From HLD565	Emergency
PRV 25 Kent	10	SE 43rd St & Lind Ave SW	Kent	Two-way	1,950	VLY196	Emergency
PRV 23 Tukwila	8	17300 West Valley Hwy S	Tukwila	Two-way	1,250	VLY196	Emergency
Dimmitt BPS(2)	6	12603 82nd Ave S	Skyway	Two-way	1,600	WH495	Emergency
WD 90(3)	None	Union Ave NE & NE 4th St	WD 90	To WD 90	1,250	HLD565	Emergency

Notes:

(1) Currently used to provide backup fire flow to the Boeing Longacres site and as source of supply to Renton. Historically it was used for domestic, irrigation and fire flow supply for the Longacres Racetrack site. Connection transitions from 8-inch to 10-inch to 12-inch.

(2) The Dimmitt BPS is owned and operated by Skyway Water and Sewer District. There is a physical limit of 1,600 gpm because of limited size of the metered connection to the zone. Connection transitions from 6-inch to 8-inch to 12-inch.

(3) Not set up with permanent connection; shop would have to manually connect valves to use. No meter present.

Abbreviation: UD – Utility District.

2.2.3 Storage

Water storage within the distribution system provides for operational, equalizing, firefighting, and standby storage volumes. Storage is provided by reservoirs, standpipes, and elevated tanks located within the distribution system. The City currently maintains and operates ten reservoirs and one operational storage/equalizing/detention clearwell at the Maplewood Treatment and BPS Facility.

This section provides a description of the function and condition of each of these facilities. Table 2.4 lists all of the City's existing storage facilities and summarizes the physical characteristics. The recommended sizing and location of future storage facilities are presented in Chapter 9 - Capital Improvement Plan.

2.2.3.1 Maplewood Clearwell

Located at the Maplewood Treatment and BPS facility, this clearwell was constructed in 1995 (W-1052). The treated water from the Maplewood Treatment and BPS facility is pumped to the clearwell. After at least three to four hours of contact time, the water is pumped to either the Highlands 565 PZ or the Rolling Hills 590 PZ.

Additional details can be found under Section 2.2.2.6.

2.2.3.2 North Talbot Reservoir (Valley 196 PZ)

Located at Talbot Hill Park near the intersection of Talbot Road S and S 19th Street, this 5-million gallon (MG), cast-in-place, reinforced concrete underground reservoir was constructed in 1976 (W-0419). The reservoir replaced two uncovered 0.5-MG reservoirs that occupied the same site. In 1989, CH2M Hill visually inspected the reservoir. Leaching of the concrete was observed, but the joint sealant was in generally good condition. Following the inspection, CH2M Hill recommended that the access ladder and overflow pipe supports be replaced with stainless steel. They also recommended that the City install galvanic cathodic protection anodes to protect metal associated with the intake piping, wash-down piping, and other metals submerged in the reservoir.

The interior was visually inspected again in 2010 by Water Utility staff who noted that all steel and iron surfaces were badly corroded and need to be replaced or recoated (WTR-27-0419). Because of the corrosion, the inlet/outlet pipes and 2.5-inch wash down pipes are no longer usable. The floor slab appeared to be in good shape with no exposed rebar and minor pitting near the columns. The columns appeared to be in fair condition with some areas of exposed aggregate and rust staining. The origin of the rust staining was not determined. The roof to column connections appeared to be in good condition. The exterior of the reservoir roof is a tennis court. It has been noted that several depressions exist on the roof and retain rain water during storm events.

In 2017, the reservoir was drained and inspected. A leak test was performed and noted that even with missing joint material the reservoir does not leak. Likely this is due to the rubber joint material installed.

2.2.3.3 Mt. Olivet Reservoir (Valley 196 PZ)

Located near the intersection of NE 3rd Street and Bronson Way NE, this 3-MG aboveground cylindrical steel reservoir was constructed in 1954 (W-1141). CH2M Hill has periodically inspected it over the years (1969, 1977, 1982, 1985, 1989, and 1997). In 1971, an impressed-current cathodic protection system was installed (W-0371). The exterior was recoated in 1978 (W-0476). The interior was recoated in 1991 (W-1035). The exterior was recoated and the cathodic protection system replaced in 1999 (W-2787). The exterior was recoated again in 2008 (W-3449) because of the failure of the 1999 coating. The interior was inspected most recently in 2009. The steel stringers between the roof beams are corroded badly and need to be replaced. Norton Corrosion Limited inspected the reservoir's cathodic protection system in 2017 (WTR-13-0123). They reported that the reservoir had adequate protection based on their testing results. One issue with this tank site is the aerial high voltage lines close to the steel tank.

Based on the observations made during the 2009 inspection, the City performed a preliminary design (WTR-13-0104, Water Distribution Storage Planning Study) of replacing the existing reservoir with a 7-MG reservoir. The estimated cost of replacing the reservoir is $8.25 million.

2.2.3.4 Highlands 435 Reservoir – 1.5-MG (Highlands 435 PZ)

Located at the Highlands Reservoir site east of the intersection of NE 12th Street and Monroe Avenue NE, this 1.5-MG reservoir was originally constructed as an uncovered reservoir during World War II (circa 1942). The reservoir was concrete-lined, rectangular in shape, partially in-ground and partially aboveground with bermed excavated material. In 1966, the reservoir was covered (W-0098). In 1986, the beams for the cover were sand blasted and painted. In 1987, the roof beams were inspected for cracks; none were found (W-0909).

In 2000, CH2M Hill inspected the reservoir for leaks and a preliminary design was conducted to increase the inflow and outflow piping (WTR-13-0072). The inspection was prompted by a concern that the two Highlands 435 Reservoirs had been damaged in the 1995 Robinson Point Earthquake (5.0 magnitude) as evidenced by wet ground around the chlorination building (further examination discovered the problem was a leaking service line). Because of the concern that these reservoirs will suffer major damage in a large earthquake, the City plans to replace both reservoirs. In 2009, the City performed a preliminary design (WTR-13-0104, Water Distribution Storage Planning Study), which estimated the cost of replacing both reservoirs at $21.3 million for one 15-MG, two-compartment reservoir built in two phases. The reservoir replacement project is currently in final design review (W-3888).

2.2.3.5 Highlands 435 Reservoir – 2-MG (Highlands 435 PZ)

Also located at the Highlands reservoir site, this covered, concrete lined, partially in-ground, partially aboveground reservoir was constructed in 1960 (W-0024). In 1986, the beams for the cover were sand blasted and painted. In 1987, the roof beams were inspected for cracks; some were found at the column locations (W-0909). In 1992, reinforcing collars were installed at the roof beam-column intersections and various cracks and joints in the concrete liner were sealed (W-1081). See discussion above for the 2000 inspection and reservoir replacement.

There is a project under construction (WTR-27-03888, Replace Highlands Reservoirs and Mains) to replace the two reservoirs in Highlands 435 (Sections 2.2.3.4 and 2.2.3.5) with a 6.4-MG concrete partially buried reservoir. The tank will include a partition dividing it in half, so that it can be cleaned / maintained one half at a time and include replacement of mains along NE 12th from the reservoir site to Edmonds Ave NE and along Monroe Ave next to the site.

2.2.3.6 Highlands 565 Reservoir - 0.75-MG (Highlands 565 PZ)

Also located at the Highlands reservoir site, this 0.75-MG elevated steel tank was constructed in 1960 (W-0018). CH2M Hill has periodically inspected it over the years (1969, 1973, 1977, 1985 1989, 1998, and 2009). In 1971, an impressed-current cathodic protection system was installed (W-0371). The exterior was recoated in 1978 (W-0476). In 1996, Chicago Bridge & Iron inspected the reservoir. Based on the inspection, the interior and exterior of the reservoir were recoated, the impressed-current cathodic protection system was replaced, and additional railing and a safety climb rail were added in 1997 (W-2210 and W-2303).

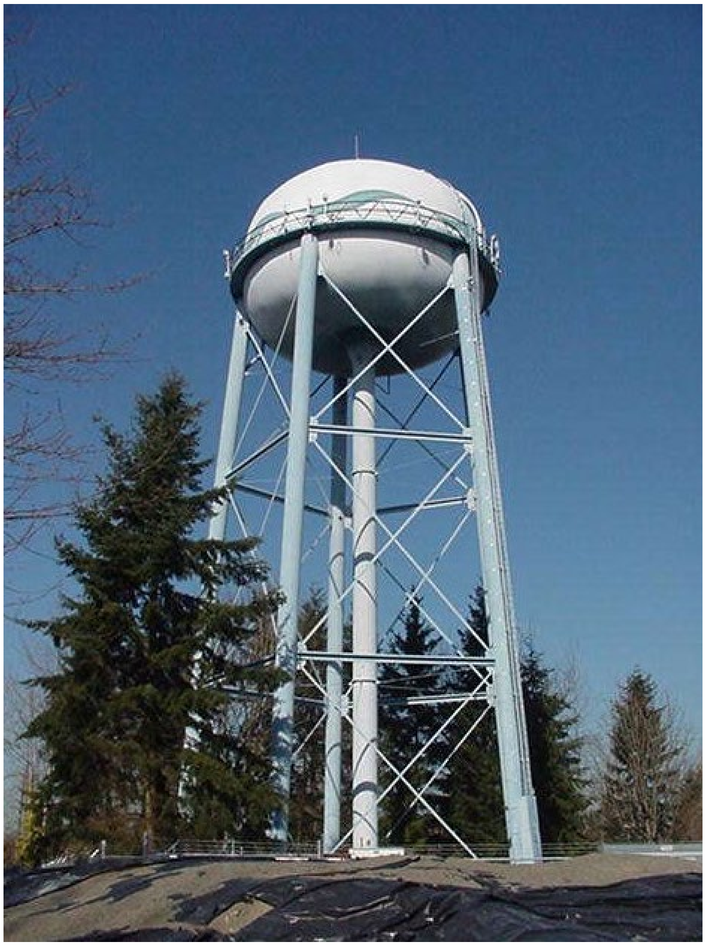
During the 2001 Nisqually earthquake (6.8 magnitude), the cross bracing of the tower structure was plastically deformed. In 2003, the bracing was repaired and the tank structure seismically rehabilitated (W-3005). The rehabilitation consisted of installing friction dampeners on the cross bracing and flexible connections where the water mains interface with the tank. In 2009, a two-way flow meter was added to the single inlet / outlet pipe that connects the reservoir to the distribution system (W-3214). In 2010, LiquiVision Technology performed a dive inspection of the interior surfaces (WTR-13-0112). The interior protective coating appeared to be in good condition at that time. Norton Corrosion Limited inspected the reservoir's cathodic protection system in 2017 (WTR-13-0123). They reported that the reservoir had adequate protection based on their testing results.

2.2.3.7 Hazen 565 Reservoir (Highlands 565 PZ)

Located north of the Hazen High School campus with address 4901 NE Sunset Boulevard, this 4.2-MG steel standpipe was constructed in 2009 (W-3214). It has flow meters on both the inlet and outlet pipes that connects the reservoir to the distribution system.

2.2.3.8 Rolling Hills 590 Reservoir (Rolling Hills 590 PZ)

Located at the Rolling Hills reservoir site near the intersection of Puget Drive SE and Edmonds Avenue SE, this 0.3-MG elevated steel tank was constructed in 1970 (W-0323). The exterior was recoated in 1980 (W-0524). Project W-3005 (see Section 2.2.3.5) also included repairing the Rolling Hills 590 Reservoir. The rehabilitation consisted of installing friction dampeners on the cross bracing and flexible connections where the water mains interface with the reservoir. In addition, both the interior and exterior were recoated and an impressed-current cathodic protection system was installed in 2003. Norton Corrosion Limited inspected the reservoir's cathodic protection system in 2017 (WTR-13-0123). They reported that the reservoir had adequate protection based on their testing results. Replacement of this reservoir is included in the City's long-term water CIP (Chapter 9).



Rolling Hills 590 Reservoir

2.2.3.9 Rolling Hills 490 Reservoir (Rolling Hills 490 PZ)

Also located at the Rolling Hills reservoir site, this 3-MG aboveground steel reservoir was constructed in 2001 (W-2230).

2.2.3.10 West Hill Reservoir (West Hill 495 PZ)

Located adjacent to Dimmitt Middle School near the intersection of 82nd Avenue S and S 126th Place, this 1.3-MG steel standpipe was constructed in 1985 (W-0489). Both the interior and exterior of the reservoir were recoated in 2010 (W-3488). Additionally, two concentric rings of handrail on the top of the standpipe were constructed and an impressed-current cathodic protection system was added as part of Project W-3488. Norton Corrosion Limited inspected the reservoir's cathodic protection system in 2017 (WTR-13-0123). They reported that the reservoir had adequate protection based on their testing results.

2.2.3.11 South Talbot Reservoir (Talbot Hill 350 PZ)

Located on Mill Avenue SE south of Carr Road, this 1.5-MG aboveground steel reservoir was constructed in 1990 (W-0722). CH2M Hill inspected the reservoir in 1998 (WTR-13-0063) and its interior and exterior protective coatings were founded to be in good and very good condition, respectively. In 2008, the exterior was recoated due to pitting that appeared to be from rocks being thrown at the reservoir (W-3449). Water Utility staff performed an inspection of the interior of the reservoir in 2015. The interior protective coating appeared to be in generally good condition, with the exception of rust staining at the locations were the roof beams connect to the walls. The access ladder was also severely corroded at that time.

South Talbot Reservoir

Table 2.4 Existing Storage Facilities

Reservoir Name	PZ Served	Gross Volume (gallons)	Year Constructed	Base Elevation (ft)	Overflow Elevation (ft)	Height (ft)	Diameter (ft)	Type	Highest Service Elevation (ft)	40 psi HGL (ft)	30 psi HGL (ft)	20 psi HGL (ft)	Reservoir Volume w/40 psi (gallons)	Reservoir Volume w/30 psi (gallons)	Reservoir Volume w/20 psi (gallons)
North Talbot Reservoir	VLY 196	5,078,381	1976	173.2	199.7	26.5	N/A	variable	129	221	198	175	0	268,292	4,695,107
Mt. Olivet Reservoir	VLY 196	2,814,553	1954	146.9	184.1	37.2	113.5	cylindrical	129	221	198	175	0	0	673,555
Highlands 435 - 1.5-MG Reservoir	HLD 435	1,555,223	1942	425.6	440.3	14.7	N/A	variable	367	459	436	413	0	421,074	1,555,223
Highlands 435 - 2.0-MG Reservoir	HLD 435	1,947,664	1960	425.3	439.8	14.5	N/A	variable	367	459	436	413	0	467,439	1,947,664
Highlands 565 - 0.75-MG Reservoir	HLD 565	747,985	1960	534.1	569.1	35.0	N/A	variable	473	565	542	519	78,645	572,315	747,985
Hazen Reservoir	HLD 565	4,203,521	2009	457.5	569.3	111.8	80	cylindrical	473	565	542	519	146,634	1,015,162	1,883,689
Rolling Hills 590 Reservoir	RH 590	300,000	1970	565.5	593.6	28.1	N/A	variable	476	568	545	522	269,305	300,000	300,000
Rolling Hills 490 Reservoir	RH 490	3,036,535	2001	458.0	494.5	36.5	119	cylindrical	392	485	462	438	822,776	2,744,528	43,036,535
West Hill Reservoir	WH 495	1,394,155	1985	395.6	498.6	103.0	48	cylindrical	393	485	462	439	178,398	491,068	803,737
South Talbot Reservoir	TH 350	1,586,190	1990	326.6	353.6	27.0	100	cylindrical	254	346	323	300	421,809	1,586,190	1,586,190
Maplewood Clearwell	MWD 79	212,846	1992	68.7	79.3	10.6	66	cylindrical	N/A	N/A	N/A	N/A	212,846	212,846	212,846

2.2.4 Booster Pump Stations

The City maintains and operates 12 pump stations that provide regular and emergency supply from lower pressure zones to the higher pressure zones. The Windsor Hills BPS, which had been a backup to the Mt. Olivet and Houser Way BPS, was taken out of service in 2010. A description of each of the facilities is included in the following sections. Table 2.5 provides a summary of each BPS with the rated capacity of each pump.

2.2.4.1 Mt. Olivet Booster Pump Station

Located adjacent to the Mt. Olivet Reservoir, the Mt. Olivet BPS pumps from the Valley 196 PZ to the Highlands 435 PZ. The BPS was constructed in 1967 (W-0262). In 1989, one booster pump was added and the electrical, heating, and ventilation systems were rehabilitated (W-0931). In 2007, an emergency electrical power generation facility was constructed at the Mt. Olivet reservoir site to provide backup power for the Mt. Olivet BPS and Wells RW-1, RW-2, and RW-3 (W-3239). This BPS now has emergency backup electrical power with auto-start of the generator and auto-transfer from commercial to backup power. Flow from the station is measured by one meter located in a vault outside the station. The pumps are controlled by the water level elevation in the Highlands 435 Reservoirs.

Mt. Olivet Booster Pump Station

2.2.4.2 Houser Way Booster Pump Station

Located on the northwest corner of the intersection of Houser Way N and N Marion Street, the Houser Way BPS pumps from the Valley 196 PZ to the Highlands 435 and Kennydale 320 PZs. The BPS was constructed in 1996 (W-2089). The station has a receptacle for an emergency generator hook-up and a manual transfer switch. Meters located inside the station measure flow to the two pressure zones. The pumps are controlled by:

1. The water level elevation in the Highlands 435 PZ reservoirs.
2. The pressure in the Kennydale 320 PZ measured at the station.

Table 2.5 Booster Pump Stations

Name	PZ Pumps From	PZ Pumps To	Pump Number	Pump Capacity (gpm)	Pump TDH (ft)	Pump (hp)	Total BPS Max Capacity (gpm)	Total BPS Max Capacity (mgd)	BPS Firm Capacity (gpm)	Backup Capacity (gpm)	Standby Power Type
Mt. Olivet	VLY 196	HLD 435	1 2 3	1,050 1,500 1,800	300 320 360	100 150 200	4,350	6.3	2,550	4,350	Auto Start / Auto Transfer
Houser Way	VLY 196 VLY 196	KD 320 HLD 435	1 2 3	700 2,050 2,050	162 295 290	40 200 200	700 4,100	1.0 5.9	0 2,050	700 4,100	Trailer-in / Manual
Monroe Ave	HLD 435	HLD 565	1 2	1,500 1,000	80 60	75 50	2,500	3.6	1,000	0	None
Highlands	HLD 435	HLD 565	1 2 3	1,500 1,200 1,200	152 152 152	60 60 60	3,900	5.6	2,400	3,900	Auto Start / Auto Transfer
West Hill	VLY 196	WH 495	1 2 3	600 600 1,000	305 295 305	60 60 10	2,200	3.2	1,200	1,000	None None Auto Start, Diesel Direct Drive
Rolling Hills[(1)]	RH 490	RH 590	1 2 3 4	2,500 2,500 1,000 1,000	121 122 120 121	100 100 40 40	5,000	7.2	3,500	5,000	Auto Start / Auto Transfer
North Talbot	VLY 196	RH 490	1 2 3	1,750 1,500 933	422 418 424	250 200 125	4,183	6.0	2,433	4,183	Auto Start / Auto Transfer
	VLY 196	TH 350	5	500	170	30	500	0.7	0	500	
Maplewood[(2)]	MWD 79	RH 590	1 2	1,550 2,400	525 560	300 450	2,400	3.5	1,550	1,550	Trailer-in / Manual None
		HLD 565	4 5	2,400 1,550	560 252	450 300	2,400	3.5	1,550	1,550	None Trailer-in / Manual

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Name	PZ Pumps From	PZ Pumps To	Pump Number	Pump Capacity (gpm)	Pump TDH (ft)	Pump (hp)	Total BPS Max Capacity		BPS Firm Capacity (gpm)	Backup Capacity (gpm)	Standby Power Type
							(gpm)	(mgd)			
South Talbot[3]	VLY 196	TH 350	1 2 3 4	200 600 3,500 3,500	200 200 225 225	20 50 250 250	4,300	6.2	3,500	4,300	Trailer-in / Manual
Tiffany Park	SPU 490	RH 590	1 2	350 700	196 168	25 40	1,050	1.5	350	0	None
Fred Nelson	SPU 490	RH 590	2 3	700 225	168 196	40 25	925	1.3	225	0	None
Dimmitt[4]	Skyway 460	WH 495	1 2 3 4	300 300 300 2,400	160 160 160 196	15 15 15 200	1,600	2.3	900	1,600	Auto Start / Auto Transfer

Notes:

(1) Any two pumps may be operated at one time.

(2) The current maximum capacity of the wellfield is 3,000-gpm and is limited by current installed treatment. Two of the 1,550-gpm pumps or one of the 2,400-gpm pumps may be operated at one time based upon treatment limitations.

(3) Only one of the 3,500-gpm fire pumps can be run at one time. Preliminary (30 percent) design in 2018 for installing emergency generator and auto transfer switches and replacing the existing fire pumps (two 3,500-gpm). Construction by ~ 2021.

(4) There are two modes of moving water from Skyway to Renton: 1) Pump from Skyway 460 PZ. There is a physical limit of 1,600-gpm in this mode because of limited size of the metered connection to the pressure zone and friction losses. Pumping above 1,600-gpm causes negative pressures on the suction side of the pump. 2) Gravity feed from Skyway 550 PZ via a PRV located in the Dimmitt BPS.

Abbreviations: TDH - total dynamic head; hp - horsepower.

2.2.4.3 Monroe Avenue Booster Pump Station

Located on the northwest corner of the intersection of NE 4th Street and Monroe Avenue NE, the Monroe Avenue BPS pumps from the Highlands 435 PZ to the Highlands 565 PZ. An 8-inch supervisory control and data acquisition (SCADA) controlled transfer valve can allow flow from the Highlands 565 PZ to the Highlands 435 PZ. The valve is used in coordination with the Maplewood BPS when water is being pumped to the Highlands 565 PZ. The BPS was constructed in 1969 (W-0324). In 1991, the station's electrical system was rehabilitated (W-1048). Flow from the station is measured by one meter located in the station. The pumps are controlled by the water level elevation in the Highlands 565 Reservoir. The pump station does not have emergency power backup capability. Installing backup power is included in the City's short-term water CIP (Chapter 9).

2.2.4.4 Highlands Booster Pump Station

Located at the Highlands Reservoir site, the Highlands BPS pumps from the Highlands 435 PZ to the Highlands 565 PZ. The BPS was constructed in 1960 (W-0018). In 1989, two pumps and motors were replaced and the third pump was rebuilt; the electrical system was also rehabilitated (W-0924). An isolation valve was installed in 1992 (W-1023). In 2003, the wooden doors on the west side of the building were replaced with metal. This station has emergency power backup with auto-start and auto-transfer (W-0815). A new 275 kW electrical generator with auto start / auto transfer was completed in 2017 (WTR-27-03759). Flow from the station is measured by one meter located in a vault outside the station. The pumps are controlled by the water level elevation in the Hazen 565 Reservoir. Replacement of this pump station is planned to occur concurrently with the Highlands 435 Reservoirs Replacement Project.

Highlands Booster Pump Station

2.2.4.5 North Talbot Booster Pump Station

Located near the intersection of SR 515 (Benson Road) and South 19th Street, the North Talbot BPS pumps from the Valley 196 PZ to the Rolling Hills 490 and Talbot Hill 350 PZs. It originally pumped to the Rolling Hills 590 PZ and Talbot Hill 350 PZ. The BPS was constructed in 1979 (W-0450). A manual transfer switch with Kirk-Key safety system was added in 1999 to allow the station to be powered by a City-owned portable generator (W-2784). In 2007, an emergency electrical power generation facility was constructed at the North Talbot Reservoir site to supply power to the North Talbot BPS (W-3239). The power is auto-start and auto-transfer. The portable generator and manual transfer switch configuration remains as a secondary backup.

In 2001, a backpressure sustaining valve was added to the station's primary discharge when a portion of the Rolling Hills 590 PZ was converted to the Rolling Hills 490 PZ as part of the Rolling Hills 3 MG reservoir and pump station project (W-2230). The station's electrical, heating, and ventilation and control systems were rehabilitated in 2003 (W-2878). Flow to the two pressure zones is measured by meters located inside the station. The pumps are controlled by:

1. The water level elevation in the Rolling Hills 490 Reservoir.
2. The water level elevation in the South Talbot Reservoir.

North Talbot Booster Pump Station

2.2.4.6 Rolling Hills Booster Pump Station

Located at the Rolling Hills reservoirs site, the Rolling Hills BPS pumps from the Rolling Hills 490 PZ to the Rolling Hills 590 PZ. The BPS was constructed in 2001 (W-2230). Two backpressure sustaining valves in the pump station allow water to flow from the Rolling Hills 590 PZ to the Rolling Hills 490 PZ when the Rolling Hills 590 Reservoir is near overflow. This allows the Rolling Hills 3-MG reservoir to be filled by either the Maplewood BPS or the North Talbot BPS.

Two flow meters are located inside the station. One flow meter measures flow from the Rolling Hills 490 PZ to the Rolling Hills 590 PZ. Another meter measures flow from the Rolling Hills 590 PZ to the Rolling Hills 490 PZ. The pumps are controlled by the water level elevation in the Rolling Hills 590 Reservoir. This pump station is equipped with an emergency generator with auto-start and auto-transfer, but only allows two pumps to operate at the same time. It is recommended that backup power be installed such that all four pumps can be operated at the same time. This project is included in the City's short-term water CIP (Project ST-01 in Chapter 9).

2.2.4.7 Tiffany Park Booster Pump Station

Located in Tiffany Park near the intersection of Kirkland Avenue SE and SE 20th Court, the Tiffany Park BPS pumps from the SPU 66-inch Cedar River transmission main to the Rolling Hills 590 PZ. The BPS was constructed in 1962 (W-0226). The pumps were replaced in 1972 (W-0383). The entire station was rehabilitated in 1984 (W-0742) but does not have emergency power backup capability. In 2011, a flow meter was installed. The pumps are controlled by the water level elevation in the Rolling Hills 590 Reservoir.

Tiffany Park Booster Pump Station

2.2.4.8 Fred Nelson Booster Pump Station

Located adjacent to the Nelsen Middle School on Benson Road S, the Fred Nelson BPS pumps from SPU 60-inch Bow Lake transmission main to the Rolling Hills 590 PZ. The BPS was constructed in 1962 (W-1125). It does not have emergency power backup capability. In 2011, a flow meter was installed. The pumps are controlled by the water level elevation in the Rolling Hills 590 Reservoir.

2.2.4.9 Maplewood Booster Pump Station

Located at the Maplewood Golf Course, the Maplewood BPS pumps from the clearwell to the Highlands 565 and Rolling Hills 590 PZs. The BPS was constructed in 1995 (W-1052). The BPS roof was replaced in 2016 (W-3765). Flow to the two pressure zones is measured by meters located inside the station. The pumps are controlled by:

1. The water level elevation in the Highlands 565 Reservoir.
2. The water level elevations in both the Rolling Hills 490 and 590 Reservoirs.

The Maplewood Treatment and BPS Facility is equipped with a manual transfer switch with Kirk-Key safety system that allows one production well, one booster pump, and associated treatment equipment to be powered by a City-owned portable generator (W-2953). It is recommended that auto-start and auto-transfer capability be installed at the Maplewood BPS. This project is included in the City's short-term water CIP (Chapter 9).

2.2.4.10 South Talbot Booster Pump Station

Located on SW 43rd Street just west of SR 167, the South Talbot BPS pumps from the Valley 196 PZ to the Talbot Hill 350 PZ. The BPS was constructed in 1982 (W-0600). A manual transfer switch with Kirk-Key safety system was added in 1999 to allow the station to be powered by a City-owned portable generator (W-2784). Flow from the station is measured by one meter located in the station. The domestic pumps are controlled by the water level elevation in the South Talbot Reservoir, while the fire flow pumps are controlled by the pressure of the Talbot Hill 350 PZ measured at the station. Note that only one fire pump can operate at a time. Installing emergency backup power at the South Talbot BPS is currently in preliminary design (WTR-13-0129) and is included in the City's short-term water CIP (Chapter 9).

2.2.4.11 West Hill Booster Pump Station

Located on West Perimeter Road at the Renton Municipal Airport near the control tower, the West Hill BPS pumps from the Valley 196 PZ to the West Hill 495 PZ. The BPS was constructed in 1985 (W-0715). It has one 1,000-gpm fire pump that is driven by a diesel engine with auto-start and two 600-gpm domestic pumps. Flow from the station is measured by one meter located in the station. The pumps are controlled by the water level elevation in the West Hill Reservoir. Installing emergency backup power at the West Hill BPS is currently in preliminary design (WTR-13-0129) and is included in the City's short-term water CIP (Chapter 9).

2.2.5 Pressure Reducing Stations

PRV stations are installed between pressure zones and allow water from a higher-level pressure zone to flow into a lower level pressure zone at reduced pressures. The PRVs in the pressure reducing stations hydraulically vary the flow rate through the valve to maintain a constant and preset discharge pressure up to the limit of the flow capacity of the valve. The effect of a PRV on the lower pressure zone is the same as that as a reservoir whose overflow elevation is the same as the pressure setting on the valve (hydraulic elevation).

Lead PRVs are located in hydraulically remote areas from both upper and lower pressure zone reservoirs to promote good circulation in both pressure zones, thus maintaining water quality. Lag PRVs may be located hydraulically closer to storage to minimize system head losses during high flow rate conditions when the lag valves need to operate.

The primary purposes of the PRVs in the City's system are as follows:

1. To maintain pressures in the lower pressure zone during high demand periods.
2. To increase pressure and flow which would otherwise be required during an emergency such as a fire or pipeline failure.
3. To achieve optimum circulation in each pressure zone, thereby maintaining water quality.

When a PRV malfunctions in an open position and allows downstream pressures to rise above the PRV setpoint, damage can occur due to over pressuring of the pressure zone. The probability of over pressuring the lower pressure zone can be greatly reduced by placing a pressure relief valve on the discharge (pressure-reduced) side of the PRV. If a pressure sensor is also installed on the PRV discharge and the pressure reading is telemetered and alarmed at the central control center, the City will know quickly when the failure is occurring and will be able to minimize damages as a result of the PRV failure.

The City's PRV stations currently in operation are listed in Table 2.6. WTR-13-00130 (PRV Station Rehabilitation and Replacement Study) occurred in 2018.

The following list provides additional information on PRV stations that are no longer in operation:

- PRV Stations 17, 18, 19, 20, 21, and 33 were put on inactive status (zone valves opened; PRVs set to wide open) in 2001 as part of the reconfiguration of the Rolling Hills 490 and 590 PZs following the completion of the Rolling Hills 3-MG Reservoir and BPS project (W-2230).
- PRV Station 6 is closed and out-of-service.
- PRV Station 11 was removed in 1995 (W-2126).
- PRV Station 15 was removed in 1992.
- PRV Station 27 was removed in 1992.
- PRV Station 42 was removed in 2000.

Pressure Reducing Valve (PRV) 52

Table 2.6 Pressure Reducing Stations

Station Number	Station Location	Receiving PZ	Supplying PZ	Map Book Index No.	Map Book Page No.	Project Number	Valve Size (inches)	Valve Elevation (ft)	Pressure Settings (psi)
1	Taylor Pl NW southeast of intersection of Taylor Pl NW and Stevens Ave NW 602 Taylor Pl NW	WH 300	WH 495	E3W	73	W-0704	2 4 8	154.6	65 60 50
2	NW 4th Street & Lind Ave NW 371 Lind Ave NW	WH 300	WH 495	E3W	74	W-0308	4 8	176.6	40 40
3	SW Langston Rd SW & Bagley Place SW 510 Langston Rd SW	WH 300	Earl 370	F3W	75	W-0285	4 8	178.6	40 40
47	NW 3rd Street & Maple Ave NW 301 Maple Ave NW	WH 300	WH 495	F3W	112	W-3123	2 8	149.5	70 50
4	Mill Ave S & S 6th Street 536 Mill Ave S	SH 370	RH 490	F4W	76	W-2240	8	157.5	85
5	Cedar Ave S & S 5th Street 444 Cedar Ave S	SH 370	RH 490	F4W	77	W-0410	4	191.6	70
6(1)	Beacon Way S between Renton Ave S & Cedar Ave S 1318 Beacon Way S	SH 370	SPU CRPL #3 490	F4W	78	W-1939	6 6	267.6	37 37
22	Renton Ave S & Beacon Way S 424 Renton Ave S	SH 370	RH 490	F4W	92	W-1939	1.5 6	222.6	60 50
7	Benson Rd S & Berkshire Apt Access Rd South of 1240 Benson Rd S	ETH 300	RH 490	G4W	79	W-0620	2 8	125.9	92 82
8	Eagle Ridge Dr & Berkshire Apt Access Rd North of 1600 S Eagle Ridge Dr	ETH 300	RH 490	G4W	80	W-0620	3 10	220.5	48 35
9	North Talbot BPS 730 S 19th Street	TH 350	RH 490	G3E	81	W-0419	3 8	165.1	76 65
12	S 23rd Street & Williams Ave S 2217 Williams Ave S	TH 350	RH 490	G3E	83	W-2126	4 12	222.6	48 45
28	S 23rd Street & Shattuck Ave S 2226 Shattuck Ave S	TH 350	SPU Bow Lake Pipeline 490	G3E	97	W-0709, 0708	2 8	188.1	50 45
49	S 35th Street & Wells Ave S West of 1001 S 35th Street	TH 350	RH 490	H4W	114	W-3190	3 12	198.9	64 55
10	S 16th Street & Talbot Rd S East of 1605 Talbot Rd S	WTH 300	TH 350	G3E	82	W-0552	2 6	112	80 73
29	S 23rd Street & Shattuck Ave S 2226 Shattuck Ave S	WTH 300	TH 350	G3E	98	W-0709, 0708	2 8	187.6	41 31
13	Meadow Ave N & N 28th Street 1440 N 28th Street	KD 320	HLD 435	C4W	84	W-2180	3 10	203	54 44
14	Meadow Ave N & N 32nd Street 1415 N 32nd Street	KD 320	HLD 435	C4W	85	W-0456	4 12	208.6	54 37
16	NE 3rd Street & Sunset Blvd N South of 324 Sunset Blvd N	KD 320	HLD 435	F4E	86	W-0395	4 12	41	122 107
26	Marina Landing Apartments 1300 N 20th Street	KD 320	HLD 435	D4W	96	W-1994	2.5 10	85.8	105 95

Station Number	Station Location	Receiving PZ	Supplying PZ	Map Book Index No.	Map Book Page No.	Project Number	Valve Size (inches)	Valve Elevation (ft)	Pressure Settings (psi)
39	Inside Houser Way BPS 325 Houser Way N	KD 320	HLD 435	-	-	W-2089	3 10	35	110 110
43	N 26th Street & Park Ave N 1405 N 26th Street	KD 320	HLD 435	D4W	108	W-2820	2 8	180	65 55
52	North of West Hill BPS 615 West Perimeter Road Renton Municipal Airport	KD 320	WH 495	E3W	117	W-3324	2 2 10 10	21.7	130 125 115 115
23	Tukwila Emergency Intertie 17300 West Valley Highway	VLY 196	Tukwila 360	H2W	93	W-0515	1.25 8	24.6	50 45
24	Boeing Longacres Intertie PID 0886700140	VLY 196	SPU Bow Lake Pipeline 490	H2E	94	W-2071	10 10	12	120 55
25	Kent Intertie SW 43rd Street & Lind Ave SW 4208 Lind Ave SW	VLY 196	Kent 240	I3W	95	W-0515	1.25 10	17.3	52 47
30	Park Ave N & N 8th Street 750 Park Ave N	VLY 196	KD 320	E4W	99	W-1922	3 12	26.1	65 65
31	Garden Ave N & N 7th Street 636 Park Ave N	VLY 196	KD 320	E4W	100	W-1922	3 12	25.8	66 66
32	SW Sunset Blvd & Maple Ave SW 203 SW Sunset Blvd	VLY 196	WH 300	F3W	101	W-0854	2 8	68.4	50 50
36	Talbot Rd S & 177th Ave SE 17600 Talbot Rd S	TH 270	TH 350	I3E	105	W-2091	3 12	98.6	75 70
37	East of N 4th Street & Houser Way N North of 353 Sunset Blvd N	VLY 196	HLD 435	F4E	106	W-2089	3 12	46	58 58
40	Inside Maplewood BPS 4024 Maple Valley Highway	VLY 196	RH 590	-	-	W-1052	12	80	40
48	NW Corner of Maplewood BPS 4024 Maple Valley Highway	VLY 196	HLD 565	G6W	113	W-2953	2 2 8 8	80	47 100 41 100
34	Benson Rd S & S 26th Street SE corner of 2223 Benson Rd S	RH 490	RH 590	H4W	103	W-1827	2.5 10	372.1	48 42
46	SE 8th Place Between S 7th Court & SE 8th Street South of 1801 SE 8th Place	RH 490	RH 590	G4E	111	W-2981	3 12	385.2	40 35
35	Thomas Ave SW & SW Langston Rd PID 1823059026	EARL 370	SPU CRPL #2 520	F3W	104	W-1033	6	233	48
41	84th Ave S & Renton Ave S 13223 84th Ave S	EARL 370	WH 495	F3W	107	W-2280	3 12	218	74 68
38(2)	Inside Monroe Ave BPS Transfer Valve SE corner of 401 Monroe Ave NE	HLD 435	HLD 565	-	-	None	8	343.6	
44	Shadow Hawk Condos SE 12th Street & Kirkland Ave SE	RH 395	RH 590	G5W	109	W-2900	3 12	240.5	65 55

Station Number	Station Location	Receiving PZ	Supplying PZ	Map Book Index No.	Map Book Page No.	Project Number	Valve Size (inches)	Valve Elevation (ft)	Pressure Settings (psi)
45	Shadow Hawk Condos SE 12th Street & Harrington Place SE	RH 395	RH 590	G5W	110	W-2900	3 12	296	36 26
50	East of 4127 Wells Ave N	KD 218	KD 320	C4W	115	W-3330	2.5 10	33.3	80 70
51	N 42nd Place & N 43rd Street	KD 218	KD 320	B4W	116	W-3330	2.5 10	32	74 70
53(3)	2610 Lynwood Ave NE	Coal Creek UD 440	HLD 565	-	-	W-3455	8	346.5	30
54(4)	Perimeter Rd W, east of West Hill BPS	VLY 196	KD 320	-	-	W-3810	2 8	21	70 65
55(5)	S 23rd St and Wells Ct S	TH 350	RH 490	-	-	W-3969	2 6	219.1	60 50
20	Grant Ave S, south of S 10th St	RH 490	RH 490	G4W	90	W-1660, 0410	2.5 10	330.6	Open(6) 65

Notes:
(1) PRV is closed and out of service.
(2) PRV is present, but not used.
(3) PRV 53 serviced by Coal Creek UD.
(4) Added in January 2016.
(5) Added in January 2017.
(6) PRV station only activated to temporarily change pressure zone areas when reservoir is taken out of service.

2.2.6 Distribution System

The City's water pipelines are shown in plan view in Figure 2.1. Tables 2.7a and 2.7b summarize the length of mains in the water system by diameter, material, and age.

Table 2.7a Pipe Inventory – Length by Diameter and Age

Diameter Size	1900s	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s	2010s	Total (ft)	Total System Percent (%)
4-inch and less	8,287	1,372	1,535	35	11,673	5,272	17,313	8,010	5,437	4,414	7,362	2,446	**73,156**	**4.5%**
6-inch	8,689	20,755	584	164	12,537	10,049	90,223	30,585	14,408	4,609	1,003	747	**194,352**	**11.9%**
8-inch	263	7,427	0	328	5,389	5,655	54,354	91,592	120,720	119,120	116,053	30,997	**551,899**	**33.9%**
10/12-inch	0	2	0	0	9,650	16,846	72,836	102,531	177,076	141,595	122,544	33,861	**676,941**	**41.5%**
14/16-inch	0	769	0	0	0	4,283	14,354	17,409	25,305	28,436	11,957	2,507	**105,020**	**6.4%**
18/20-inch	0	0	0	0	0	2,353	1,009	599	1,303	2,094	215	93	**7,667**	**0.5%**
24-inch	0	0	0	0	0	0	2,058	11,396	5,933	1,066	57	16	**20,526**	**1.3%**
Total (ft)	**17,239**	**30,324**	**2,119**	**528**	**39,249**	**44,458**	**252,148**	**262,122**	**350,181**	**301,335**	**259,190**	**70,667**	**1,629,560**	
Total System Percent (%)	**1.1%**	**1.9%**	**0.1%**	**0.0%**	**2.4%**	**2.7%**	**15.5%**	**16.1%**	**21.5%**	**18.5%**	**15.9%**	**4.3%**	**100.0%**	**100.0%**

Table 2.7b Pipe Inventory – Length by Diameter and Material

Diameter Size	Asbestos Cement	Cast Iron	Copper	Ductile Iron	Galvanized Iron	Galvanized Steel	HDPE	PVC	Steel	Total (ft)	Total System Percent (%)
4-inch and less	285	42,136	45	21,474	941	3,877	98	265	4,034	**73,156**	**4.5%**
6-inch	4,193	146,216	0	28,558	4	0	0	0	15,381	**194,352**	**11.9%**
8-inch	5,359	110,329	0	430,928	0	0	0	0	5,283	**551,899**	**33.9%**
10/12-inch	7,726	101,841	0	561,900	0	0	145	1,596	3,733	**676,941**	**41.5%**
14/16-inch	48	18,128	0	85,117	0	0	594	1,081	51	**105,020**	**6.4%**
18/20-inch	0	3,362	0	4,305	0	0	0	0	0	**7,667**	**0.5%**
24-inch	0	0	0	20,526	0	0	0	0	0	**20,526**	**1.3%**
Total (ft)	**17,611**	**422,013**	**45**	**1,152,807**	**945**	**3,877**	**838**	**2,942**	**28,483**	**1,629,560**	**100.0%**
Total System Percent (%)	**1.1%**	**25.9%**	**0.0%**	**70.7%**	**0.1%**	**0.2%**	**0.1%**	**0.2%**	**1.7%**	**100.0%**	

Note:
Abbreviations: HDPE - high-density polyethylene; PVC - polyvinyl chloride.

The City's system is comprised of two types of pipes:

- Transmission pipelines, and
- Distribution pipelines.

2.2.6.1 Transmission Mains

Transmission capability for the system is primarily provided by 12-inch, 16-inch, and 24-inch diameter pipelines that convey water from the wellfields located in Liberty Park, Cedar River Park, and the Maplewood Golf Course to various points within the service area. Transmission mains generally convey water between the supply sources (reservoirs or wells) to the local distribution grid and individual customers. Ideally, minimal head loss should occur in transmission pipelines during normal demand periods, allowing these mains to also convey fire demands to the distribution system and to meet other emergencies without experiencing adverse head losses.

Since approximately 96 to 97percent of the system's supply is provided from the wellfields and artesian spring, major transmission facilities are required in the Valley 196 PZ to ensure adequate water distribution throughout the service area. As shown in Figure 2.1, the transmission pipelines are located primarily along the major transportation corridors. The looped 8-inch pipelines in the well-developed residential areas of the system also provide some transmission capability:

- Transmission pipelines in the Valley 196 PZ predominantly run north to south, supplying the downtown business pressure zone, the Green River Valley industrial complexes, and the BPS that serve the other areas of the system.
- East-west pipelines that connect to the north-south transmission mains also provide additional transmission capacity. The pipe loops or grids formed by these connections help to increase system reliability and capacity throughout the system.
- Transmission pipelines from the Maplewood Wellfield carry finished water to the Highlands and Rolling Hills PZs. Both transmission pipeline routes follow unimproved corridors and steep slopes. A high-pressure fire loop (320-ft hydraulic grade line) encompasses a high-risk area of the industrial sector near the Paccar and Boeing plants for improved fire protection.
- For areas on the eastern side of the valley, the topography of the terrain dictates that the transmission corridors run in a north-south orientation within each pressure zone and in a west-east orientation between the different pressure zones.
- The transmission corridor in the West Hill area runs east and west from the West Hill BPS to the reservoir and north and south on 84th Avenue S. A separate transmission route connects the reservoir with Skyway Water and Sewer District. Looped 8-inch and 6-inch distribution mains provide a large percentage of the transmission capacity in the West Hill area.

Pipeline -Flex Joint Installation

2.2.6.2 Distribution Mains

Unlike, transmission pipes, the distribution system functions by meeting individual demands in the immediate vicinity via branching and looping pipelines through the service area. Figure 2.1 also presents the smaller pipelines, below 12 inches in diameter, which convey water from the transmission grid to the individual service connections.

The transmission and distribution system is comprised of water mains of four different materials: asbestos cement, steel, ductile iron, and cast iron. Current City policy is to replace all asbestos cement and steel water mains in the system as the budget permits, since transmission lines made of these materials are prone to leakage and failure.

The City completed deployment of Advanced Metering Infrastructure (AMI) throughout the entire system in 2015 (W-3499). The AMI system enhances the City's water conservation activities, improves leak detection capabilities, and optimizes pumping of the City's water supply wells.

2.2.7 Treatment

The City began chlorinating its drinking water in 1976. Each source treatment is currently designed with primary disinfection to provide 4-log inactivation of viruses (CT of 6 mg-min/L) and the City maintains a chlorine residual between 0.6 and 1.0 milligrams per liter (mg/L) throughout the distribution system. CT pipelines were installed at Springbrook Springs and in Liberty Park and Cedar River Park for the Downtown Wells. Primary disinfection at Wells PW-11, PW-12 and PW-17 occurs at the Maplewood Water Treatment Plant as a result of the treatment process to remove ammonia from the raw water. Water in the Chlorine Contact Basin and Clearwell has a contact of at least four hours before entering the distribution system. Each source is equipped with an automatic shutdown and alert notification when the chlorine residual drops below a safe level.

Renton citizens voted for fluoridation in 1985. The current fluoride target dose is 0.7 mg/L, as recommended by DOH. Wells RW-1, RW-2, RW-3, and EW-3R have fluoride saturation and metering equipment located in the wellhouses. Wells PW-8 and PW-9 are served by the

Fluoridation Building, which is located next to Well PW-8. This building also serves as a storage facility for bagged sodium fluoride. Fluoridation for Wells PW-11, PW-12, and PW-17 occurs in the Maplewood BPS and Treatment Building.

In 1999, the City began treating the water from the Downtown Wells and Springbrook Springs with sodium hydroxide to raise the pH of the water. The goal is to decrease the corrosivity of the water and to comply with the Lead and Copper Rule. For the Downtown Wells, sodium hydroxide is stored at the Corrosion Control Treatment Facility (CCTF) located in Cedar River Park. From this facility, diluted sodium hydroxide is fed to each of the Downtown Wells via HDPE pipes. At Springbrook Springs sodium hydroxide is fed from a storage building, which is located adjacent to the chlorination building. A corrosion inhibitor and sequestering agent (Aqua Mag®) is also used for additional corrosion control in areas of the distribution system that contain a high number of unlined cast iron water mains.

In 2006, the City redesigned the treatment method at Maplewood to include the removal of manganese using greensand filters, hydrogen sulfide using GAC, and ammonia using sodium hypochlorite.

Maplewood Treatment Facility

2.2.8 Telemetry and SCADA

The telemetry and SCADA systems for the water system have changed over the years with the changes in technology that is available. The following is a brief description of the current system. Certain aspects of operation and capability are not discussed for security reasons.

Each site (all sources, all booster pump stations, all reservoirs, all treatment facilities, Boeing Longacres Intertie, Skyway Wholesale Meter, Dimmitt BPS, Coal Creek emergency intertie) has a remote telemetry unit (RTU) that in some cases also serves as a programmable logic controller (PLC).

Information about the site is forwarded from the site to the master telemetry unit (MTU) that is located at the Water System Control Room (City Shops Administration Building). The MTU sends information and instructions back to the RTUs. Signals between the RTUs and MTU travel either by dedicated phone lines or by radio waves. At the Water System Control Room, the operations staff monitor (and control as necessary) the system using a Human Machine Interface (HMI). The HMI is a PC running software that communicates with the MTU and can display information. The HMI computer also runs an auto-dialer application (Win 911) that calls a 24-hour manned call service and/or water shop stand-by staff. There is a backup auto-dialer that is used in the event the HMI computer or MTU fails.

Each RTU, the MTU, and the HMI computer have various levels of backup power and redundancy. Various analog (e.g., flow rate, water elevation), discrete (e.g., pump status), and alarm information is stored in a SQL Server database for historical and analysis purposes.

By 2016, the City finished upgrading its MTU and RTUs to Emerson Control Wave Micro equipment (W-3826). All radios were changed to Viper SC 450-512-megahertz (MHz) radio units in 2015. The City also added fiber connection for North Talbot BPS, North Talbot Reservoir, North Talbot generator building, Mt. Olivet BPS, Mt. Olivet Reservoir, and Mt. Olivet generator building in 2017 (W-3885).

In-line Water Quality Meters at the Maplewood WTP

2.3 Summary of Updates to System Since 2012 Plan

The following is a list of updates and improvements completed by the City since the completion of the last Water System Plan in 2012:

- Major Pipe Replacement Projects:
  - Sunset Lane NE Improvement Project – WTR2703875 – 2017.
  - Renton Hill Utility Improvements - WTR2703824 – 2019.
  - SE 5th St AC Main Replacement Project - WTR2703604 - 2012.
  - Rainier Ave S Utilities Improvements - WTR2703430 - 2013.
  - President Park Main Replacement Project - WTR2703638 - 2013.
  - NE 5th Pl Water Main Replacement - WTR2703673 - 2014.
  - Monterey Terrace Water Main Replacement - WTR2703674 - 2014.
  - SW 27th St-Strander Blvd Extension Project - WTR2703693 - 2014.
  - Lake Youngs Ct SE Project - WTR2704017 - 2019.
  - Renton Ave S Resurfacing Project - WTR2704043 - 2019.
- Added primary disinfection for Springbrook Springs – WTR2703648 – 2013.
- Added emergency power for CCTF building - WTR2703583 – 2013.
- SPU Intertie Upgrades, Upgrade three interties with SPU for the purpose of purchasing water on a routine basis: Bow Lake Intertie, Fred Nelson BPS and Tiffany Park BPS – WTR2703553 – 2013.
- Added primary disinfection for Wells EW-3R, PW-8 and PW-9 – WTR2703582 – 2014.
- Added security fencing at West Hill reservoir, South Talbot reservoir, South Talbot BPS, Hazen Reservoir – WTR2703764 – 2014.
- SCADA / Telemetry, Changed operating frequency of radios because old frequency was getting 'stepped on'. Changed all radios to Viper SC 450-512 MHZ radio units with programmable frequencies and TCP / IP connectivity capabilities – WTR2703767 – 2015.
- Maplewood WTP, Equipment access and hydrogen sulfide (H2S) mitigation improvements. Added access platforms around GAC contactors and greensand filter vessels; ventilation improvements – WTR2703610 – 2015.
- Repaired Fluoride Building Roof – WTR2703766 – 2015.
- Advanced Metering Infrastructure, Completed deployment – WTR2703499 – 2015.
- Added PRV Station 54 at Renton Airport – WTR2703810 – 2016.
- Replaced Maplewood BPS Roof – WTR2703765 – 2016.
- Replaced Wellhouse (Wells 1-2-3) Roof – WTR2703806 – 2016.
- SCADA / Telemetry, Finished upgrading MTU / RTUs to Emerson Control Wave Micro equipment – WTR2703826 – 2016.
- Added fiber connectivity for North Talbot BPS, North Talbot reservoir, North Talbot generator building, Mt Olivet BPS, Mt Olivet reservoir and Mt Olivet generator building – WTR2703885 – 2017.
- Added PRV Station 55 at Wells Ct S – WTR2703969 – 2017.

Chapter 3

DEMAND PROJECTIONS

3.1 Introduction and Methodology Overview

Three future water demand scenarios (Low, Medium, and High) were projected for the City of Renton (City) using the following information:

- Historical production and consumption trends from 2008 to 2017.
- Puget Sound Regional Council (PSRC) demographic projections.
- Future predictions of the impacts placed on demands by factors such as water use efficiency (WUE), climate change, and the expected future consumption of the City's largest water consumers.

The Medium scenario's predictions most closely resemble the City's future demands, while the Low and High demand projection scenarios provide a range that the City's future water demands are expected to fall within.

The High and Medium scenarios were used in the Chapter 6 supply analysis, which describes when the City must supplement its own supply with wholesale water purchased from Seattle Public Utilities (SPU). The Medium scenario was used for the Chapter 7 system analysis, which determines future pumping, storage, and distribution system requirements.

Between 2008 and 2017, the City's average day demand (ADD) was approximately 7 million gallons per day (mgd). During that time, historical maximum day demands (MDD) were approximately 13 mgd. The City's typical Single-Family household consumes 159 gallons per day (gpd).

For demographic trends, PSRC predicts approximately 1 percent annual growth in the number of City households and 1.9 percent annual growth in the number of employees over the 20-year planning period. The same projections for each pressure zone (PZ) were used to also predict the number of future water connections in the system.

The City's WUE program will also affect future demands. To plan its water system, the City selected three measurable WUE goals, which were incorporated into the demand projections:

1. Limit the peaking factor to less than 2.0.
2. Reduce distribution system leakage (DSL) to 10 percent or less by 2022.
3. Maintain an equivalent residential unit (ERU) value under 160 gpd/ERU.

3.2 Land Use

The City's water service area encompasses the majority of the Renton city limits, small portions of unincorporated King County, and a few parcels within the City of Tukwila. Northwest of Interstate 405 (I-405) and west of Washington highway 167 (WA-167), the City is predominantly commercial and industrial, while the areas east of I-405 and WA-167 are less dense and more residential.

Figure 3.1 shows the City's zoning, which was used as the baseline for the analysis presented in this chapter. Figure 3.2 shows the City's existing land use, while Figure 3.3 shows future land use based on zoning of the City and King County. For this Plan, the City's zoning and land use data was compiled into 11 land-use designations as follows:

- Agriculture.
- Commercial.
- Industrial.
- Mixed Use.
- Multi-Family.
- Open Space.
- Park.
- Public/Quasi-public.
- Right of Way.
- Single-Family.
- Vacant.

The City's Comprehensive Plan encourages high-density, mixed-use redevelopment of the City Center, South Lake Washington/Southport area, and Sunset Neighborhood. Much of the City's vacant parcels are zoned for industrial and commercial purposes.

3.3 Historical Supply and Consumption

To help Carollo Engineers, Inc. (Carollo) establish historical demand trends, the City provided historical water purchase records, the number of connections, and consumption data between 2008 and 2017. The data was then evaluated to characterize the unique water use of the City's customers, generate several key demand parameters, and predict future water demand.

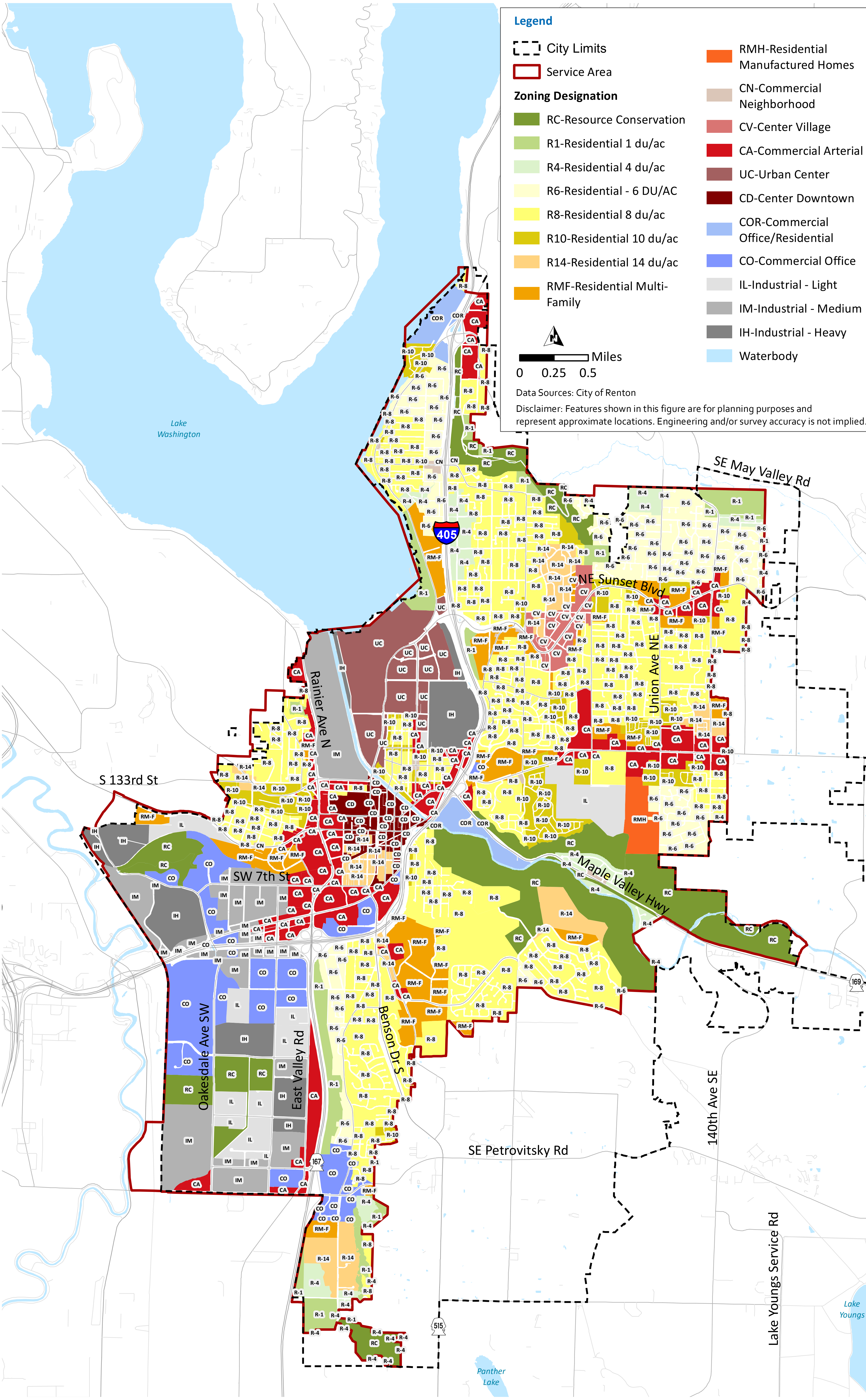


Figure 3.1 Zoning

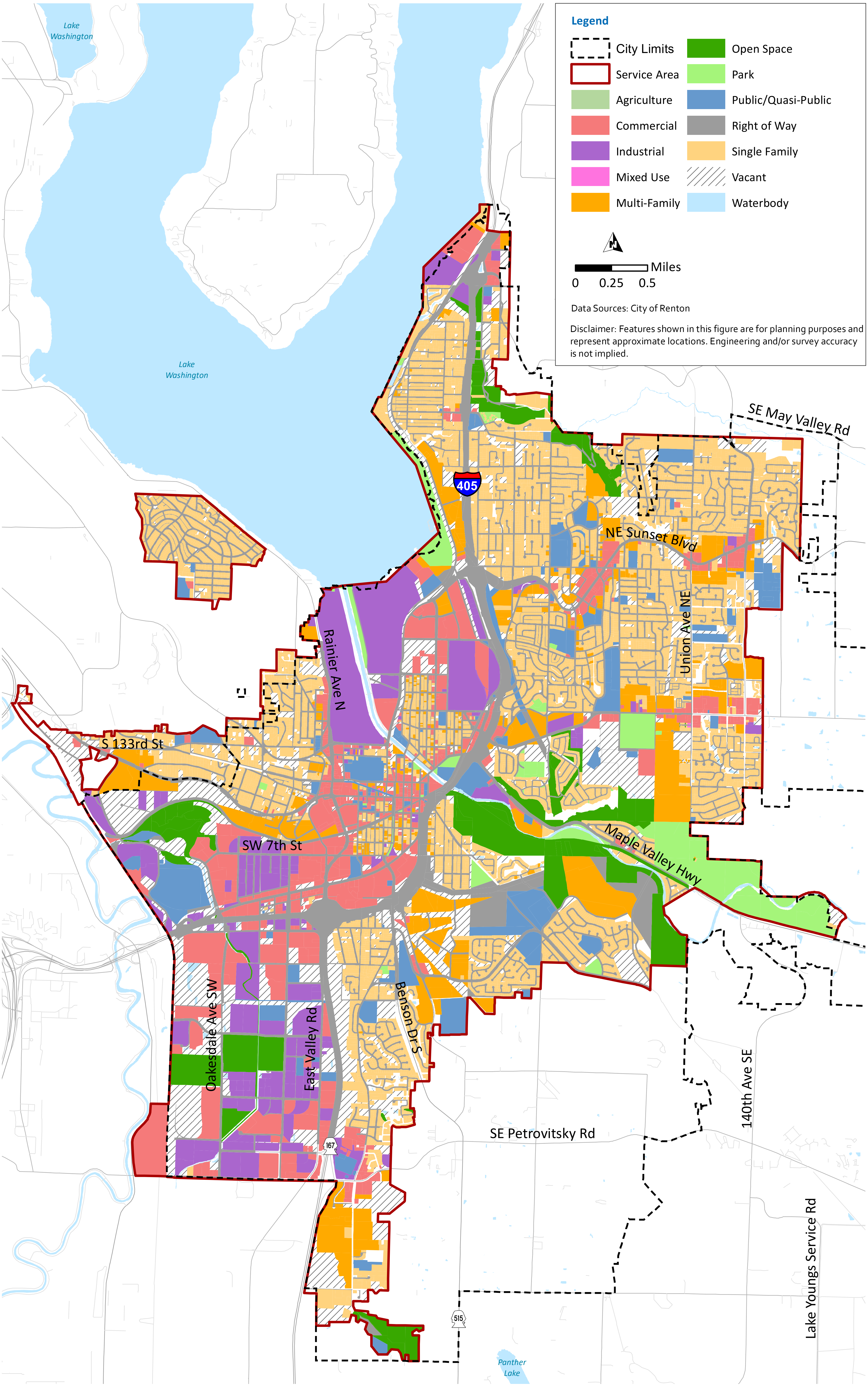


Figure 3.2 Existing Land Use

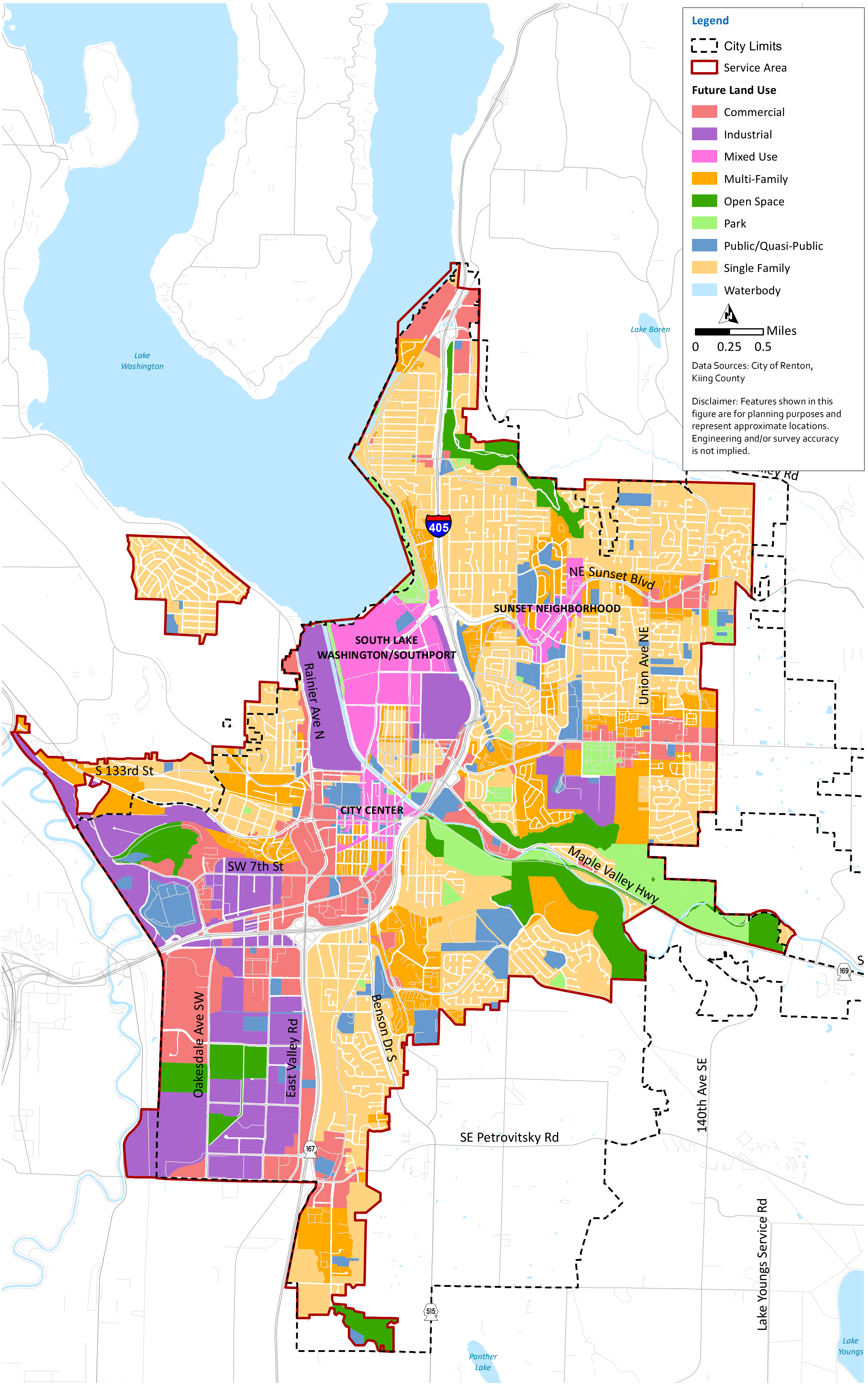


Figure 3.3 Future Land Use Based on Zoning

3.3.1 Historical Water Production

The City has a variety of supply sources, including Springbrook Springs, 10 production wells, and interties with SPU. Springbrook Springs and the City's wells produce most of the water for the City's customers.

Wholesale water purchased from SPU primarily serves the Boeing Renton Plant through two metered connections. The SPU water mains supplying the Boeing Plant are isolated from the rest of the City's water system. When necessary, the City can purchase water from SPU through other interties to supplement its supply.

Table 3.1 shows the City's monthly production in 2017 by supply source, while Table 3.2 lists the historical annual production from 2008 through 2017. As shown, the annual production ranged from a low of 2,411 million gallons (MG) in 2012 to a high of 2,799 MG in 2009.

Figure 3.4 shows the average production percentage by source from 2008 to 2017. As shown, the City relies on Wells RW-1, RW-2, and RW-3 for more than half of its water supply. When water demands are elevated, these wells account for 52 percent of water produced by the City. Other major sources of supply include Springbrook Springs, the Maplewood Wellfield (PW-11, PW-12, and PW-17), and Well PW-8, which accounted for 18 percent, 17 percent, and 11 percent, respectively. The remaining 2 percent consisted of water purchased from SPU for the Boeing Renton Plant.

3.3.1.1 Average Day Demand

ADD is a water system's average daily demand for a year. To calculate ADD, the total water produced by the City over a year is divided by the number of days in the year. Table 3.3 and Figure 3.5 show ADD values from 2008 through 2017, which average out to 7 mgd during that time.

Table 3.1 2017 Monthly Water Production (CCF) by Source

Source	Springbrook Springs	Wells RW-1, RW-2, and RW-3	Well EW-3R(1)	Well PW-5A(1)	Wells PW-8 and PW-9	Wells PW-11, PW-12, and PW-17	Total
January	54,000	131,000	0	0	0	51,000	236,000
February	21,000	140,000	0	0	0	48,000	209,000
March	0	186,000	0	0	3,000	53,000	242,000
April	22,000	158,000	0	0	0	51,000	231,000
May	59,000	151,000	0	0	0	62,000	272,000
June	56,000	156,000	0	0	53,000	75,000	340,000
July	59,000	118,000	0	0	168,000	93,000	438,000
August	58,000	144,000	0	0	170,000	91,000	463,000
September	62,000	64,000	0	0	142,000	78,000	346,000
October	63,000	129,000	0	0	20,000	59,000	271,000
November	57,000	128,000	0	0	4,000	51,000	240,000
December	20,000	112,000	0	0	15,000	55,000	202,000
Total	**531,000**	**1,617,000**	**0**	**0**	**575,000**	**767,000**	**3,490,000**

Note:
(1) EW-3R and PW-5A are emergency-use wells.
Abbreviation: CCF – hundred cubic feet.

Table 3.2 Historical Annual Water Production (MG) by Source

Source	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Springbrook Springs	522	494	428	473	441	431	461	494	543	397
Wells RW-1, RW-2, and RW-3	1,752	1,690	1,203	1,399	1,155	1,275	1,203	1,252	1,043	1,209
Well EW-3R	13	1	0	0	1	4	1	5	7	0
Well PW-5A	0	0	0	0	0	0	0	0	0	0
Wells PW-8 and PW-9	188	165	326	55	276	225	467	331	395	431
Wells PW-11, PW-12, and PW-17	229	417	506	510	500	456	340	546	563	575
Purchase from SPU	29	32	45	66	38	33	36	41	35	42
Total	**2,733**	**2,799**	**2,508**	**2,493**	**2,411**	**2,424**	**2,508**	**2,669**	**2,586**	**2,654**

Table 3.3 Historical Well Production

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Annual Production (MG)	2,733	2,799	2,508	2,493	2,411	2,424	2,508	2,669	2,586	2,654
Average Day Demand (mgd)	7.47	7.67	6.87	6.83	6.59	6.64	6.87	7.31	7.07	7.27
Maximum Day Demand (mgd)	12.74	14.81	12.83	12.48	11.44	12.36	12.41	13.59	12.75	13.10
Date of Maximum Day Demand	August 16	July 29	July 25	August 26	Sep 7	August 9	August 1	July 18	July 29	August 6
MDD/ADD Peaking Factor	1.7	1.9	1.9	1.8	1.7	1.9	1.8	1.9	1.8	1.8

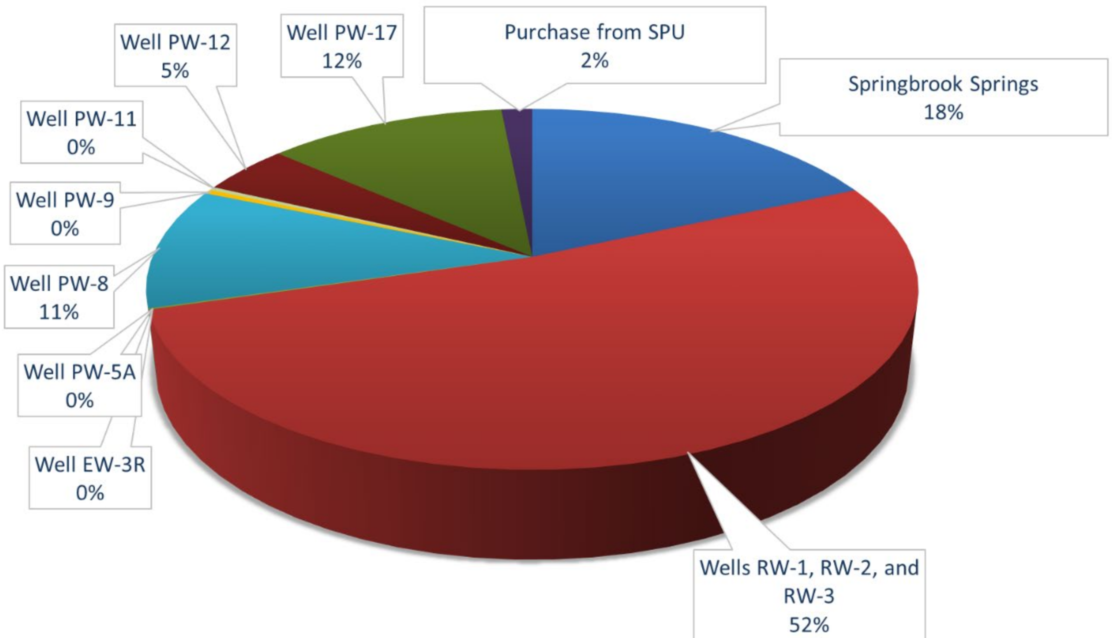


Figure 3.4 Average Water Production by Source (2008-2017)

3.3.1.2 Maximum Day Demand

Historical MDD values represent the largest amount of water produced in a single day in a given year, usually during the summer when irrigation use is highest. MDD must be established to determine system requirements for supply capacity, pump station discharge rates, and reservoir capacity.

The MDD and date of occurrence for each year since 2008 are also shown in Table 3.3. As this table and Figure 3.5 show, MDD has fluctuated around 13 mgd with no definitive trend moving up or down.

The historical MDD to ADD peaking factor is also a key parameter used to develop future MDD projections. The City's average historical peaking factor is 1.8, while the MDD to ADD peaking factor fluctuated between 1.7 in 2008 and 1.9 in 2009.

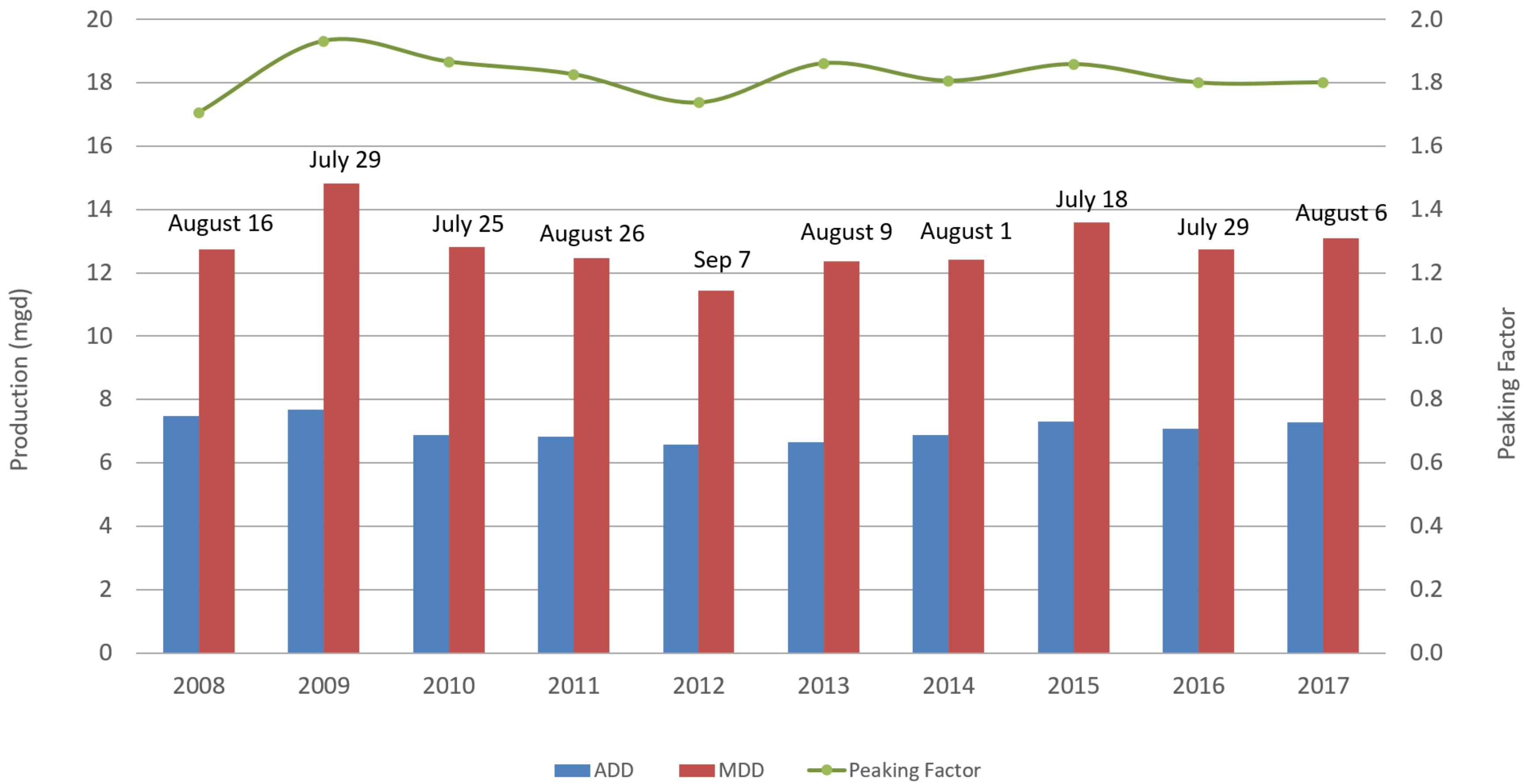


Figure 3.5 Historical Average and Maximum Day Water Production (2008-2017)

3.3.2 Historical Customer Connections

From 2008 to 2017, the total number of the City's retail water service connections increased by 5.6 percent. By the end of 2017, the City provided water to 17,831 connections. Table 3.4 and Figure 3.6 show the historical number of connections per customer type. Table 3.5 shows the total number of connections in 2017 as distributed by pressure zone. Figure 3.7 shows the average percent of connections by customer category from 2008 through 2017.

For this Plan, the City's thirteen customer classes were consolidated into the following eight categories:

- **Single-Family Residential:** Single-Family homes accounted for 77 percent of customer connections in 2017. From 2008 through 2017, Single-Family Residential connections increased by 801 connections, which corresponds to roughly a 0.7 percent annual growth.
- **Multi-Family Residential:** Multi-Family housing, including Duplexes, accounted for about nine percent of customer connections in 2017. Because the City tracks the number of dwelling units per residential customer, Multi-Family Residential water consumption trends are reported per dwelling unit. Between 2009 and 2017, the number of Multi-Family Residential dwelling units served by the City increased by 330. (Note that reliable statistics for Multi-Family dwelling units were not available in 2008.) This corresponds to an annual growth rate of 0.3 percent.
- **Commercial:** Commercial accounted for six percent of customer connections in 2017. From 2008 through 2017, Commercial connections increased by 32 connections, corresponding to a 0.3 percent annual growth.
- **Industrial:** Industrial accounted for less than one percent of customer connections in 2017 and has not grown within the last decade.
- **Government:** Government combines two customer classes (City and School, State, Federal). Government connections accounted for less than one percent of connections in 2017. From 2008 through 2017, Government connections grew by eight connections, or roughly 1.2 percent annually.
- **Irrigation:** Irrigation consists of the City's Irrigation and Irrigation from the other customer classes. Multi-Family Housing Developments, Mobile Home Parks, Schools, Commercial Complexes, and Industrial Plants often have separate connections for irrigation. Between 2008 and 2017, Irrigation connections accounted for 3.4 percent of the system and grew by 0.6 percent annually.
- **Other Authorized Use:** Other Authorized Use combines two customer classes (Hydrants and Fire). Commercial and Multi-Family Residential customers often have separate connections for fire suppression. Revenue water is also sold to contractors and tracked by portable hydrant meters checked out to the contractor.
- **Largest Consumers:** The City's six Largest Consumers were evaluated separately. The City supplies wholesale water to the Skyway Water and Sewer District (Skyway) through one connection located in the West Hill 495 PZ. Wholesale water is purchased from SPU and sold to the Boeing Plant through two connections. Other large consumers include the King County South Plant, Valley Medical Center, G&K Services, and Service Linen Supply. (Note that throughout this analysis, the King County South Plant connection was subtracted out of the Industrial category and the Valley Medical Center, G&K Services, and Service Linen Supply connections were subtracted out of the commercial category).

Table 3.4 Historical Number of Connections

Customer Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Annual Growth Rate 2008 to 2017
Single-Family Residential	13,005	13,038	13,129	13,205	13,377	13,478	13,588	13,671	13,727	13,806	0.7%
Multi-Family Residential	1,539	1,541	1,539	1,537	1,537	1,534	1,539	1,543	1,535	1,534	0.0%
Multi-Family Residential (Dwelling Units)	13,252	14,169	14,119	14,124	14,175	14,166	14,191	14,376	14,489	14,499	0.3%
Commercial	1,025	1,026	1,020	1,022	1,035	1,035	1,037	1,038	1,061	1,057	0.3%
Industrial	63	63	62	61	65	65	64	65	63	63	0.0%
Government	73	81	77	79	82	83	85	84	87	81	1.2%
Irrigation	573	587	579	575	587	587	589	587	594	605	0.6%
Other Authorized Use (Hydrants and Fire)	601	615	629	643	675	635	617	646	689	678	1.3%
Largest Consumers	7	7	7	7	7	7	7	7	7	7	0.0%
Total	**16,886**	**16,958**	**17,042**	**17,129**	**17,365**	**17,424**	**17,526**	**17,641**	**17,763**	**17,831**	**0.6%**

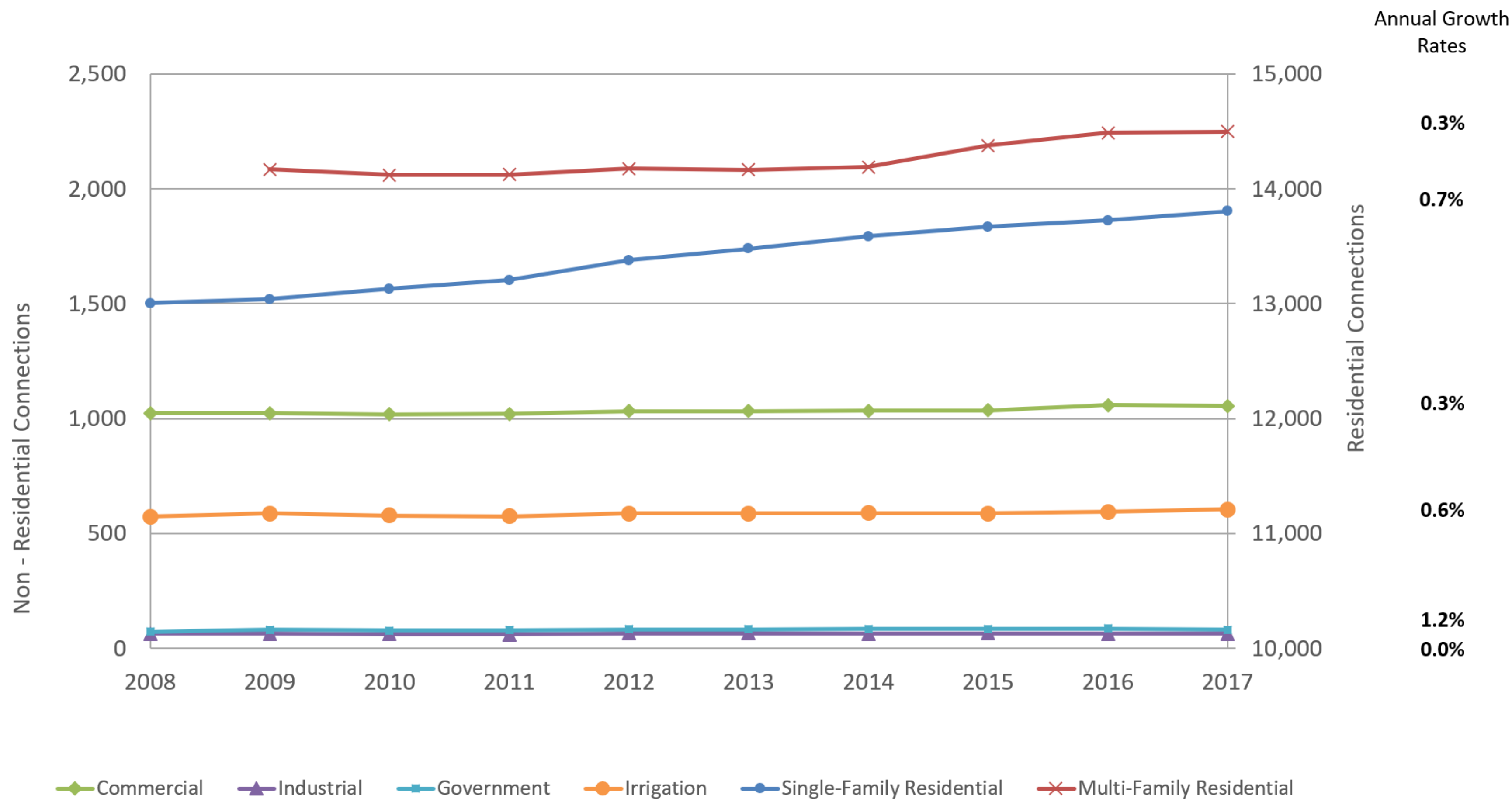


Figure 3.6 Historical Connections Trend by Customer Category (2008-2017)

Table 3.5 2017 Connections by Pressure Zone

Pressure Zone	KD218	KD320	HLD435	HLD565	VLY196	WH300	WH495	EARL370	SH370	RH590	RH490	RH395	TH270	TH350	ETH300	WTH300	Total
Single-Family Residential	113	932	2,985	5,055	1,009	177	413	272	70	1,081	531	0	1	824	4	339	13,806
Multi-Family Residential	0	108	174	483	262	24	2	23	11	109	114	45	0	155	19	5	1,534
Commercial	1	80	55	178	686	11	1	2	0	5	7	0	6	25	0	0	1,057
Industrial	0	10	0	0	53	0	0	0	0	0	0	0	0	0	0	0	63
Government	0	8	5	23	39	0	0	0	0	3	1	0	0	2	0	0	81
Irrigation	6	59	61	143	248	1	0	3	0	18	22	2	1	37	3	1	605
Other Authorized Use (Hydrants and Fire)	0	89	39	99	322	2	0	0	0	5	6	4	1	54	0	0	621[(1)]
Largest Consumers	0	0	0	0	5	0	1	0	0	0	0	0	0	1	0	0	7
Total	**120**	**3,515**	**4,951**	**9,680**	**5,305**	**537**	**417**	**369**	**124**	**2,166**	**2,046**	**248**	**9**	**2,138**	**300**	**348**	**17,774**

Note:
(1) Connections for hydrants were not available by pressure zone. Hydrant accounts not in GIS account numbers. The total number of connections for Hydrants is 57 and is not included in the totals in this table.
Abbreviation: GIS – geographic information system.

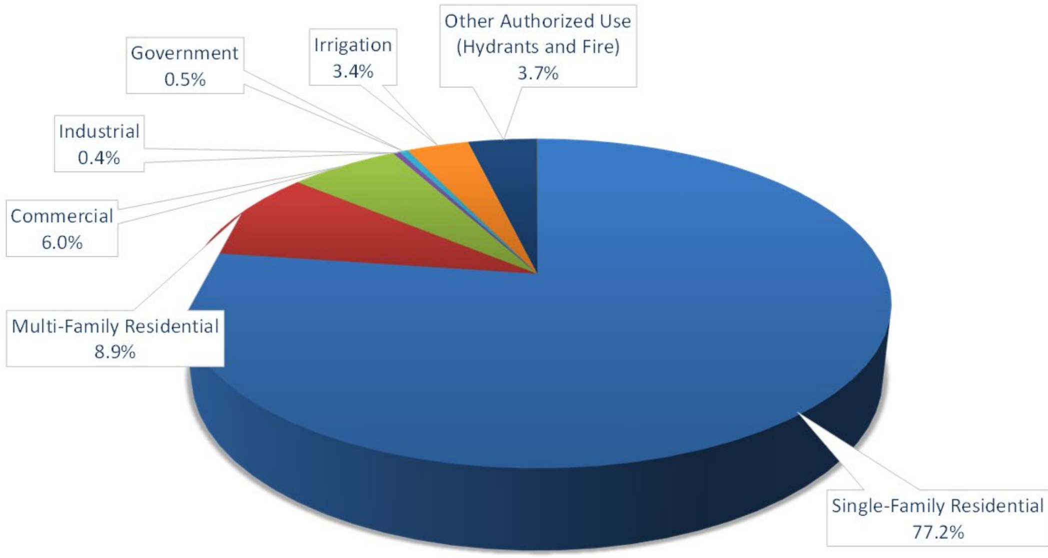


Figure 3.7 Percent of Connections by Customer Category (2008-2017)

3.3.3 Historical Water Consumption

Using the City's billing records, Carollo obtained data on the annual water consumption of each customer category from 2008 to 2017. This data is shown in Table 3.6.

Although Single-Family Residential customers make up 77 percent of the City's connections, they consumed only 35 percent of total retail water sales. The Multi-Family Residential customers accounted for 23 percent of water use, meaning that a majority of the City's water sales consisted of residential water use.

Figure 3.8 shows that Commercial customers accounted for 15 percent of water sales and Industrial customers accounted for three percent. The City's six Largest Consumers alone accounted for 10 percent of water sales. Government customers accounted for 1 percent of water sales. Although comprising only three percent of the total number of accounts, Irrigation use accounted for 12 percent of the total water used.

Figure 3.9 shows how consumption for each customer category changed between 2008 and 2017. Despite adding many new residential connections, Single-Family and Multi-Family Residential consumption grew very little over this time. As indicated by their annual consumption growth rates in Figure 3.9, Commercial, Irrigation, and the Largest Consumers had the most growth.

Other Authorized Use included billed consumption from Hydrant and Fire connections plus unbilled consumption that was authorized by the City (Authorized Non-Revenue Water). With the City's improved tracking of unbilled water use, Authorized Non-Revenue Water (water used by City maintenance and by Renton Regional Fire Authority [Renton RFA]) also grew significantly. Other Authorized Use increased from 0.6 percent in 2008 to a high of 1.8 percent in 2016 and averaged 1.3 percent of the City's overall water consumption.

Table 3.6 Historical Consumption (mgd) by Customer Category

Customer Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Single-Family Residential	2.15	2.25	2.07	2.04	2.07	2.10	2.08	2.19	2.11	2.19
Multi-Family Residential	1.44	1.42	1.47	1.43	1.45	1.46	1.42	1.46	1.41	1.45
Commercial	0.94	0.91	0.89	0.89	0.87	0.88	0.90	0.94	0.95	1.04
Industrial	0.19	0.17	0.15	0.17	0.18	0.15	0.16	0.16	0.14	0.12
Government	0.11	0.09	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07
Irrigation	0.72	0.93	0.61	0.66	0.69	0.66	0.76	0.87	0.80	0.82
Largest Consumers	0.61	0.54	0.56	0.60	0.58	0.59	0.61	0.66	0.67	0.72
Other Authorized Use	0.04	0.07	0.04	0.07	0.10	0.09	0.07	0.11	0.11	0.08
Percent Other Authorized Use	0.6%	1.1%	0.7%	1.2%	1.7%	1.5%	1.2%	1.7%	1.8%	1.2%
Total Consumption	**6.20**	**6.38**	**5.87**	**5.94**	**6.02**	**6.01**	**6.07**	**6.46**	**6.26**	**6.49**

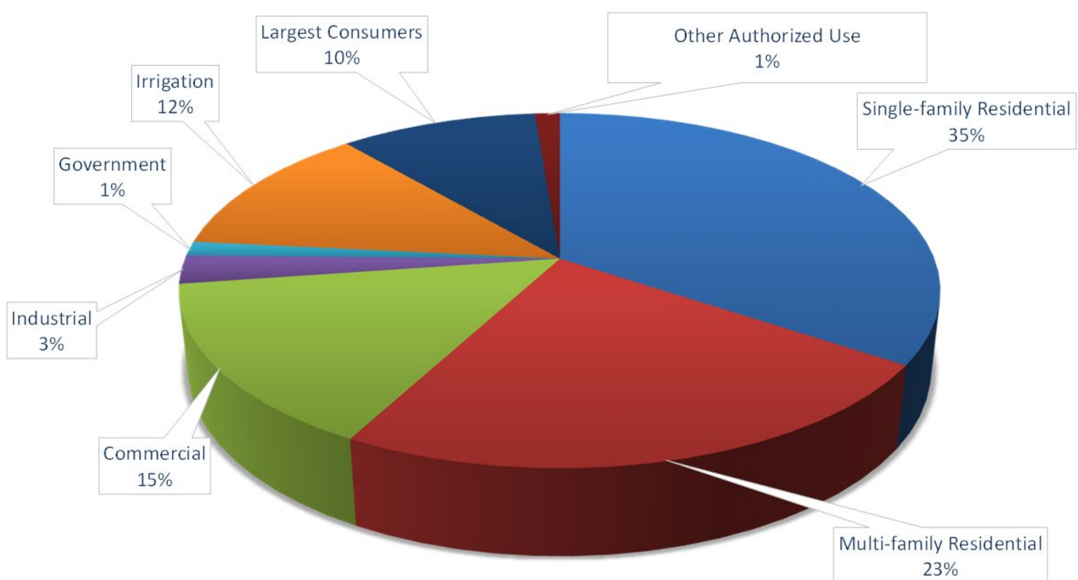


Figure 3.8 Percent of Consumption by Customer Category (2008-2017)

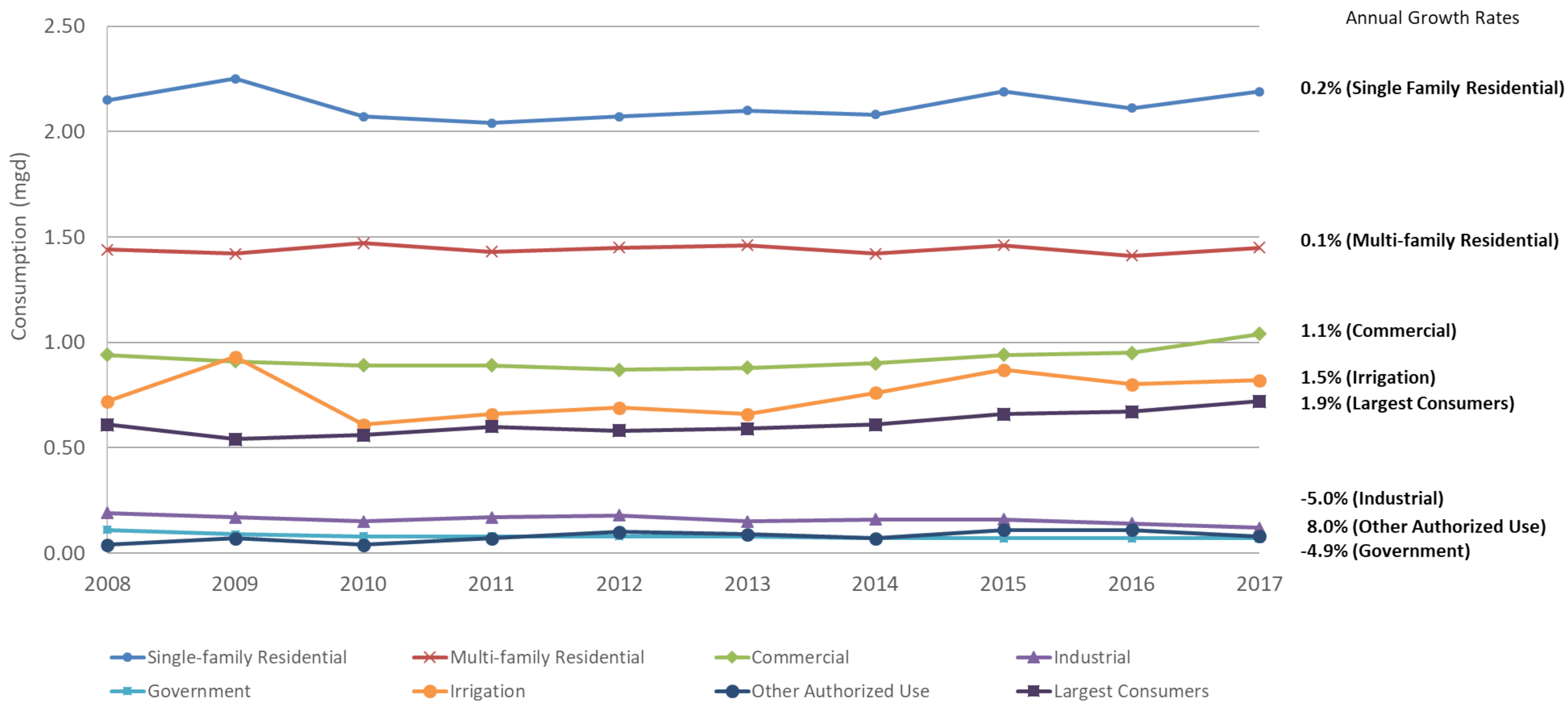


Figure 3.9 Historical Consumption Trend by Customer Category (2008-2017)

3.3.3.1 Largest Consumers

To more accurately predict the magnitude and location of future demands, the City's six Largest Consumers' consumption was evaluated separately from other customer categories. Each of these customers has an annual water demand exceeding 40,000 gpd. The seventh largest consumer used less than 15,000 gpd, making the top six a natural cutoff for customers that must be evaluated in more detail.

The City provides wholesale water to Skyway and sells water to Boeing's Renton Plant, the King County South Plant, Valley Medical Center, G&K Services, and Service Linen Supply. To more precisely predict the magnitude and location of their future demands, consumption trends for these customers were evaluated individually.

Figure 3.10 shows the historical consumption for these connections between 2008 and 2017. Wholesale to Skyway and consumption at the King County South Plant increased steadily. Figure 3.11 shows the locations of the City's six Largest Consumers.

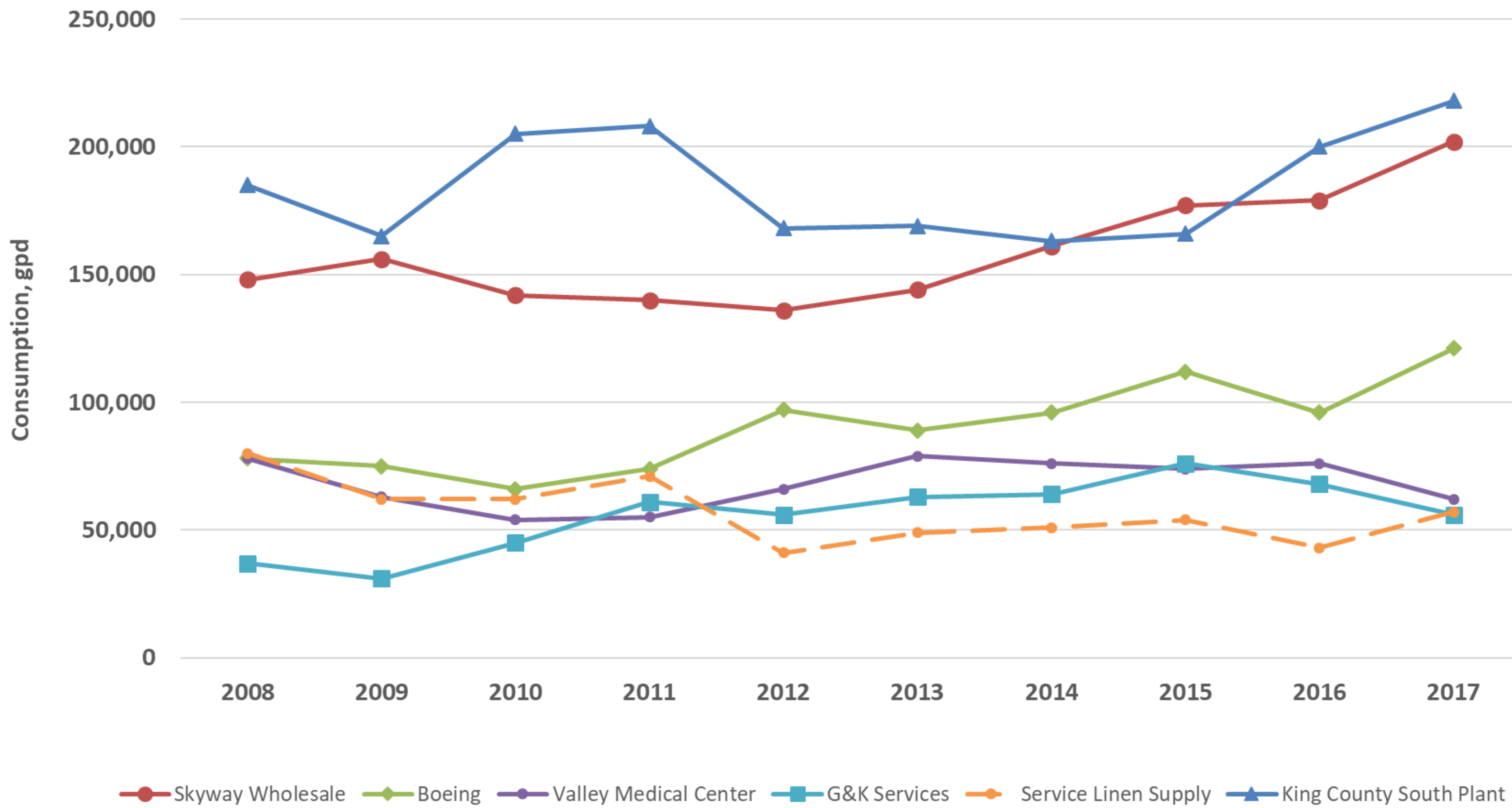


Figure 3.10 Historical Consumption by Largest Consumers (2008-2017)

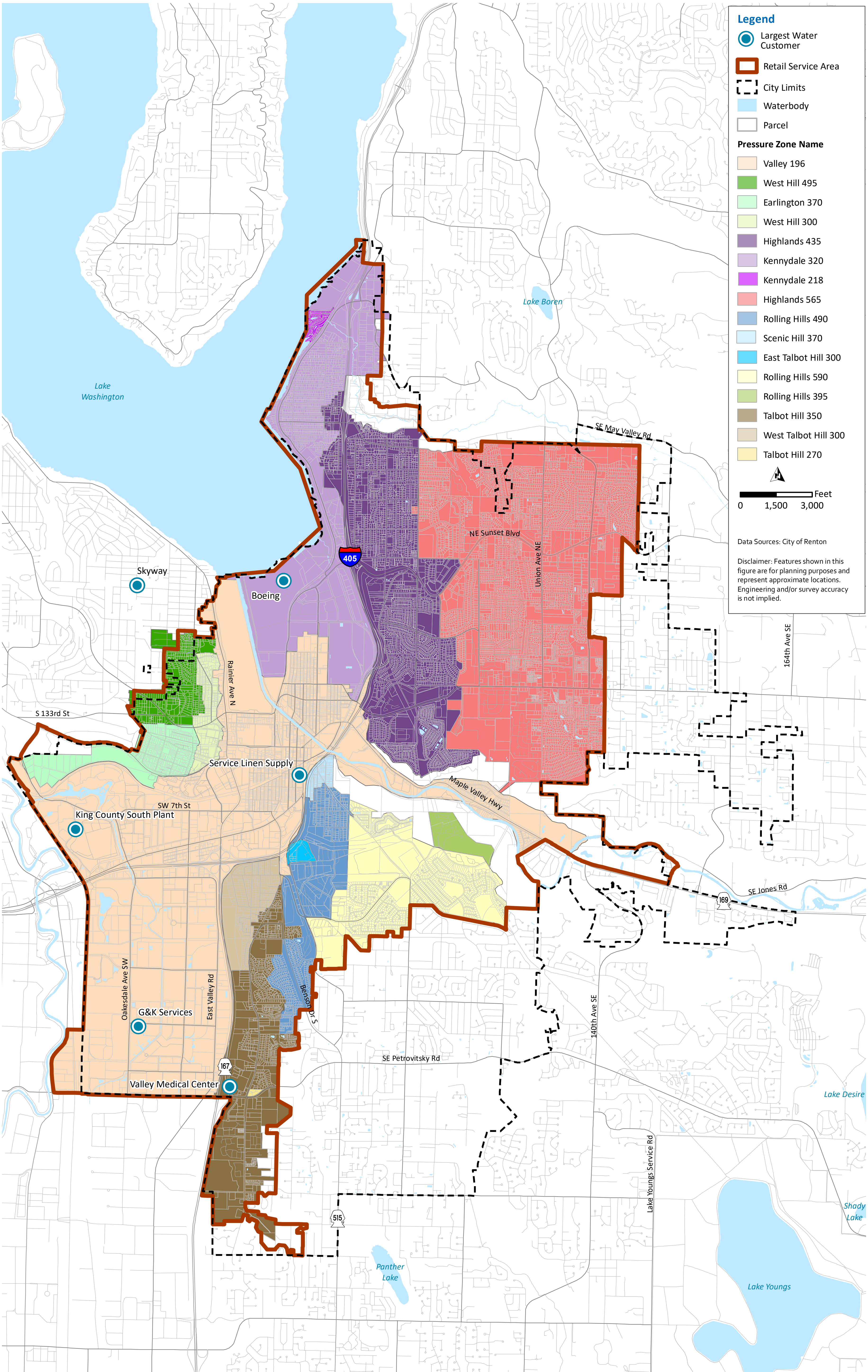


Figure 3.11 Largest Water Customers

3.3.3.2 Distribution System Leakage and Non-Revenue Water

DSL is water not authorized for consumption, and equals the total water produced/purchased minus the total authorized consumption. Deterioration of the City's aging water infrastructure leads to real losses such as water main breaks, reservoir leaks or overflows, and general distribution system leakage. However, it is important to note that the DSL includes apparent losses other than leakage such as meter inaccuracy or failure, data handling errors, water theft, and untracked authorized water use.

Table 3.7 lists the total water production, total authorized consumption, and DSL between 2008 and 2017. Figure 3.12 plots the DSL trends during this time. The average DSL was 12.5 percent, which is a reduction of 5.3 percent since the previous Water System Plan.

The City's goal is to reduce the DSL to 10 percent or less. To this end, the City deployed an Advanced Metering Infrastructure (AMI) system in 2011, which helps the City more accurately compare production and consumption and better detect stuck meters, meter tampering, and water theft.

Authorized Non-Revenue Water that is not tracked by the City contributes to the DSL. Based on recommendations in the last Water System Plan, the City installed a meter at the Regional Firefighting Training Facility in 2018 to track the fire department's authorized water use and also installed meters at the King County South Plant in 2019 to track currently authorized, but unmetered, water use. Once metered, the authorized water consumption will be subtracted out of the DSL.

In accordance with Washington State requirements for systems with DSL in excess of 10 percent, the City prepared a Water Loss Control Action Plan (WLCAP). This document is included in Appendix G.

The leakage percentages in Table 3.7 may slightly differ from the ones reported to the Washington State Department of Health (DOH). The City historically reported raw meter data to DOH. With the upgrade to AMI data, the City has been resolving data issues and the updated data is shown in Table 3.7. In the future, the City will report water use data to DOH using the updated method.

Table 3.7 Historical Distribution System Leakage

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Production (mgd)	7.47	7.67	6.87	6.83	6.59	6.64	6.87	7.31	7.07	7.27
Total Authorized Consumption (mgd)	6.20	6.38	5.87	5.94	6.02	6.01	6.07	6.46	6.26	6.49
DSL (mgd)	1.27	1.29	1.00	0.89	0.57	0.63	0.80	0.85	0.81	0.78
DSL (ERUs)	7,920	8,053	6,258	5,563	3,546	3,944	5,008	5,327	5,035	4,883
DSL Percentage	17.0%	16.8%	14.6%	13.0%	8.6%	9.5%	11.7%	11.7%	11.4%	10.7%
Rolling 3-Year Average DSL		17.3%	16.1%	14.8%	12.1%	10.4%	9.9%	10.9%	11.6%	11.3%

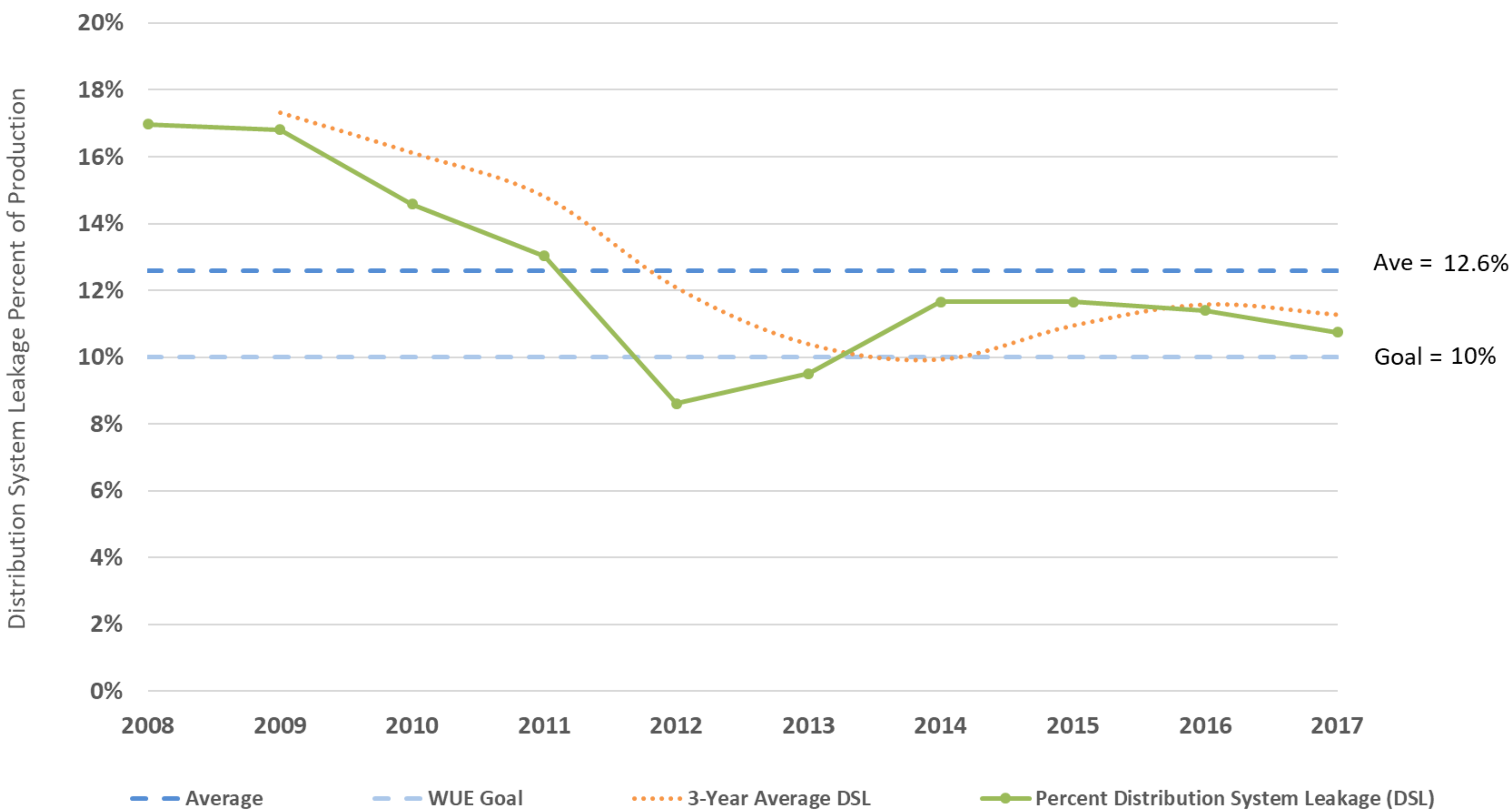


Figure 3.12 Historical Distribution System Leakage Trend (2008-2017)

3.3.4 Seasonal Variations in Water Consumption

To better assess the City's water use, Carollo also analyzed seasonal water use. Figure 3.13 depicts the variation in average monthly water consumption from 2008 to 2017, along with average monthly precipitation during that time. Figure 3.14 and Figure 3.15 show the variation of water use for each customer category throughout the year, which is based on average monthly water use between 2015 and 2017.

While most of the City's customers are billed monthly, some customers are billed bi-monthly. This accounts for the month-to-month fluctuations in water consumption for customer categories with fairly consistent water consumption throughout the year, such as Multi-Family Residential customers.

3.3.5 Water Consumption per Connection

Table 3.8 shows annual water consumption per connection for each customer category. For forecasting and planning, individual demand is expressed as ERU.

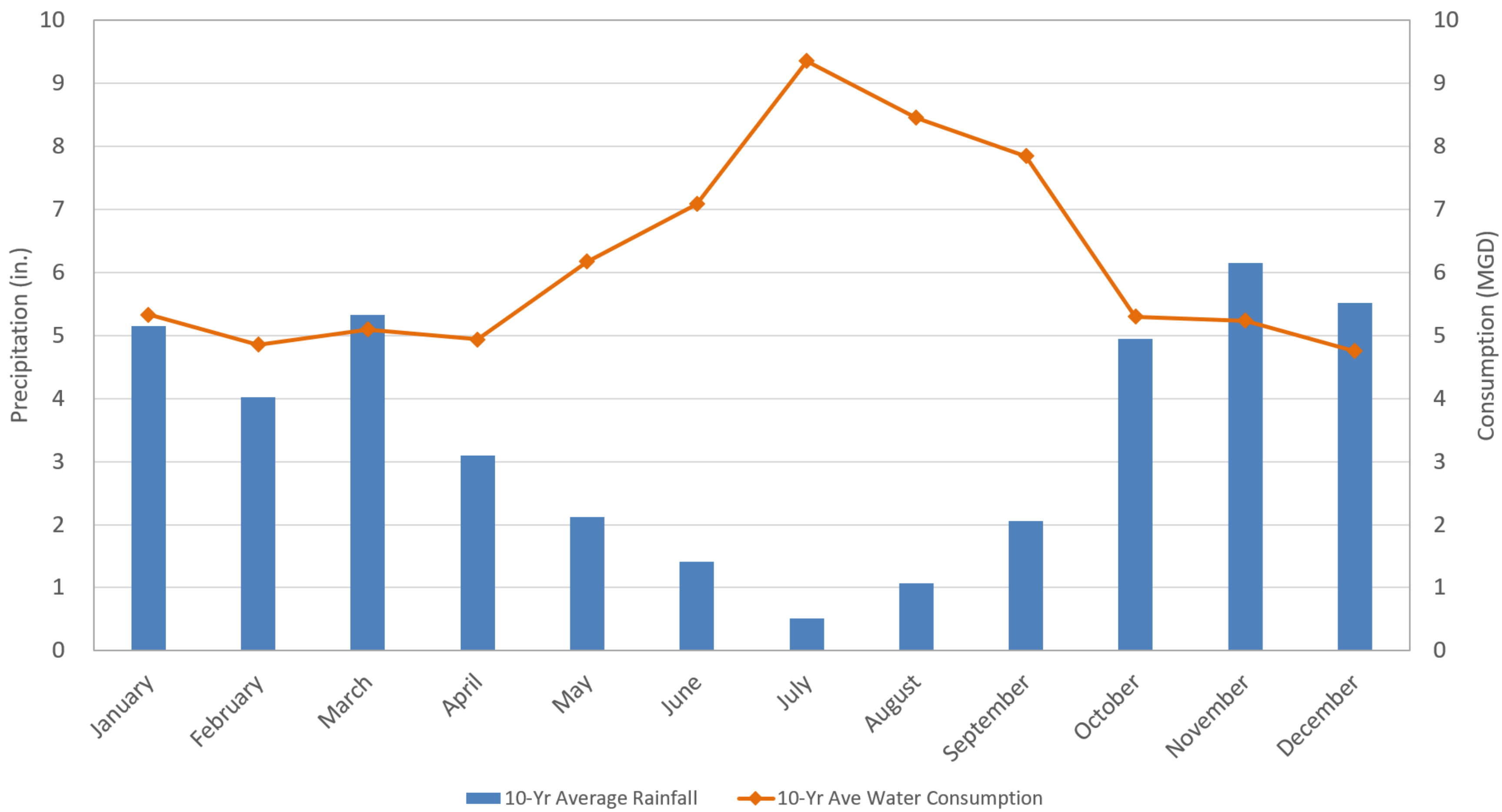


Figure 3.13 Average Seasonal Consumption and Precipitation (2008-2017)

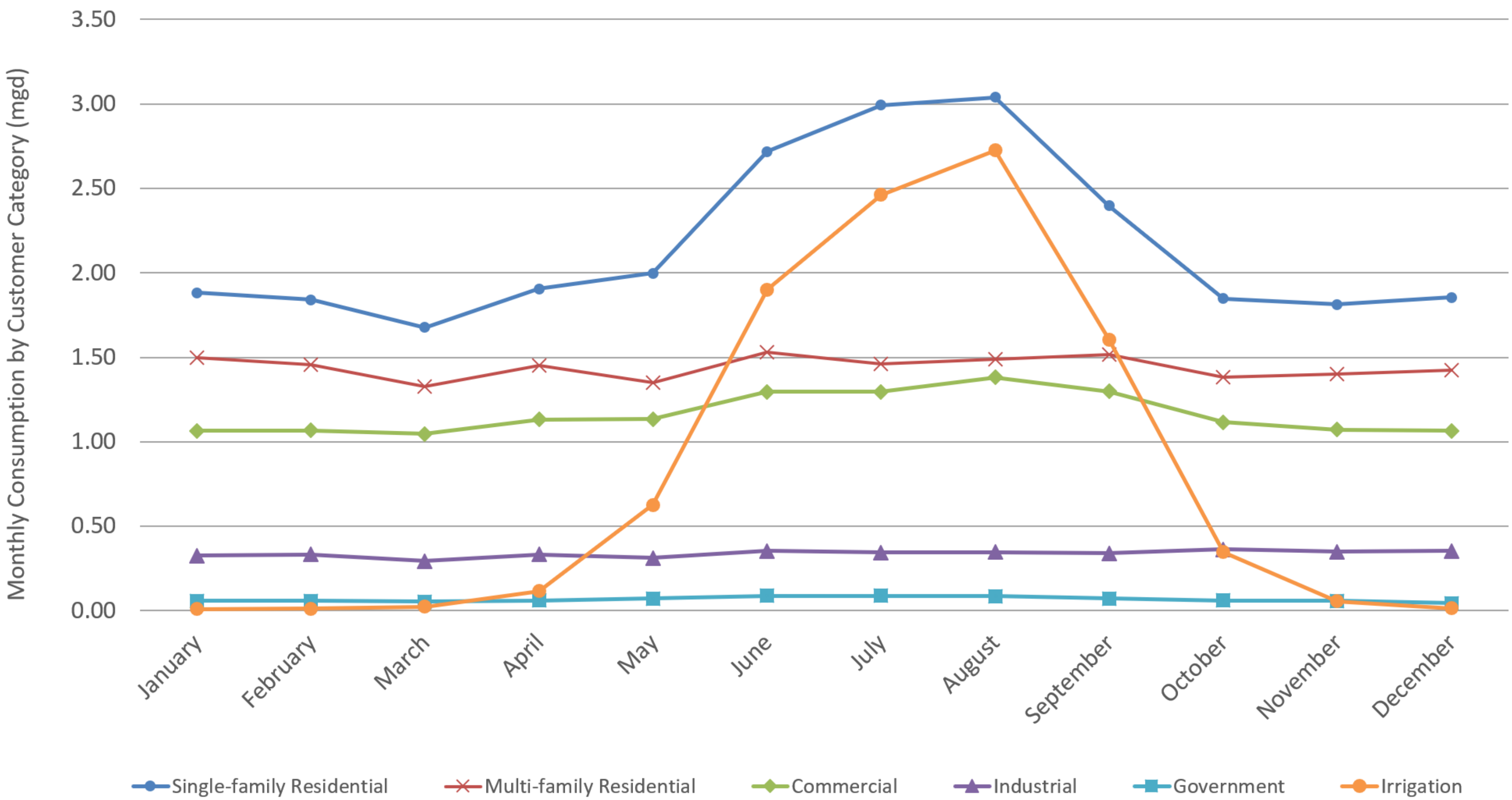


Figure 3.14 Average Seasonal Consumption per Customer Category (2015-2017)

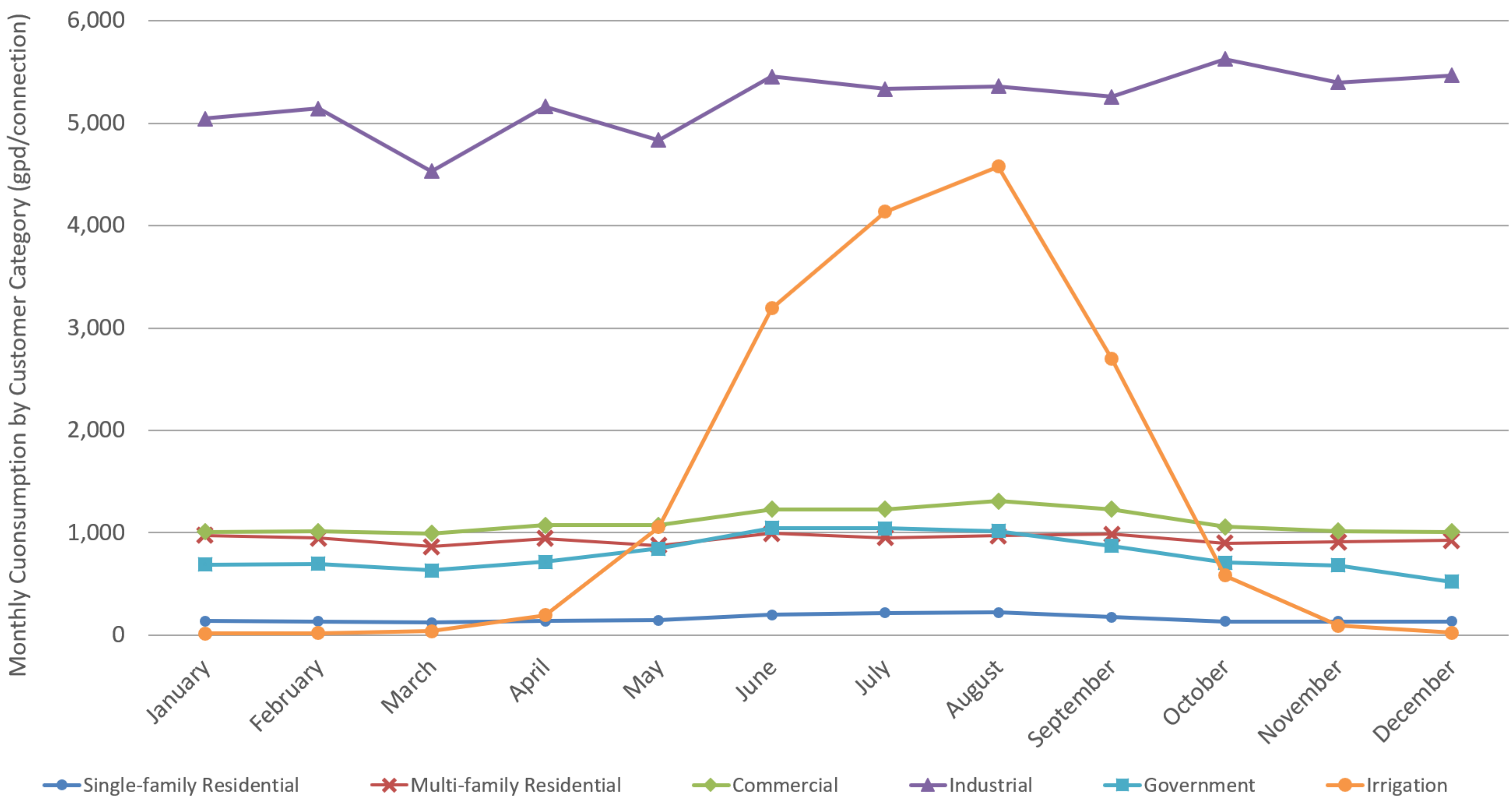


Figure 3.15 Average Seasonal Consumption per Connection (2015-2017)

Table 3.8 Historical Consumption per Connection, gpd/Connection

Customer Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average	ERUs per Connection
Single-Family Residential	165	173	158	154	155	156	153	160	154	159	159	1.0
Multi-Family Residential (Per Dwelling Unit)	109	100	104	101	102	103	100	102	97	100	102	0.6
Commercial	923	893	879	877	846	856	874	912	901	990	895	5.6
Industrial	3,065	2,742	2,459	2,833	2,813	2,344	2,540	2,500	2,258	1,935	2,549	15.9
Government	1,507	1,111	1,039	1,013	976	964	824	833	805	864	993	6.2
Irrigation	1,257	1,584	1,054	1,148	1,175	1,124	1,290	1,482	1,347	1,355	1,282	8.0

3.3.5.1 Equivalent Residential Units

An ERU is the amount of water consumed by a typical full-time Single-Family Residence. According to the Washington Administrative Code (WAC) 246-290-010, non-residential customer water use is expressed as a multiple of Single-Family Residence ERU.

To calculate ADD water use per ERU, the total annual volume of water consumed by Single-Family Residences is divided by the total number of active Single-Family Residential connections. The resulting value, also called the ERU planning value, is the average Single-Family Residence's annual water use per connection. To determine the number of ERUs used by other customer categories, the volume of water used by those customer categories is divided by the ERU value.

Table 3.8 shows each customer categories' average daily consumption per connection between 2008 and 2017. The Single-Family Residential average consumption volume was 159 gpd during that time.

As shown in Figure 3.16, the City's ERU value generally declined over the last decade and has remained below 160 gpd since 2010. Since one of the City's WUE goals is to keep its ERU value under 160 gpd, the City has selected 160 gpd as its ERU planning value.

The last column in Table 3.8 shows the average number of ERUs per connection for each customer category the City serves. This is calculated by dividing the consumption per connection by the ERU planning value.

The typical Multi-Family dwelling unit consumes 0.6 ERUs, meaning that a Multi-Family household consumes 60 percent of the water of a typical Single-Family household. Non-residential connections use significantly more water than a typical Single-Family Residence, with a range of 5.6 to 16.0 ERUs.

Table 3.9 lists each customer categories' number of ERUs between 2008 and 2017.

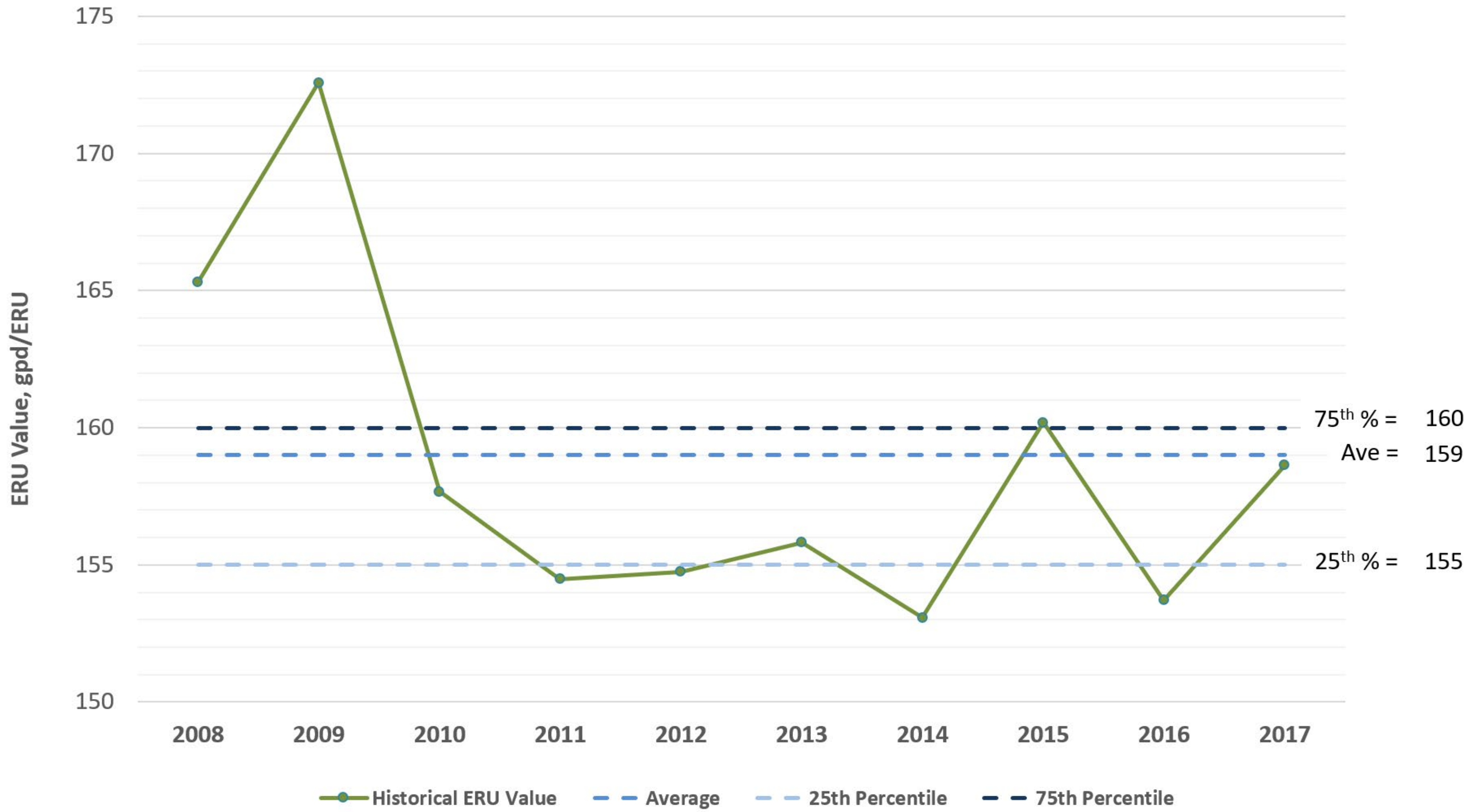


Figure 3.16 Historical ERU Value Trend (2008-2017)

Table 3.9 Historical Number of ERUs by Customer Category

Customer Type	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Single-Family Residential	13,440	14,060	12,940	12,750	12,940	13,130	13,000	13,690	13,190	13,690
Multi-Family Residential	9,000	8,880	9,190	8,940	9,060	9,130	8,880	9,130	8,810	9,060
Commercial	5,880	5,690	5,560	5,560	5,440	5,500	5,630	5,880	5,940	6,500
Industrial	1,190	1,060	940	1,060	1,130	940	1,000	1,000	880	750
Government	690	560	500	500	500	500	440	440	440	440
Irrigation	4,500	5,810	3,810	4,130	4,310	4,130	4,750	5,440	5,000	5,130
Largest Consumers	3,810	3,380	3,500	3,750	3,630	3,690	3,810	4,130	4,190	4,500
Total	**38,510**	**39,440**	**36,440**	**36,690**	**37,010**	**37,020**	**37,510**	**39,710**	**38,450**	**40,070**

3.4 Demographic Trends

To determine future demand for the City's retail water service area (RWSA), current and projected demographic trends were developed using data provided by the PSRC. The PSRC publishes population, household, and employee growth forecasts for jurisdictions within its regional boundary. The PSRC database contains historical and future yearly estimates of key demographic and employment values for the Puget Sound region by forecast analysis zone (FAZ).

The City's RWSA and pressure zone boundaries do not coincide with the PSRC's FAZ boundaries. As a result, the City allocated key demographic and employment variables (households, population, and employees) to each pressure zone within its service area using GIS techniques.

Table 3.10 shows the PSRC's population, household, and employment projections. Table 3.11 shows the PSRC's population projections by pressure zone, and Table 3.12 shows the employment projections by pressure zone.

Table 3.10 System-wide Population, Household, and Employment Projections

	2010 (Historical)	2017 (2016 for Employees)	2025	2030	2035	2040
Population	61,921	68,664	75,416	78,468	80,220	82,704
Households	25,732	29,151	33,092	34,386	35,302	36,568
Employees	53,786	62,116	75,349	79,520	87,238	97,002

Table 3.11 Population Projections by Pressure Zone

	2010 (Historical)	2017	2025	2030	2035	2040
EARL370	837	873	909	947	975	1,002
ETH300	411	503	435	437	454	457
HLD435	11,923	12,566	14,374	15,172	15,490	16,096
HLD565	21,025	23,163	25,332	26,396	26,955	27,978
KD218	212	256	310	323	335	338
KD320	5,170	6,462	7,996	8,311	8,613	8,659
RH395	432	447	459	467	481	479
RH490	3,473	3,933	3,880	4,027	4,137	4,342
RH590	4,656	4,892	4,936	5,142	5,235	5,460
SH370	225	234	272	293	305	331
TH270	2	2	3	3	3	3
TH350	3,923	4,221	4,194	4,224	4,296	4,412
VLY196	6,409	7,716	8,864	9,073	9,239	9,365
WH300	1,214	1,274	1,306	1,376	1,409	1,407
WH495	1,023	1,099	1,114	1,170	1,175	1,203
WTH300	986	1,023	1,032	1,107	1,118	1,172

Table 3.12 Employment Projections by Pressure Zone

	2010 (Historical)	2016	2025	2030	2035	2040
EARL370	42	40	93	101	128	130
ETH300	0	0	0	0	0	0
HLD435	911	978	1,230	1,572	1,734	1,874
HLD565	3,969	4,810	5,624	5,870	6,196	8,113
KD218	0	0	0	0	0	0
KD320	12,670	14,985	21,474	24,022	29,104	32,142
RH395	0	0	0	0	0	0
RH490	95	172	221	227	239	249
RH590	357	429	452	472	519	580
SH370	0	0	0	0	0	0
TH270	8	9	24	28	34	40
TH350	4,064	4,580	4,785	4,982	5,351	5,650
VLY196	31,412	35,829	41,136	41,920	43,585	47,750
WH300	242	269	272	273	283	412
WH495	15	17	38	53	65	62
WTH300	0	0	0	0	0	0

Using PSRC's household and employment projections for each pressure zone, annual growth rates were calculated to forecast future City water connections for each customer category.

Household growth rates were used to project Single-Family Residential and Multi-Family Residential connections. Employment growth rates were also used to forecast connections for all Non-Residential customer categories (Commercial, Industrial, Government, and Irrigation).

Table 3.13 and Table 3.14 show annual growth rates for each pressure zone. Note, the City assumed that negative growth will not occur, so growth rates were set to the minimum value between the calculated value and zero.

PSRC predicts the greatest residential growth rates in the Renton Highlands zones, as shown in Table 3.13, while the Valley 196 PZ and Kennydale 320 PZ will experience the highest commercial growth in terms of the number of employees added, as illustrated in Table 3.14.

The PSRC also predicts the number of households within the City's RWSA to grow by one percent annually between 2017 and 2040. This projection is higher than the 0.7 percent annual growth rate for Single-Family Residential connections experienced in the City between 2008 and 2017 (Figure 3.6).

Furthermore, the PSRC predicts that employment within the City's RWSA will experience an annual growth rate of 1.9 percent from 2017 to 2040. This projection more than doubles the annual growth rates of Commercial and Industrial that the City experienced between 2008 and 2017.

Table 3.13 Household Growth Rates by Pressure Zone

Pressure Zone	2010 - 2017	2017 - 2025	2025 - 2030	2030 - 2035	2035 - 2040	2017 - 2040
EARL370	1.1%	0.4%	0.4%	0.6%	0.6%	0.5%
ETH300	3.3%	0.0%	0.0%	0.7%	0.0%	0.0%
HLD435	0.6%	2.8%	1.2%	0.6%	0.9%	1.6%
HLD565	1.5%	1.7%	1.0%	0.5%	1.0%	1.1%
KD218	3.3%	2.8%	0.7%	0.5%	0.1%	1.3%
KD320	3.7%	2.8%	0.5%	0.7%	0.1%	1.2%
RH395	0.7%	1.1%	0.1%	0.5%	0.1%	0.5%
RH490	2.9%	0.0%	0.6%	0.5%	0.8%	0.2%
RH590	1.3%	0.3%	0.8%	0.4%	0.9%	0.6%
SH370	0.6%	1.8%	1.0%	0.6%	1.5%	1.3%
TH270	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TH350	1.4%	0.1%	0.1%	0.4%	0.4%	0.2%
VLY196	2.9%	1.8%	0.3%	0.5%	0.2%	0.9%
WH300	1.1%	0.5%	0.8%	0.4%	1.0%	0.6%
WH495	1.4%	0.6%	1.0%	0.3%	0.9%	0.7%
WTH300	1.1%	0.4%	1.5%	0.4%	1.3%	0.8%
System-wide	**1.8%**	**1.6%**	**0.8%**	**0.5%**	**0.7%**	**1.0%**

Table 3.14 Employment Growth Rates by Pressure Zone

Pressure Zone	2010 - 2016	2016 - 2025	2025 - 2030	2030 - 2035	2035 - 2040	2017 - 2040
EARL370	0.0%	9.9%	1.7%	4.9%	0.3%	5.1%
ETH300	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HLD435	1.2%	2.6%	5.0%	2.0%	1.6%	2.7%
HLD565	3.3%	1.8%	0.9%	1.1%	5.5%	2.2%
KD218	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KD320	2.8%	4.1%	2.3%	3.9%	2.0%	3.2%
RH395	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RH490	10.3%	2.9%	0.5%	1.0%	0.8%	1.6%
RH590	3.1%	0.6%	0.9%	1.9%	2.2%	1.3%
SH370	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TH270	2.7%	11.7%	3.1%	4.0%	3.3%	6.5%
TH350	2.0%	0.5%	0.8%	1.4%	1.1%	0.9%
VLY196	2.2%	1.5%	0.4%	0.8%	1.8%	1.2%
WH300	1.8%	0.1%	0.1%	0.7%	7.8%	1.8%
WH495	1.5%	9.5%	6.9%	4.2%	0.0%	5.6%
WTH300	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
System-wide	**2.4%**	**2.2%**	**1.1%**	**1.9%**	**2.1%**	**1.9%**

Water connections were projected by raising the City's existing number of water connections in each pressure zone by the growth rates in Table 3.13 and Table 3.14. Table 3.15 shows the number of connection projections for the planning years, which will be then used to estimate the City's future water demand.

Table 3.15 Projected Number of Water Connections

Customer Type	2017	2029	2039
Single-Family Residential	13,806	16,335	17,460
Multi-Family Residential (Dwelling Units)	14,499	17,545	18,589
Commercial	1,057	1,283	1,528
Industrial	63	77	90
Government	81	98	120
Irrigation	605	745	901
Largest Consumers	7	7	7
System-wide	**30,796**	**36,090**	**38,694**

3.5 Water Demand Projections

Projecting future water demand is a key part of the water system planning process. Demand projections are used to identify the system improvements required for supply, pumping, storage, and piping infrastructure.

This section summarizes the ADD and MDD projections Carollo developed for the City's water system using historical water demand trends and the future demographic growth assumptions developed in Section 3.4. Demand projections are presented for three demand scenarios (Low, Medium, High) that represent a range in potential future demands.

Low, Medium, and High water demand projection scenarios were developed by adjusting various demand projection parameters:

- The Low scenario assumes aggressive WUE, which represents the lowest future demands the City expects to experience.
- The Medium scenario is a planning case predicted to most closely match the City's future demands.
- The High scenario assumes no intentional WUE, which represents the highest demands the City could experience.

Both Medium and High scenarios were used in the Chapter 6 supply analysis, which will help the City to decide when to acquire new water rights and develop new supply sources. The Medium scenario was used for the Chapter 7 system analysis, which identifies deficiencies in future pumping, storage, and the distribution system analyses, as well as size potential improvements to achieve the City's established capacity criteria.

3.5.1 Demand Projection Methodology

For this analysis, water demand projections were developed in the following steps:

1. Increase historical water connection numbers for each pressure zone and customer type (as shown in Tables 3.4 and 3.5) by the zone-specific residential and non-residential growth rates from the demographic analysis (as shown in Tables 3.13 and 3.14). Table 3.15 shows the resulting connection projections.
2. Convert connection projections into ERU projections using the historical ERUs per connection (as shown in Table 3.8).
3. Convert ERU projections to ADD projections using demand projection parameters derived from historical data of the City's starting ERU value, DSL/Non-Revenue Water, Other Authorized Use, climate change impact, and Largest Consumer demand. City staff established unique demand projection parameters for Low, Medium, and High demand scenarios.
4. Apply the MDD to ADD peaking factor to convert ADD to MDD. Again, each demand scenario has a unique peaking factor selected by City staff.

Figure 3.17 also summarizes these steps.

3.5.2 Demand Projection Parameters

To project the City's future ADD and MDD, several parameters were used:

- ERU value.
- ERU value annual reduction.
- DSL/Non-Revenue Water.
- Other authorized use.
- Climate change scenario.
- Largest Consumer demand.
- MDD to ADD peaking factor.

For each of the above parameters, the City used historical data to establish Low, Medium, and High values, which were used to develop each of the demand projection scenarios. This information is summarized in Table 3.16 and discussed in further detail in the following subsections.

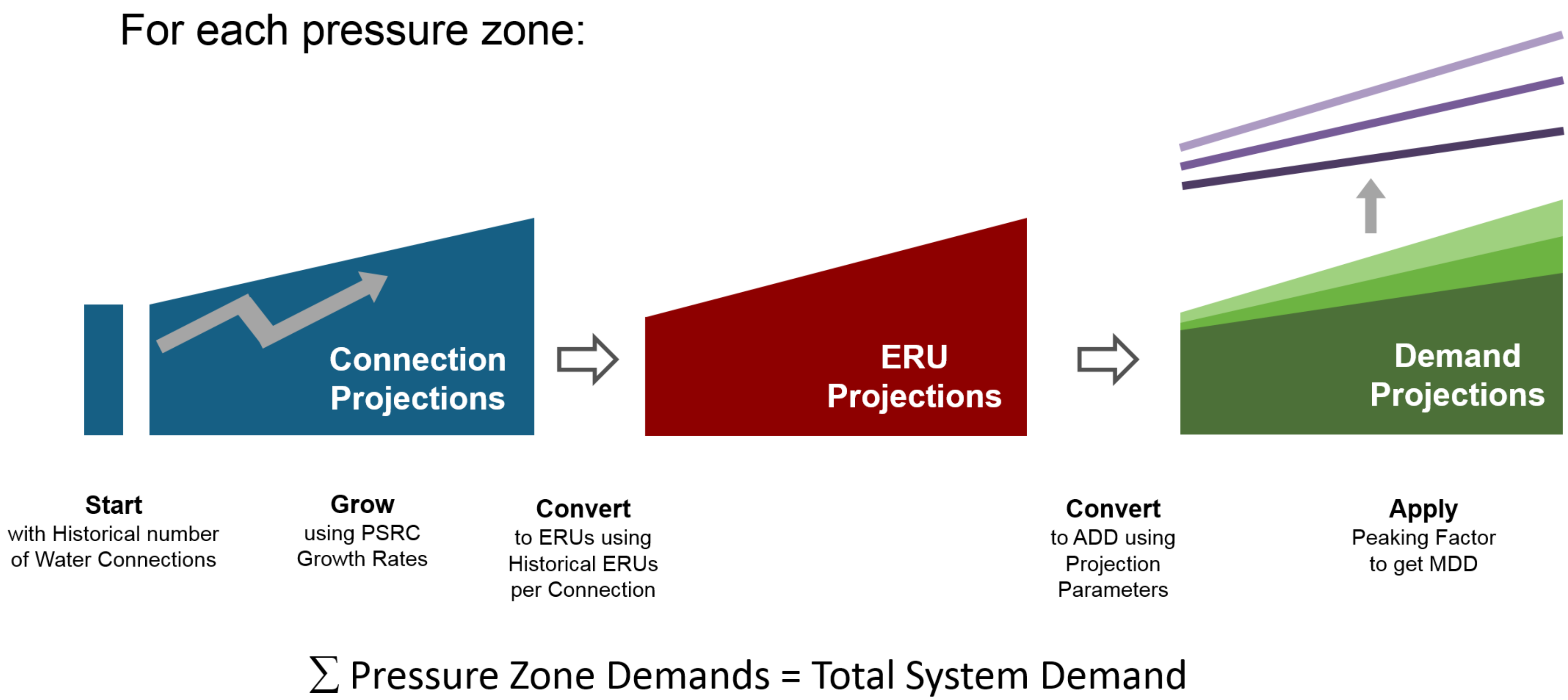


Figure 3.17 Demand Projection Methodology

Table 3.16 Demand Projection Parameters

Demand Projection Scenario	Low		Medium		High	
	Value	Notes	Value	Notes	Value	Notes
ERU Value (gpd/ERU)	153	Historical Minimum	160	WUE Goal	173	Historical Max
DSL/Non-Revenue Water (Percent of Production)	10%	WUE Goal	12.5%	Historical Average	12.5%	Historical Average
Other Authorized Use (Percent of Production)	1.3%	Historical Average	1.8%	Historical Maximum	2.0%	
Climate Change Scenario	None		Warm		Warmest	
MDD/ADD Peaking Factor	1.7	Historical Minimum	1.8	Historical Average	2.0	WUE Goal

3.5.2.1 ERU Value

The City selected a unique ERU value for each demand projection scenario. As mentioned before, the ERU value represents the consumption of a typical Single-Family household in gpd and is used to convert the number of ERU projected to ADD projections.

For the Low scenario, the City selected an ERU value of 153 gpd/ERU, which is the lowest value experienced between 2008 and 2017. An ERU value of 160 gpd/ERU was selected for the Medium scenario, which corresponds to the City's WUE goal, while the High scenario used an ERU value of 173 gpd/ERU, corresponding to the highest ERU value the City experienced between 2008 and 2017.

3.5.2.2 Distribution System Leakage

The City's goal is to reduce its DSL and Non-Revenue Water to 10 percent or less, which is reflected in the Low scenario. The Medium and High scenarios conservatively assume the City will not able to meet its goal and DSL and Non-Revenue Water will remain at 12.5 percent, the average value between 2008 and 2017.

3.5.2.3 Other Authorized Use (Hydrants and Fire)

Other Authorized Use is a small percentage of the City's water production. The historical average value of 1.3 percent was selected for the Low scenario. As the City improves its tracking of authorized use to lower DSL, it expects that Other Authorized Use may increase. Therefore, the historical maximum of 1.8 percent was selected for the Medium scenario, while the High scenario used 2 percent.

3.5.2.4 Impact of Climate Change on Demand Projections

According to climate change models, the Pacific Northwest will, in general, experience warmer, wetter winters and hotter, drier summers. To estimate climate change's impact on the City's water demands, Carollo examined results from the Water Supply Forum's 2009 Regional Water Supply Outlook, which forecasted demands for the Puget Sound Region under three general circulation models (climate change models) developed by the University of Washington. For the purpose of this Plan, these models were nicknamed Warm, Warmer, and Warmest:

- The Warm model predicted a small increase in temperature and a small decrease in annual precipitation.
- Compared to the Warm model, the Warmer model predicted a medium increase in temperature and a small increase in annual precipitation.
- The Warmest model predicted the highest increase in temperature and also the highest increase in precipitation.

Using each model's climate predictions, water demands for the Puget Sound Region were projected and compared to a baseline demand projection scenario that assumed no change in temperature or precipitation. Table 3.17 shows the difference in demand for each climate change scenario compared to the baseline.

The Warm and Warmest models were applied to the Medium and High demand projection scenarios, respectively. According to the Warm model, an approximately 2 percent increase in demands is predicted by 2040. The Warmest model, on the other hand, predicts a roughly 5 percent increase in demands by 2040. The Low scenario assumes no impact from climate change.

Table 3.17 Predicted Increase in Demand from Baseline due to Climate Change

Climate Change Scenario	2005	2010	2020	2030	2040
Baseline	0.0%	0.0%	0.0%	0.0%	0.0%
Warm	0.0%	0.2%	0.8%	1.4%	2.1%
Warmer	0.0%	0.1%	0.5%	1.4%	3.1%
Warmest	0.0%	0.4%	1.4%	2.9%	4.9%

3.5.2.5 MDD to ADD Peaking Factor

The City's WUE goal is to maintain a peaking factor of less than 2.0, which is higher than historical trends show. This peaking factor was applied to the High scenario. The City anticipates that increased WUE and conservation measures may reduce annual water consumption, thereby increasing the peaking factor.

The historical average peaking factor of 1.8 was used for the Medium scenario, and the historical minimum peaking factor of 1.7 was used for the Low scenario.

3.5.2.6 Largest Consumer Demand

Using analyses of the City's historical consumption, Carollo developed individual demand projections for the City's six Largest Consumers, as shown in Table 3.18. Each of the Largest Consumers was assigned a starting demand (the demand for 2017 in the projections) and an annual growth rate dependent on the demand scenario (Low, Medium, High). Details for each of the Largest Consumers are provided below.

Over the last decade, the annual consumption of Boeing, Valley Medical Center, G&K Services, and Service Linen Supply remained fairly constant. Therefore, no growth is projected for these customers. For all demand scenarios, the starting demand for Boeing, G&K Services, and Service Linen Supply was set to their annual average demand from 2008 to 2017.

For Valley Medical Center, the Low scenario's starting demand was set to the historical average, while the Medium and High scenarios' starting demands were set to their maximum demand from 2008 to 2017.

Conversely, water consumption at King County's South Plant fluctuated over the last decade, with consumption increasing consistently from 2015 to 2017. According to plant staff, more water was used during that time because the water reuse facility was offline for repairs and upgrades. Now that the reuse facility's upgrade is complete, the plant's water use is predicted to drop closer to figures in 2015. As such, no growth is projected for King County's South Plant.

Nonetheless, to reflect King County's South Plant's varying water consumption, the Low scenario was assigned a starting demand close to 2015 levels, the Medium scenario was assigned a starting demand equal to the average annual demand from 2008 to 2017, and the High scenario was assigned a starting demand equal to the maximum demand experienced from 2008 to 2017.

Since 2012, water sales to Skyway have increased steadily at a rate of eight percent annually. However, Skyway's most recent Comprehensive Water System Plan (2013) estimated an annual increase of 1.2 percent for the number of ERUs served by the City. Therefore, this range of growth is reflected in the annual growth rates set for each demand projection scenario.

The Low scenario has a starting demand equal to Skyway's historical average from 2008 to 2017 and a growth rate of 1.2 percent. The Medium and High scenarios have starting demands set to 202,000 gpd, representing Skyway's maximum water purchase in 2017. The High scenario has an annual growth rate of 8 percent, while the Medium scenario has an annual growth rate of 5 percent, which is a midpoint between Skyway's historical growth rates and growth rates predicted for the future.

The City and Skyway will likely negotiate a new contract in the near future, which will include a cap on water sales (the existing agreement with Skyway can be found in Appendix D). The volume of this cap, however, is not known at the time of this Plan. For planning purposes, a cap of 300,000 gpd was set for all three demand projection scenarios.

Table 3.18 Largest Consumers Projections

Demand Projection Scenario	Low			Medium			High		
	Starting Demand (gpd)	Annual Growth Rate	Cap (gpd)	Starting Demand (gpd)	Annual Growth Rate	Cap (gpd)	Starting Demand (gpd)	Annual Growth Rate	Cap (gpd)
King County South Plant	170,000	0.0%	None	185,000	0.0%	None	218,000	0.0%	None
Skyway Wholesale	157,000	1.2%	300,000	202,000	5.0%	300,000	202,000	8.0%	300,000
Boeing	92,000	0.0%	None	92,000	0.0%	None	92,000	0.0%	None
Valley Medical Center	71,000	0.0%	None	100,000	0.0%	None	100,000	0.0%	None
G&K Services	55,000	0.0%	None	55,000	0.0%	None	55,000	0.0%	None
Service Linen Supply	60,000	0.0%	None	60,000	0.0%	None	60,000	0.0%	None

3.5.3 ERU Projections

When converting projected number of accounts to ADD, the first step is to convert these number of accounts into a number of ERUs. To calculate the projected number of ERUs for the RWSA, the projected number of accounts shown in Table 3.15 were multiplied by the number of ERU per account shown in Table 3.8. Table 3.19 shows the ERU projections for each demand projection scenario.

These ERU projections include ERUs that correspond to non-revenue water (DSL and Other Authorized Use), which were calculated by dividing the ADD projections of DSL and Other Authorized Use by the ERU values in gpd/ERU shown in Table 3.16. Section 3.5.4 below describes how ADD projections for DSL and Other Authorized Use were calculated.

The number of ERUs served by the City is projected to increase from approximately 48,000 in 2019 to nearly 61,000 by 2039, an increase of 27 percent.

Table 3.19 ERU Projections - Planning Demand Projection Scenario

Demand Projection Scenario	Low			Medium			High		
Customer Category	2019	2029	2039	2019	2029	2039	2019	2029	2039
Single-Family Residential	14,125	16,171	17,286	14,125	16,171	17,286	14,125	16,171	17,286
Multi-Family Residential	9,921	11,229	11,897	9,921	11,229	11,897	9,921	11,229	11,897
Commercial	6,150	7,167	8,533	6,150	7,167	8,533	6,150	7,167	8,533
Industrial	1,060	1,227	1,430	1,060	1,227	1,430	1,060	1,227	1,430
Government	522	610	742	522	610	742	522	610	742
Irrigation	5,035	5,964	7,219	5,035	5,964	7,219	5,035	5,964	7,219
Largest Consumers(1)	3,979	4,112	4,262	4,467	4,950	4,950	4,397	4,769	4,769
DSL & Other Authorized Use	5,184	5,906	6,528	6,900	7,954	8,800	7,013	8,093	9,027
Total	**45,970**	**52,390**	**57,900**	**48,180**	**55,270**	**60,860**	**48,220**	**55,230**	**60,900**

Note:
(1) ERU values were not used to develop the projections for the large consumers. The ERU values for the Largest Consumers shown in this table were calculated by dividing the projected ADD by the ADD ERU value. Since the ADD ERU value is higher for the High Scenario than the Medium Scenario, the ERU values for the Largest Consumers in this table are shown as lower for the High Scenario than the Medium Scenario.

3.5.4 Average and Maximum Day Projections

To calculate the ADD projections for each customer category, the ERU projections were multiplied by the ERU values in gpd/ERU unique to each demand projection scenario and customer category, as shown in Table 3.16. To establish total ADD projections, non-revenue water consumption, including Other Authorized Use and DSL, was added using Low, Medium, and High assumptions. Finally, for each demand projection scenario, MDD projections were established by multiplying ADD projections by the appropriate MDD to ADD peaking factor.

Table 3.20 shows ADD projections for Low, Medium, and High demand scenarios for each customer category, while Table 3.22 shows the same projections by pressure zone. Figure 3.18 shows a chart of the system-wide demand projections.

The City's ADD is projected to be between 7.0 and 8.4 mgd in 2019, for the Low and High scenarios respectively. By 2039, ADD is estimated to be between 8.9 mgd and 10.8 mgd, for the Low and High scenarios respectively. The Medium scenario predicts 9.8 mgd.

In 2039, MDD is estimated to be between 15.1 mgd and 21.5 mgd, for the Low and High scenarios respectively, as shown in Table 3.21. The Medium scenario predicts 17.7 mgd. Additionally, the Medium scenario predicts a 1.2 percent annual increase in water system demands, which equates to a 27 percent increase over the 20-year planning period. These demands are the basis for the water resource evaluation of Chapter 6 and the water system evaluation of Chapter 7. Table 3.23 shows these MDD projections by pressure zone. Appendix H shows detailed demand projections by year.

Table 3.20 ADD Projections by Customer Category (mgd)

Demand Projection Scenario	Low Projected ADD (mgd)			Medium Projected ADD (mgd)			High Projected ADD (mgd)		
Customer Category	2019	2029	2039	2019	2029	2039	2019	2029	2039
Single-Family Residential	2.2	2.5	2.6	2.3	2.6	2.8	2.5	2.8	3.1
Multi-Family Residential	1.5	1.7	1.8	1.6	1.8	1.9	1.7	2.0	2.1
Commercial	0.9	1.1	1.3	1.0	1.2	1.4	1.1	1.3	1.5
Industrial	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Government	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Irrigation	0.8	0.9	1.1	0.8	1.0	1.2	0.9	1.1	1.3
Largest Consumers	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8
DSL & Other Authorized Use	0.8	0.9	1.0	1.1	1.3	1.4	1.2	1.4	1.6
Total	**7.0**	**8.0**	**8.9**	**7.7**	**8.9**	**9.8**	**8.4**	**9.7**	**10.8**

Table 3.21 MDD Projections by Customer Category (mgd)

Demand Projection Scenario	Low Projected MDD (mgd)			Medium Projected MDD (mgd)			High Projected MDD (mgd)		
Customer Category	2019	2029	2039	2019	2029	2039	2019	2029	2039
Single-Family Residential	3.7	4.2	4.5	4.1	4.7	5.1	4.9	5.7	6.2
Multi-Family Residential	2.6	2.9	3.1	2.9	3.3	3.5	3.5	3.9	4.2
Commercial	1.6	1.9	2.2	1.8	2.1	2.5	2.1	2.5	3.0
Industrial	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.4	0.5
Government	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Irrigation	1.3	1.6	1.9	1.5	1.7	2.1	1.8	2.1	2.6
Largest Consumers	1.0	1.1	1.1	1.3	1.4	1.4	1.5	1.7	1.7
DSL & Other Authorized Use	1.4	1.5	1.7	2.0	2.3	2.5	2.4	2.8	3.1
Total	**12.0**	**13.6**	**15.1**	**13.9**	**16.0**	**17.7**	**16.8**	**19.3**	**21.5**

Table 3.22 ADD Projections by Pressure Zone (mgd)

Pressure Zone	Low Projected ADD (mgd)			Medium Projected ADD (mgd)			High Projected ADD (mgd)		
	2019	2029	2039	2019	2029	2039	2019	2029	2039
EARL370	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ETH300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HLD435	0.9	1.1	1.3	1.0	1.2	1.4	1.1	1.4	1.5
HLD565	1.8	2.0	2.3	1.9	2.2	2.5	2.1	2.4	2.8
KD218	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KD320	0.6	0.8	0.9	0.7	0.9	1.0	0.8	1.0	1.1
RH395	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RH490	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.4	0.4
RH590	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5
SH370	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TH270	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TH350	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.6
VLY196	2.2	2.4	2.6	2.3	2.6	2.8	2.5	2.8	3.1
WH300	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
WH495	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5
WTH300	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**7.0**	**8.0**	**8.9**	**7.7**	**8.9**	**9.8**	**8.3**	**9.7**	**10.8**

Table 3.23 MDD Projections by Pressure Zone (mgd)

Pressure Zone	Low Projected MDD (mgd)			Medium Projected MDD (mgd)			High Projected MDD (mgd)		
	2019	2029	2039	2019	2029	2039	2019	2029	2039
EARL370	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
ETH300	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
HLD435	1.5	1.9	2.1	1.7	2.2	2.5	2.1	2.7	3.0
HLD565	3.0	3.4	3.9	3.4	3.9	4.5	4.1	4.8	5.5
KD218	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
KD320	1.1	1.4	1.6	1.3	1.6	1.8	1.5	1.9	2.3
RH395	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
RH490	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8
RH590	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9
SH370	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
TH270	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1
TH350	0.7	0.7	0.8	0.9	0.9	0.9	1.0	1.1	1.1
VLY196	3.7	4.0	4.3	4.2	4.6	5.0	5.1	5.6	6.1
WH300	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
WH495	0.4	0.5	0.5	0.6	0.8	0.8	0.7	0.9	0.9
WTH300	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Total	**12.0**	**13.6**	**15.1**	**13.9**	**16.0**	**17.7**	**16.7**	**19.3**	**21.5**

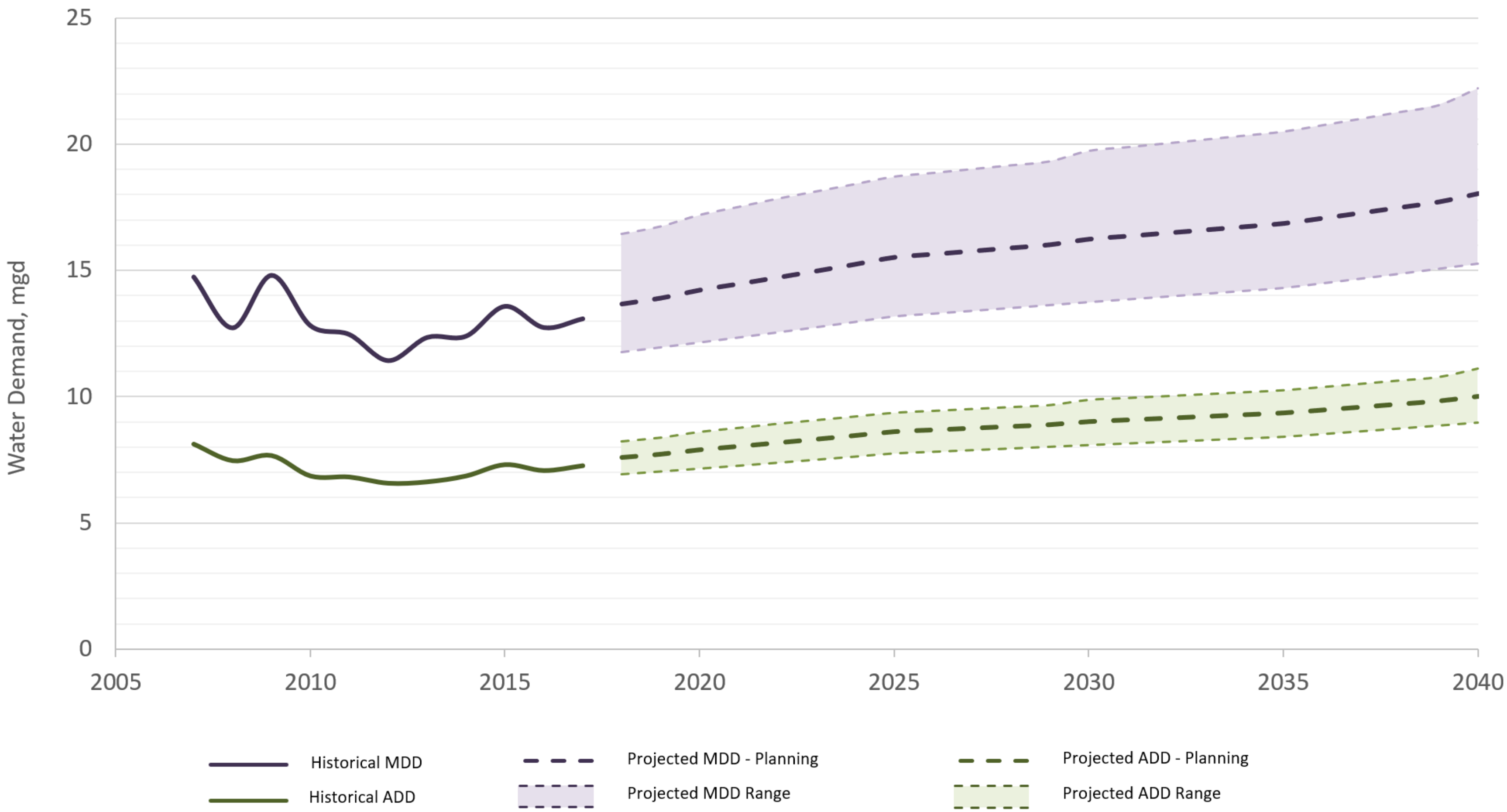


Figure 3.18 Projected Water Demands

3.5.5 Summary

The City's WUE program will affect future demands. To plan its water system, the City selected three measurable WUE goals, which were incorporated into the demand projections:

1. Limit the peaking factor to less than 2.0.
2. Reduce DSL to 10 percent or less by 2022.
3. Maintain an ERU value under 160 gpd/ERU.

These factors were used to develop the demand projections shown in Figure 3.17. As shown, the City's ADD is projected to be between 7.0 and 8.4 mgd in 2019, and between 8.9 mgd and 10.8 mgd by 2039. The Medium demand scenario predicts 9.8 mgd.

By 2039, the City's estimated MDD will be between 15.1 mgd and 21.5 mgd. The Medium demand scenario predicts 17.7 mgd. The Medium scenario also predicts a 1.2 percent increase in water system demands annually, which translates to a total increase in demand of 27 percent over the 20-year planning period.

Chapter 4

WATER USE EFFICIENCY AND CONSERVATION PLAN

In 2003, the Municipal Water Law (MWL), to address the increasing demand on Washington's water resources. As part of this law, the state implemented the Water Use Efficiency (WUE) Rule, which requires all municipal water suppliers to use water more efficiently in exchange for guaranteed, flexible water rights to help meet future demands.

The City of Renton (City) started a WUE program in 2007 to emphasize the importance of measuring water use and evaluating the rule's effectiveness. The intent was to minimize water withdrawals and use by implementing water-saving activities and adopting applicable policies, resolutions, ordinances, or bylaws.

This chapter presents the City's current and proposed actions to comply with conservation planning requirements and to promote using water efficiently. The chapter focuses specifically on the following four fundamental elements of the WUE program:

1. Planning requirements.
2. Distribution leakage standard.
3. Metering requirements.
4. Conservation planning and goal setting.

This discussion follows the Washington State Department of Health (DOH) guidelines established in the WUE Guidebook, Third Edition (revised January 2017), which replaces the former Conservation Planning Requirements (March 1994).

4.1 Planning Requirements

A municipal water system plan must include the following WUE elements:

- Data collection.
- Demand forecast.

Both are described in greater detail below.

4.1.1 Data Collection

The WUE Rule requires that all municipal water suppliers regularly collect production and consumption data.

The City uses its source, intertie, purchase, and service water meters to collect system production and consumption data, which is summarized as monthly and annual totals. This planning document uses unique data, divided into the categories shown Table 4.1, to forecast future demand, describe water supply characteristics, help with decisions on water management, calculate distribution system leakage (DSL), and evaluate the WUE program. This information was ultimately compiled into the annual WUE report and submitted to the state.

Table 4.1 Categories of Data Collection

Water Volume Entering Distribution System
Water Produced (from City sources)
Water Purchased (from SPU)
Authorized Water Consumption - Metered
Single-family Residential
Multi-family Residential (including Duplexes)
Industrial/Commercial/Government
Irrigation
Hydrants and Fire
Wholesale
Interties
Regional Firefighting Training Center
City Maintenance Use
Tank/Reservoir Draining and Cleaning
Authorized Water Consumption - Non-metered
Firefighting
King County South Plant

Note:
Abbreviation: SPU – Seattle Public Utilities.

4.1.2 Demand Forecast

Demand forecasting estimates how much water will be needed in the future. To do this, forecasted demands were developed using demographic projections from the Puget Sound Regional Council (PSRC), all of which are detailed in Chapter 3 – Demand Projections.

4.2 Distribution System Leakage

The WUE Rule requires the 3-year rolling average for DSL to be 10 percent or less. Table 4.2 shows annual DSL between 1988 and 2017. As the graph of the rolling 3-year average (Figure 4.1) shows, the DSL has generally been on a downward trend. However, the DSL has risen again in recent years, even though the City lowered its DSL below 10 percent in 2012 and 2013.

To comply with the DSL standard, the City developed a Water Loss Control Action Plan (WLCAP) in 2008.The WLCAP was updated in 2018 and summarizes the City's current and proposed water loss control efforts. The updated plan can be found in Appendix G.

The leakage percentages in Table 4.2 may slightly differ from the ones reported to DOH. The City historically reported raw meter data to DOH. With the upgrade to AMI data, the City has been resolving data issues and the updated data is shown Table 4.2. In the future, the City will report water use data to DOH using the updated method.

Table 4.2 Distribution System Leakage

Year	Volume (cf)	Percent (%)	Rolling 3-Year Average
1988	156,434,000	33.9%	
1989	78,414,000	20.8%	
1990	73,674,000	19.7%	24.8%
1991	72,448,000	19.7%	20.1%
1992	74,680,000	20.4%	20.0%
1993	52,878,000	16.8%	19.0%
1994	48,138,000	14.5%	17.2%
1995	45,496,000	13.7%	15.0%
1996	57,026,000	16.4%	14.9%
1997	60,243,000	17.1%	15.7%
1998	63,538,000	17.2%	16.9%
1999	62,292,000	16.6%	16.9%
2000	51,907,000	13.8%	15.9%
2001	48,188,000	13.5%	14.6%
2002	47,290,000	13.1%	13.5%
2003	45,520,000	12.1%	12.9%
2004	59,899,000	15.8%	13.7%
2005	51,673,000	14.5%	14.1%
2006	67,070,000	17.2%	15.8%
2007	71,974,000	18.2%	16.6%
2008	61,832,000	17.0%	17.4%
2009	62,870,000	16.8%	17.3%
2010	48,854,000	14.6%	16.1%
2011	43,433,000	13.0%	14.8%
2012	27,687,000	8.6%	12.1%
2013	30,793,000	9.5%	10.4%
2014	39,095,000	11.7%	9.9%
2015	41,588,000	11.7%	10.9%
2016	40,107,000	11.4%	11.6%
2017	38,119,000	10.7%	11.3%

Note:
Abbreviation: cf - cubic feet.

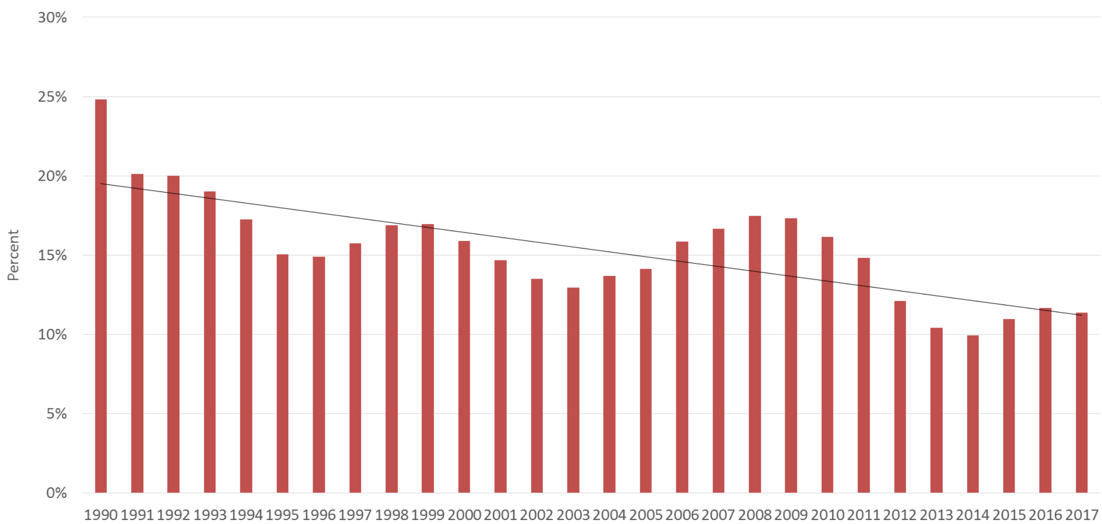


Figure 4.1 DSL 3-Year Rolling Average

4.3 Metering

As required by the MWL, all of the City's sources of supply are metered via production meters. This includes all of the City-owned production wells, Springbrook Springs, interties with adjacent districts, and water purchased from SPU. The production meters are calibrated periodically.

The City also provides service metering for all customers. The consumption meters are categorized either as large (3 inches or greater) or small (smaller than 3 inches). All large service meters are tested annually and repaired as needed. In 2012, the City implemented an Advanced Metering Infrastructure (AMI) system, which provides more time for water maintenance staff to perform repairs on small meters as well. With these measures in place, the City is in full compliance with the WUE metering requirements.

4.4 Conservation Planning

To develop a successful WUE and conservation plan, the City must understand how, where, and when water is used. This knowledge reveals where savings and efficiencies can be made.

The City had a total of 17,831 connections in 2017, most of which were residential connections. Commercial and Industrial sectors make up only about 6 percent of connections, yet account for 25 percent of overall consumption. This indicates that these sectors have opportunities for additional efficiency and conservation savings.

Table 4.3 2017 Connections by Customer Category

	Single Family Residential	Multi-Family Residential	Commercial	Industrial	Government	Irrigation	Large Consumers	Other Authorized Use	Total
# of Connections	13,806	1,534	1,057	63	81	605	7	678	17,831
Percent of Total	77.4%	8.6%	5.9%	0.4%	0.5%	3.4%	0.0%	3.8%	100.0%

Figure 4.3 presents monthly water production in 2017. Summer irrigation season generally begins in May and extends through September. In 2017, the peak irrigation months of July and August experienced a 55 percent increase in average daily water consumption over annual average day demand (ADD). Although this result is typical, it shows that irrigation and general outdoor summer use could also have additional efficiency and conservation savings.

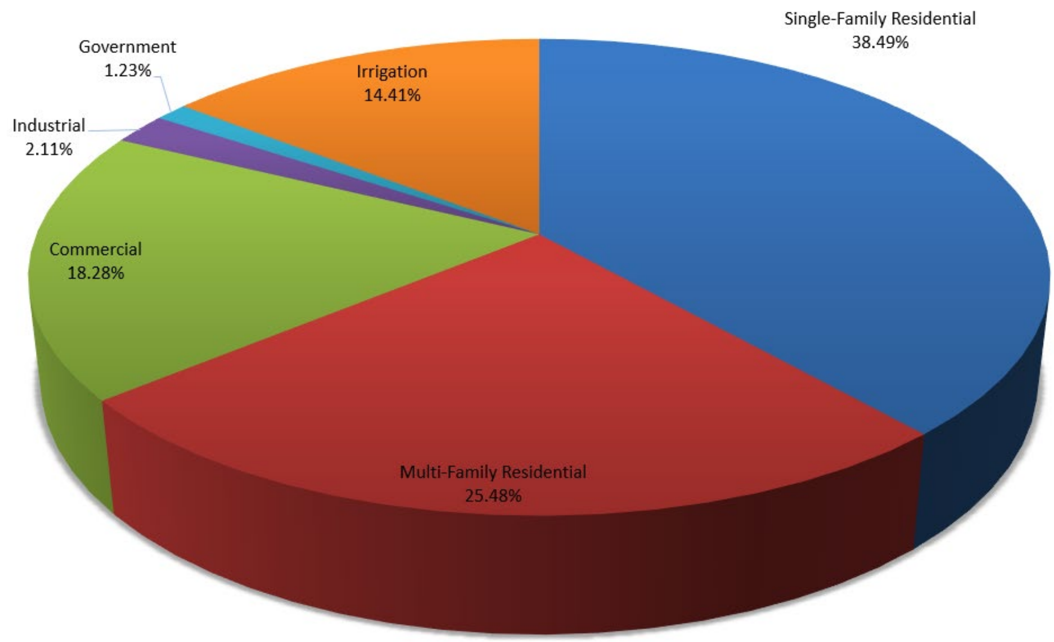
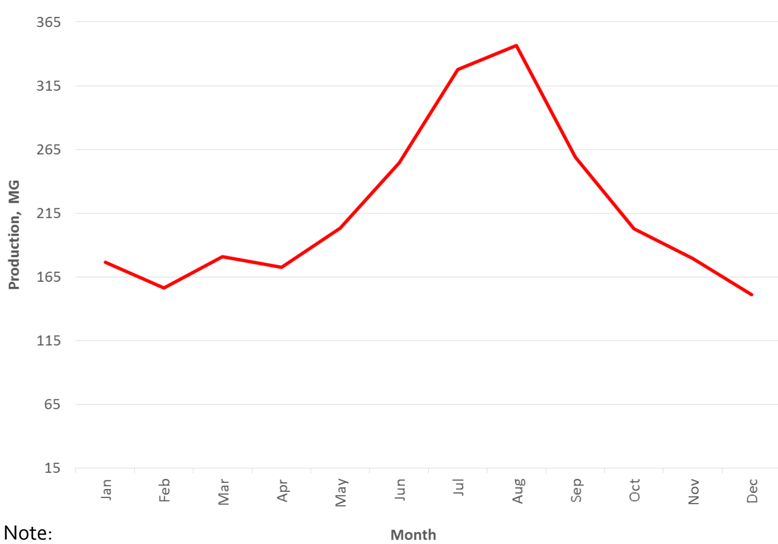


Figure 4.2 2017 Water Use by Customer Category



Month	Production (MG)
January	177
February	156
March	181
April	173
May	203
June	254
July	328
August	346
September	259
October	203
November	180
December	151
Total	**2611**

Note:
Abbreviation: MG = Million Gallons.

Figure 4.3 2017 Monthly Water Production

4.4.1 Historic Conservation Program

The City's water conservation program was implemented in compliance with the Water Use Efficiency Act of 1989, which requires all public water systems to have a conservation program. After initiating its leak detection and repair program in 1989, the City observed a noticeable drop in volume of DSL. Since then, the conservation program has expanded to include school outreach, a speakers' bureau, fairs, and promotion of regional programs.

In addition, a 12-month water consumption history was added to water bills in 1992 to help customers understand their usage. In 1994, the City also began implementing tiered water-pricing rates to encourage consumer conservation.

Table 4.4 summarizes past and current conservation efforts. Current measures are indicated with a "C" and have been in effect for the last 6 years. Measures that will continue through the next 10 years are indicated with a "P."

4.4.1.1 Consumption History

Figure 4.4 shows average water use per connection for the Single-Family Residential customer class between 1988 and 2017. During this period, Single-Family consumption per connection decreased steadily by approximately 30 percent. However, over the most recent decade (2008 to 2017), the decrease was less dramatic, with average Single-Family usage decreasing by 7 gallons per day (gpd), a 4 percent decrease.

Figure 4.5 shows that total annual consumption has increased very little since 1988. However, annual consumption per connection, shown in Figure 4.6, has decreased by 32 percent.

Various events and influences affected this downturn. One significant decline in water use occurred in 1993, which was largely attributable to the drought that occurred from 1992 to 1993 and to major regional education efforts to remediate the situation. This, coupled with the 1994 change in the City's rate structure (with inverted-rate blocks), prevented water use from returning to pre-drought levels.

In 2009, the City again instituted a more aggressive inverted-rate block structure for Single-Family and Duplex customers and changed Multi-Family and Irrigation rates. Rate increases in subsequent years have continued to encourage conservation and impact consumption.

Although many factors contribute to the amount of water consumed, a consistent decline in water use over time indicates that water conservation measures and education do have a long-term impact.

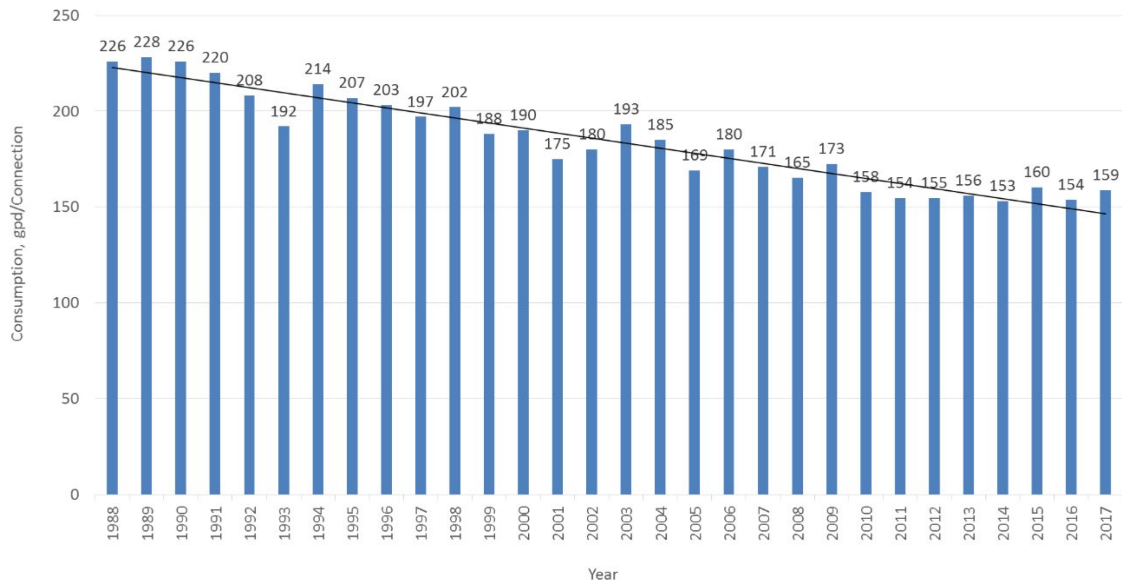


Figure 4.4 Average Annual Consumption per Single-Family Connection

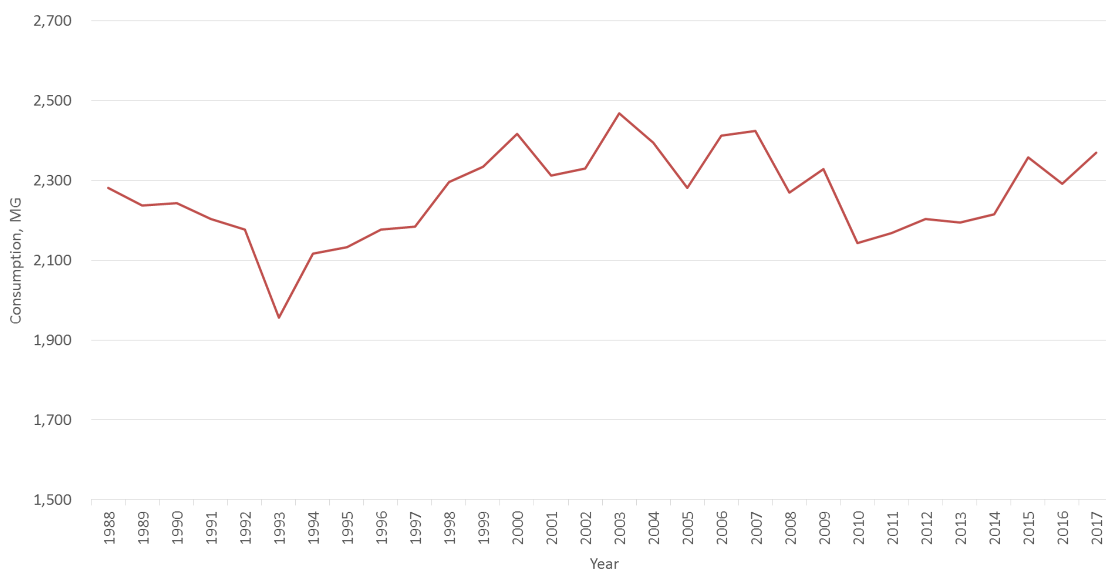


Figure 4.5 Total Consumption (1988 – 2017)

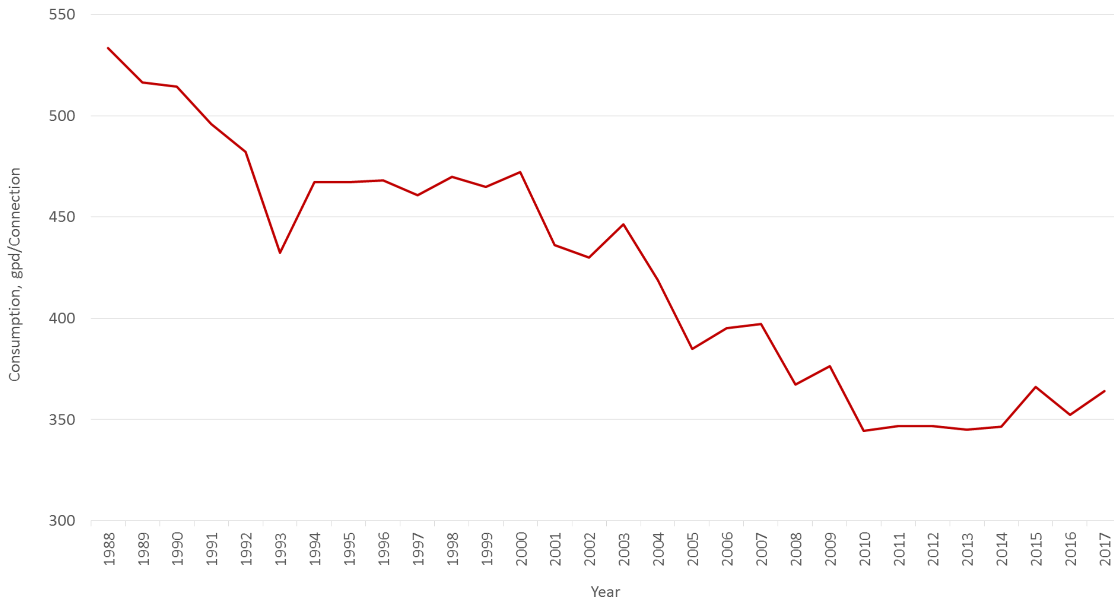


Figure 4.6 Annual Consumption per Connection (1988 – 2017)

Table 4.4 Renton Historical, Current, and Proposed Water Conservation Measures

Measure	Description	Savings	Implementation
Production Metering (M)	Annually calibrate meters on all sources	Supply Side	H C P
Consumption Metering (M)	All service connections are metered	Supply Side	H C P
Pipe Leak Detection and Repair (M)	Leak detection and pipe replacement	Supply Side	H C P
WLCAP (M)	Systematic pipe and valve leak check, repair and replacement to decrease DSL for WUE compliance	Supply Side	H C P
Household Leak Detection Kits	Available at City's Utility Office and at annual Renton River Days	Demand Side	H C P
Sprinkler Rain Gauge	Small yard gauge for measuring rain and sprinkler	Demand Side	H C
Sink Aerator	Free aerator reduces flow to 1.0-gpm	Demand Side	H C P
Water Rates (M)	Increasing block rate	Demand Side	H C P
School Outreach	Classroom presentations, currently through SWP membership	Demand Side	H C P
Utility Bill Inserts	Inclusion of conservation tips in utility bill mailing	Demand Side	H C P

Measure	Description	Savings	Implementation
Public Presentations	Presentation at fairs and workshops in Renton	Demand Side	H C P
Water Bill Consumption History	History included with all customer utility bills, waterusage.rentonwa.gov	Demand Side	H C P
Advertising	Public advertising through membership in SWP	Demand Side	H C P
Natural Yard Care Workshops	Coordinate SWP gardening classes with other utility departments	Demand Side	H C P
City Demonstration Garden	Located at Renton City Hall	Demand Side	H C P
Toilet Rebates	Rebates for single-family and multi-family toilets available through SWP	Demand Side	C P
Non-residential Appliance Rebates	Rebates for toilets, urinals, dishwashers, and other technologies available through SWP	Demand Side	C P
Sprinkler System Upgrade Rebates	Irrigation timer and custom rebates available through SWP	Demand Side	C P
Hose Gaskets	Garden hose gaskets to stop leaks	Demand Side	H C P
Web Page	Indoor, outdoor tips as well as links and kids' page	Demand Side	H C P
Showerheads	Free showerhead reduces flow to 1.5-gpm	Demand Side	C P

Note:
Abbreviations: H - historically implemented measure; C - currently implemented measure; P - implementation of measure will continue into the future; M - mandatory WUE measure; gpm - gallons per minute.

4.4.2 Current Conservation Program

4.4.2.1 Municipal Water Law

The MWL governs water conservation planning. The minimum number and type of efficiency measures a conservation program must evaluate or implement is based on the system's total number of connections. With more than 17,000 connections, the City must implement five mandatory measures and must either implement or evaluate two additional measures. These mandatory measures are detailed in Table 4.5.

The City must also evaluate or implement nine measures of its own choice. These selected measures are conducted either by the City or by the Saving Water Partnership (SWP), on behalf of the City.

The City's current conservation program was developed through a public process to support the City's WUE goals. The original objectives and goals are being carried forward to this Plan with the goal of encouraging residents to actively and instinctively conserve water.

Table 4.5 WUE Mandatory Measures

Must implement the following WUE measures:	Status
Install production (source) meters	Implemented
Install consumption (service) meters	Implemented
Perform meter calibration	Implemented / ongoing
Implement a WLCAP to control leakage if exceeds 10%	Implemented / ongoing
Educate customers about water efficiency at least once per year	Implemented /ongoing
Must evaluate or implement these WUE measures:	
Evaluate rates that encourage water demand efficiency	Implemented
Evaluate reclamation	Implemented

WUE Objectives

As part of the initial WUE compliance, the City reviewed its water system and water usage and developed four objectives for its WUE plan:

1. Identify and reduce sources of DSL.
2. Ensure efficient water supply for continued growth in the service area.
3. Reduce peak day and peak season demands.
4. Maintain the historically low levels of customer water usage.

WUE Goals

The City has defined the following measurable goals:

1. Reduce DSL to 10 percent or less by 2022.
2. Limit the maximum daily demand (MDD) to ADD peaking factor to less than 2.0.
3. Maintain an equivalent residential unit (ERU) value under 160 gpd/ERU.

As part of the SWP, the City also supports the regional 2019-2028 WUE goal to keep the total average annual retail water use of SWP members under 110 million gallons per day (mgd) through 2028 despite forecasted population growth by reducing per capita water use."

4.4.2.2 Mandatory Measures

Meters

To fulfill all mandatory measures related to meters, the City installed AMI for both production and consumption meters. These meters are calibrated and/or tested periodically. Appendix G presents the City's updated WLCAP.

Reclamation

In response to the Washington State Department of Ecology's water resource policy initiative and the DOH's 1994 Interim Conservation Guidelines, the City thoroughly evaluated the usage potential of its reclaimed water. This study, titled "City of Renton Conceptual Reuse Plan" (COR File Code WTR-09-0009), included a pilot project and long-range plan to develop a city-wide distribution system that would use reclaimed water for various uses.

Then in 1995, King County, the City, and the City of Seattle Water Department published a study titled "Water Reclamation and Reuse: A Feasibility Study for the King County Metropolitan Area." According to this study, the cost of reclaimed water service would be higher than the marginal cost of developing new potable supplies at that time under most conditions. A successful reuse project would have to serve a reasonably large demand (at least 1 mgd) and be located adjacent to a source of secondary treated effluent.

The study also noted that the King County Renton Effluent Transfer System included a 96-inch pipeline in the Duwamish Corridor with 12 taps in place for reclamation and reuse. Therefore, site-specific reuse projects along the Duwamish Corridor were suggested as the most cost-effective and promising options (detailed in a King County report titled "An Economic Analysis of the North Seattle Reclaimed Water Project").

In 2011, the King County Wastewater Treatment Division began another engineering, environmental, and economic analysis of conceptual reclaimed water strategies. The City is now working with King County to provide them appropriate information for this analysis. Appendix I includes a completed King County Water Reclamation Evaluation Checklist for this use. The checklist identifies potential reclaimed water users from the City's largest consumers.

Education

The mandatory requirement for annual customer WUE education is met through the City's annual water quality report, also known as the consumer confidence report, or CCR. This report includes annual WUE data and water conservation education advice. City customers receive a postcard in the mail which provides a link to an electronic copy of the annual report (https://rentonwa.gov/city_hall/public_works/utility_systems/water_quality_report). Customers may also contact the Water Utility and request a hardcopy of the annual reports. Other customer education measures are part of the selected measures described below.

Rate Structure

A balanced water-rate structure is an important way to encourage water conservation. The City introduced a two-tiered inverted block rate pricing structure for single-family homes and duplexes in 1994. Then in 2009, the City reevaluated and instituted changes to its rate structure by defining rates for more customer classes, offering a more aggressive inverted-rate block structure for Single-Family and Duplex customers, and adjusting Multi-Family and Irrigation rates. Rate increases in subsequent years have continued to encourage conservation. Table 4.6 shows the City's 2018 rate structure.

Table 4.6 2018 Customer Class Rates

	Rate Structure (Cost per 100 cf)
Single-family / Duplex	3-tier block rate ($2.54, $3.41 and $4.30)
Multi-family	$3.29
Non-residential	$3.48
Irrigation	$5.58
Irrigation (city accounts)	$3.92

4.4.3 Proposed Conservation Program

Based on the number of the City's connections, the WUE Rule requires the City to evaluate or implement at least nine measures of its choice that support the proposed goals, in addition to the mandatory measures described above. The nine selected measures are described below.

The City's conservation strategy has been to focus on the residential consumer, both indoor and outdoor, a strategy that has proved successful by continued savings. Most recently, emphasis has been on reducing summer peak usage, which is now a WUE goal. To lower peak consumption, the City has instituted a third tier and has increased irrigation rates.

4.4.3.1 Selected Measures

1 - Water Bill Consumption History

Current customer bills provide historical data to help educate customers of their usage patterns throughout the year, particularly to see the impact of outdoor watering. With this information, they are encouraged to make informed conservation choices and to save money.

2 - School Outreach

As part of the SWP, the City provides interactive educational experiences to Renton Elementary School students presented by Nature Vision. Presentations cover subjects such as Water Cycle Terrariums, Water Use Exploration, and more.

The City also partners with other purveyors through the SWP to produce educational materials that explain the groundwater process and promote conservation.

3 - Utility Bill Inserts

This avenue of communication is effective in delivering a focused message to customers. Once or twice per year, conservation information specifically geared toward residential customers is included with the utility bill.

4 - Natural Yard Care Workshops

The City's Water Utility department partners up with its solid waste and surface water departments to educate customers about water-efficient gardening and ways to reduce toxic chemicals in the yard and garden by hosting SWP gardening classes.

5 - Advertising and Public Outreach

The City is a member of the regional SWP, the national Alliance for Water Efficiency, and the US Environmental Protection Agency's WaterSense partnership. As a member, the City supports these organizations' missions to promote water efficiency and conservation through local, regional, and national advertising.

6 - City Demonstration Garden

At the 200 Mill Avenue South building, the City maintains a demonstration garden that features low water and low maintenance plants. The garden presents an educational viewing of well-established plants that thrive in limited water and sloped conditions.

7 - Indoor Water Conservation Giveaways

The City provides customers with free high efficiency showerheads and aerators as well as toilet leak kits. Distribution of these items also allows staff to discuss water conservation principles with residents and answer any related questions.

8 - Hose Gaskets

Replacement rubber hose gaskets are offered at community events such as Renton River Days, helping to reduce a source of common outdoor water waste. Although the annual savings cannot be qualified, the hose gaskets do contribute to summer peak reduction.

9 - Water Conservation Education Web Page

The City's water conservation web page provides information for indoor and outdoor savings and links to rebates and other resources. It also presents information for all age groups, including a "kids" page accessible to children and teachers. The City's participation in the SWP offers access to a broad set of online conservation resources that are linked on the City's web page.

4.4.3.2 Regional Conservation Participation

To help achieve its stated WUE objective to "ensure efficient water supply for continued growth within its service area," the City implemented long-range water supply planning. As part of this effort, the City evaluated alternate sources of water to meet the growing demand from the projected population growth and from development within the City's water service area.

In 2010, the Water Utility evaluated alternatives for the City to obtain additional water supply from SPU and Cascade Water Alliance (CWA) and to improve water quality in Well PW-5A. The most cost-beneficial and reliable alternative was determined to be purchasing water from SPU; thus, a contract was negotiated between the City and SPU in 2011 (CAG-11-093).

With this contract, the City became a part of the SWP, a consortium of water utilities with contracts with SPU. The SWP has created a collection of water conservation measures and technical assistance to City customers that took the City's conservation program from one geared primarily toward residential customers to one that now includes owners/managers of apartments and condos as well as industrial and commercial customers.

Table 4.7 presents the current SWP measures, rebates, and resources to be expected in 2019.

Table 4.7 Saving Water Partnership Conservation Measures and Strategies

Types of Measures	Types of Strategies
Residential Indoor	
Replace toilets, showerheads, and faucets (multi-family)	Free showerhead and aerator distribution to multifamily properties
Fix leaks (toilets)	Multi-family and single-family toilet rebates, free dye strip distribution for leak detection
Change behaviors (toilet flushes, faucet use, shower, full loads)	Multi-family building owner and operator recruiting
	Behavior messaging
	Collaboration with energy utilities
	Program recruiting through media, direct mailing, web
	Promotion of Maximum Performance (MaP) toilet performance
Residential Landscape	
Reduce peak water use	Irrigation system efficiency rebates
Landscape watering behaviors	Gardening classes

Types of Measures	Types of Strategies
Practices that affect watering (mulch, soil prep, plant selection)	Promotion of free gardening advice service - The Garden Hotline at (206) 633-0224
	Natural lawn and garden guides (how-to materials)
	Trainings for irrigation professionals
	Online weather data, watering index, irrigation scheduling tools
Commercial Process/Domestic	
Upgrade equipment efficiency for cooling process, other industrial uses	Rebates for projects that aim to reduce water usage during space cooling, refrigeration, and ice-making
	Small and large business targeting. Promotion through vendors, trade groups, and agencies.
Upgrade efficiency of specific water consuming medical and lab equipment	Outreach to businesses about water saving techniques and available rebates
Outreach to ethnic businesses	Technical assistance, assessments, workshops
Commercial Landscape	
Improve watering efficiency	Targeted outreach to large commercial customers
Upgrade irrigation equipment (controllers, rain sensors, drip)	Provide site-specific recommendations and technical assistance
Improve scheduling and maintenance	Financial incentives (custom projects and rebates)
	Targeted recruiting and promotion to large commercial customers
	Market transformation by establishing and building vendor and contractor relationships
	Online weather data, watering index, irrigation scheduling tools
	Trainings for irrigation professionals
Youth Education	
Build conservation awareness	Classroom presentations through Nature Vision, take-home materials and devices
	Educator resources online
	Support of water conservation events
Overall Messaging	
Conservation awareness supporting recruitment of residential and commercial customers	Targeted marketing
	Outreach at conservation events
Program Evaluation	
Evaluate program effectiveness	Annual reports
	Customer baseline surveys of attitudes and behaviors

Chapter 5

POLICIES, CRITERIA AND STANDARDS

5.1 Introduction

The City of Renton (City) Water System Plan (Plan) is based upon the following mission statement for all City utilities, including the City water system:

> "The City strives to protect the environment and empowers its citizens to be engaged in sustainability programs. The City manages its water system in a manner that ensures public health and safety, meets all regulatory requirements, and protects environmental resources." (Source: Renton Results – A Community Accountability Program)

The policies, design criteria, and standards used in the Plan are based on laws and policies that originate from the following sources, listed in descending order, from those with the broadest authority to those with the narrowest:

- Federal Regulations - Environmental Protection Agency.
- Washington State Regulations - Department of Health and Department of Ecology.
- King County Regulations.
- City of Renton Ordinances - City Council.
- City of Renton Administrative Policies – Mayor.
- City of Renton Comprehensive Plan.
- Department Policies - Public Works Department.
- Water System Plan Utility Policies – Utility Systems Division/ Water Utility Staff.

The City is committed to providing customers high-quality drinking water that is reliable, affordable, and meets strict safety standards. We strive to serve as responsible community stewards by upholding the City's 2021-2026 Business Plan mission to provide a safe, healthy, and vibrant community by maintaining clean and sustainable drinking water services.

The Plan includes policies, effective practices, and goals over time to improve the operation and management of the City's water supply sources and water system toward sustainability, at a pace consistent with the current and future needs of the community. These goals have been applied to the planning process of the Water System Plan Update and will continued to be implemented in current and future programs and capital projects identified in the Plan.

Law is set by the federal government through federal regulations, by the State of Washington (State) in the form of statutes: Revised Codes of Washington (RCW), Washington Administrative Code (WAC), by King County in the form of policies, and by Renton City Council (Council) in the form of ordinances and resolutions. City policies are established in order to provide a vision or mission of the Water Utility and to provide a framework for the planning, design, operation, management, and maintenance of the water system. City policies cannot be less stringent or in conflict with adopted laws.

5.2 Service Area, Policies, and Standards

The City manages its water utility and water system in accordance with established federal and state regulations for public water systems. City policies and standards set forth in this chapter provide a consistent framework for the planning, design, construction, maintenance, operation, and service of the City's water system and water supply sources. The City has additional land use, development, and finance policies that specify additional requirements for new development or redevelopment projects that require water service for domestic, fire protection, and other uses.

The City's policies are grouped into the following major categories:

- Service Area.
- Water Supply Planning and Management.
- Water Main Extension and Service Ownership.
- System Reliability and Emergency Management Plan.
- Fire Protection.
- Financial.
- Facilities.
- Organization.

5.3 Summary of Policies for Water System Plan

5.3.1 Service Area

5.3.1.1 Mission Statement

Ensure that the City's drinking water supply is safe and sufficient and that the City's infrastructure is adequate to meet our community's present and future needs for water[1].

5.3.1.2 Service Availability

The City's goal is to provide water service to all customers within the City's retail service area (RSA) in a timely and reasonable manner consistent with applicable City policies, resolutions, ordinances, the Municipal Water Law, Washington State Department of Health (DOH) rules and guidelines, and applicable federal, state, and local laws and plans[2].

The City shall serve an applicant for new service within its retail service area if all of the following conditions are met.

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

5.3.1.3 Government Consistency

Provisions of water service should be consistent with the goals, objectives, and policies of this Plan and the Renton Comprehensive Plan. This Plan will be consistent with local, county, and

[1] Sources: Renton Comprehensive Plan Goal U-N, Outcome Management for Water Utility Service Delivery Plan.
[2] Sources: WAC-246-290, Municipal Water Law, Renton Comprehensive Plan, Water System Plan.

state land use authorities and plans. Water service should be consistent with the growth and development concepts directed by the City's Comprehensive Plan[3].

5.3.1.4 Existing Water Service Area and Retail Service Area

The City's RSA (Figure 1.3 in Chapter 1) encompasses the area where the City has existing distribution mains or where distribution mains can be extended in a reasonable timeframe[4]. The City's retail service area is established in accordance with the East King County Coordinated Water System Plan and the Skyway Coordinated Water System Plan. The City also has inter-local agreements with neighboring cities and water districts to address minor adjustments of service area boundaries. In general, the City's RSA area is located within incorporated City of Renton with the exception of several very small areas within unincorporated King County. The City uses its existing service area agreements to determine areas where water service will be provided. Therefore, annexations to the City do not affect the provisions of water service.

The City's water service area encompasses the retail service area, the portion of the Skyway Water and Sewer District that is served by City of Renton water through a wholesale agreement, and the future service area described in the next section. The City's water service area is shown in Figure 1.3 of Chapter 1.

5.3.1.5 Future Service Area

The only potential changes to the City's RSA is for a small area near the westerly City limits. This area is currently served by Seattle Public Utilities (SPU) and may be served by the City in the future upon annexation. The future annexation area to be served by the City is also described in Skyway Water & Sewer District Comprehensive Plan and in the Skyway Coordinated Water System Plan.

5.3.1.6 Potential Annexation Areas

The City's potential annexation areas (PAA) boundary extends beyond the City's city limits and water service area boundary. Other water purveyors serve areas outside of the City's water service area. Due in large part to the geography of the City, it is unlikely that its water service area would be extended further beyond the existing water service area. Any new areas within the City's PAA that are annexed by the City would likely continue to be served by the other utilities currently serving them[5].

5.3.1.7 Satellite/Remote Systems

The City does not allow satellite/remote systems.

5.3.1.8 Service for Annexations without Existing Municipal Water Supplies

The City intends to provide water service to areas annexed to the City that do not have existing water service from other municipal water suppliers and water districts. Service extension by the City may be considered under such conditions only if the City's costs are recovered and sufficient financial resource is available and that service to annexations will not decrease the level of service to existing customers or increase the cost of service to existing customers[6].

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[3] Sources: WAC-246-290, Renton Comprehensive Plan Policy U-1, Water System Plan.

[4] Sources: WAC-246-290, East King County Coordinated Water System Plan, Skyway Coordinated Water System Plan, Water System Plan.

[5] Source: Renton Comprehensive Plan, Water System Plan.

[6] Source: Renton Comprehensive Plan Policy U-5, Water System Plan.

5.3.1.9 Service for Annexations with Existing Municipal Water Supplies

The City will not provide water service to areas annexed to the City that are already served by other existing municipal water suppliers or water districts. Areas annexed with existing municipal supply must meet the City water utility standards[7].

5.3.1.10 Service for Protection of Public Health

The City will allow extension of water service without annexation to areas outside of the City limits when such areas are within the City's water service area, or when no other reasonable service is available, and it is determined by the City and/or by DOH that a public health emergency exists or is imminent[8].

5.3.1.11 Conditions for Service to Properties with Existing Private and or Exempt Wells

The City will provide water service for domestic and for fire protection to properties within the City water service area that have existing private wells and/or exempt wells subject to the following conditions:

1. All "exempt" wells and private wells on the property must be decommissioned in accordance with Washington State Department of Ecology (DOE) standards and regulations, except when such wells can be used by the City for purposes including but not limited to: water supply, water supply mitigation, resource protection, environmental monitoring, or remediation of contamination.
2. All water rights, permits, or certificates must be deeded to the City if the type of use is municipal, community, or domestic. Any associated source(s) must either be decommissioned or deeded to the City, at the discretion of the City. Water rights, permits or certificates, for which the type of use is irrigation, industrial, or agricultural may be retained if the proposed land use is consistent with the type of use listed on the water right. If the proposed land use is not consistent with the type of use listed on the water right, then the water right must be deeded to the City; and any associated source(s) must either be decommissioned or deeded to the City, at the discretion of the City.

5.3.1.12 Requests for Assumption by Water Districts or Private Water Systems

The City may assume the operation of a water district or private water system at their request if the following conditions are met and subject to the approval of the Council[9]:

1. The district or private system is adjacent to or within the City's water service area.
2. The district's or private system's facilities meet the City's performance criteria and engineering standards, or a plan is in place to assure that they will be brought up to Renton's standards without adversely impacting the City's existing customers financially or with regard to level of service.
3. The assumption of the district or private system is permitted by State law.
4. The City shall require that the district or private system to transfer the ownership of its water supply sources and associated water rights to the City. Water rights must be

[7] Source: Water System Plan.
[8] Source: RCW, Water System Plan.
[9] Source: RCW, WAC, Water System Plan.

successfully transferred to the City and approved for municipal water use by the DOE prior to commitment from the City for water service.

5.3.1.13 City Initiated Assumption of Water Districts or Private Water Systems

The City will seek to assume the operation of a water district when the Council determines that the assumption is in the best interest of the City and the assumption is consistent with the City's Comprehensive Plan. The City will follow State laws and guidelines in assuming portions of adjacent water systems as a result of annexations[10].

5.3.1.14 Wholesaling Water

The City will continue to provide wholesale water to Skyway Water and Sewer District through a single metered connection in accordance to the current wholesale water supply agreement between the City and the District. The City is not planning to provide additional water to the District above the quantity identified in the existing wholesale agreement. The City has no plans to sell water wholesale on a long-term basis to any other purveyor. Sales of water for short term basis will be evaluated on a case by case basis. Current service agreements are included in Appendix D.

5.3.1.15 Wheeling Water

The City does not currently wheel water. Water chemistry compatibility and its effects on water quality, including aesthetics such as taste and odor would be a primary consideration. The City will evaluate any request for wheeling water on a case by case basis.

5.3.1.16 Water Service to Properties in King County and within Renton Retail Service Area

As a result of numerous annexations to the City up to 2018, there is one developed area that is within the City's RSA and within unincorporated King County, which could be served by the City. The City currently serves three areas outside of its RSA: Skyway area, Cedar Rim Apartments in Newcastle, and the commercial area in Tukwila near 17900 West Valley Hwy. For these areas the City has adequate existing infrastructure and is providing water service to all existing residences within this area known as the Sierra Heights Division 3 and 4 and the Western Hills subdivisions.

For any new development or redevelopment projects within the above unincorporated King County and within the City's RSA, the City intends to provide "timely and reasonable water service" consistent with State Law RCW 19.27.097.

For all new development and redevelopment projects and building permit applications requiring a "King County Certificate of Water Availability", the City typically processes and issues the requests for water availability within one week of our receipt of the applicants' written requests. Developers' extensions of water mains will be required to provide water service for domestic and for fire protection to all new development and redevelopment projects. The City typically reviews the civil plans for water main extensions within 3 weeks of our receipt of the plans and the plans are approved as soon as our review comments have been addressed. The City also coordinates with King County to assure that all county road permits are obtained and that all fees are paid to the county for plan review and for inspection of the roadway restoration related to the construction of the water lines within the county roads.

[10] Source: RCW, WAC, Council Discretion, Renton Comprehensive.

The City charges a higher water commodity rate to customers that are outside of the City limits and within the City's RSA, at 1.5 times the inside City Limit water rate[11]. The higher rate is necessary for the City to recover additional costs incurred for obtaining King County right-of-way permits for the installation, maintenance, repair of water mains, water service lines, hydrants and related appurtenances within the county roads. The City must also relocate its water mains at its own cost, when directed by King County under franchise agreement to accommodate future County roadway improvement work and the roadway overlay program.

5.3.2 Water Supply Planning and Management Policies

5.3.2.1 Water Supply Planning

It is the City's goal to have system-wide reliable supply sources, treatment, pumping and storage facilities to meet the current and projected maximum daily demand (MDD) – with the largest source out of service[12]. The City will work cooperatively with adjacent purveyors to assure reliable water supply at the lowest environmental and economic cost.

The City will pursue additional and/or new water supply and use water conservation, water use efficiency (WUE) measures and water reuse programs to ensure adequate water supply needs to meet the essential needs of the community and water demand created by growth targets established through the Growth Management Act (GMA) planning process.

Adequate supply is enough water to meet normal peak day demands of the City's customers. Peak day demand includes the effects of drought and curtailment. As time passes, normal demand is expected to decrease on a per household basis for two reasons. First, average household size is expected to decline, reducing the number of water users per house. Second, continued efforts to use water wisely by all customers will reduce demand. The City intends to take a cautious approach toward demand reductions that result from behavioral changes, which will not be considered permanent. Alternately, structural improvements (e.g., low-flush toilets, low-flow shower heads, or other water-saving devices) will be considered permanent reductions in demand. The City supports efficient use of water. The City supports eliminating the "waste" of water[13]. The City has adopted rates to achieve these objectives.

The quantity of water at the source shall: (1) be adequate to meet the maximum projected water demand of the RSA as shown by calculations based on the extreme drought of record; (2) provide a reasonable surplus for anticipated growth; (3) be adequate to compensate for all losses such as silting, evaporation, seepage, etc.; and (4) be adequate to provide ample water for other legal users of the source[14].

5.3.2.2 Regional Water Supply Planning

The City will participate in regional water supply management and planning activities. The City will monitor legislative, regulatory, litigation, and planning activities that may impact or influence the adequacy or reliability of supply[15].

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[11] Source: City Ordinance 4461, Renton Municipal Code 8-4-32(A).

[12] Source: WAC 246-290-222, Renton Comprehensive Plan Goal U-C and Policy U-11.

[13] Sources: City Ordinance 1437, Renton Municipal Code 8-4-23, Renton Comprehensive Plan Policies U-6 and U-8.

[14] Sources: WAC 246-290-420, WAC 246-290-200, RCW 19.27.097, RCW 58.17.110, Renton Comprehensive Plan Policies U-9 and U-10, Water System Plan.

[15] Source: Council and Administration Discretion.

5.3.2.3 Water Supply and Resources Management

The City will practice and support water resource management that achieves a maximum net benefit for all citizens and promotes enhancement of the natural environment[16].

The City operates and monitors its water supply sources to ensure compliance with all conditions and withdrawal quantities limits for total annual withdrawal quantity and for instantaneous withdrawal quantity, established under State issued water rights certificates and permits[17]. The City will continue to monitor the pumping of its wells to allow aquifer recovery and to avoid impacts to in-stream flows for the Cedar River.

The City has installed flow control/throttling valves and flow metering equipment on its well pumps to monitor instantaneous pumping rates and total pumping rates. The controls are set up so that the well pumps cannot exceed their individual and total instantaneous flow rates established under the water rights certificates and permits issued by the DOE. If the demand calls for additional water, the controls are set up so that the City will receive additional water through the intertie with SPU's 60-inch Bow Lake pipeline, and if needed through two other interties with SPU at Tiffany Park and Fred Nelson pump stations[18].

5.3.2.4 Reclaimed Water Use

The City will support the regional supplier's study of reclaimed water use opportunities and will work with King County Department of Natural Resources to identify potential reclaimed water users and demand. Any reclaimed water to be used as a source of supply should only be provided through regional water suppliers. The City has identified several potential users of reclaimed water for landscape irrigation uses, including the Boeing Longacres facilities[19].

5.3.2.5 Conservation and Water Use Efficiency

The City will actively continue to promote voluntary conservation and the wise use of water and implement a water conservation program and measures consistent with the requirements of the DOH. The City will cooperate with SPU to regional conservation goals[20]. The City has implemented a water rate structures promoting conservation such as, residential inverted block rate and higher commodity rate for commercial and multifamily irrigation.

In 2015, the City completed the deployment of an Advanced Metering Infrastructure (AMI) system, which enhances the City's water conservation activities and optimizes the pumping of its water supply wells[21].

The City has adopted the following WUE goals:

- Reduce distribution system leakage to 10 percent or less by 2022.
- Limit the MDD to average day demand (ADD) peaking factor to less than 2.0.
- Maintain an equivalent residential unit (ERU) value under 160 gallons per day (gpd) per ERU.

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[16] Source: Renton Comprehensive Plan Policy U-16.
[17] Source: Renton Comprehensive Plan Policy U-11.
[18] Source: Municipal Water Law, Water System Plan, Water Rights Certificates and Permits.
[19] Source: Municipal Water Law, Water System Plan.
[20] Source: Renton Comprehensive Plan Policy U-17.
[21] Source: WAC 246-290, Water System Plan, WUE Goals.

5.3.2.6 Water Shortage Response Plan

The City maintains and updates a local response plan in case of a water supply shortage caused by a drought or supply interruption. The City will implement necessary water conservation measures to avoid curtailment in all but the most exceptional circumstances. The Mayor and/or Council are empowered to declare an emergency and to carry out the necessary actions to ensure compliance with the Water Shortage Response Plan[22].

5.3.2.7 Emergency Interties

The City has emergency interties with adjacent water systems for short-term emergency uses. The City will evaluate requests for emergency interties on a case by case basis and shall support emergency interties with adjacent systems if they benefit both providers and if they don't compromise the City's ability to serve its existing customers or its future supply needs.

5.3.2.8 Water Quality

The City shall operate and manage the system to provide water quality that meets or exceeds all health requirements. The City will take steps to meet or exceed all water quality laws and standards. The City will take all reasonable measures to ensure that water reaching the point of delivery, the customer's meter, meets all water quality standards. The City shall continue to maintain and upgrade its system to provide the best water quality and service[23]. The City shall submit Monthly Water Quality Reports to DOH.

5.3.2.9 Cross Connection Control

The City shall administer a cross connection control program that protects the City's public water supply and users of the public water supply from backflow contamination in accordance with State law and to the DOH regulations and guidelines. The City has an established cross connection control program and related ordinances and procedures to implement the program. The City shall submit an Annual Summary Report to the DOH[24].

5.3.2.10 Wellhead Protection Program

In conjunction with Plan development, the City updated its Wellhead Protection Plan that will be reviewed by the DOH along with this Plan. Updates of the plan are described in Appendix J of this Plan. The Wellhead Protection Plan will be reviewed and updated, if necessary, in conjunction with the Plan update.

5.3.2.11 Aquifer Protection Program

In 1998, the City established an Aquifer Protection Program and adopted ordinances, policies, standards, and regulations for existing and new development within the City's aquifer protection areas (APAs) to protect the aquifers from potential contamination by hazardous materials[25]. The City shall continue to provide outreach and training to facilities within the APAs.

The City is in the process of updating the program: 1) update APA zones to reflect our capture zone delineations, 2) will be performing site surveys at facilities within the APA zones that store/use hazardous materials, 3) provide outreach and training for aquifer protection."

[22] Source: WAC 246-290, Water System Plan.

[23] Sources: USEPA, Safe Drinking Water Act, Council Discretion, WAC 246-290-310, WAC 246-290-135. Renton Comprehensive Plan Policy U-13.

[24] Sources: WAC-246-290-490, Water System Plan.

[25] Sources: Renton Comprehensive Plan Policy U-18, City Ordinances 4851, 4992, 5478.

5.3.3 Water Main Extension and Service Ownership

5.3.3.1 Orderly Extension of Utilities

All utilities within the City will be extended in an orderly manner, in and along routes which comply with the City's Comprehensive Plan and Water System Plan. All City utilities will be extended and installed in a manner as to best serve the citizens of Renton[26].

5.3.3.2 Extension across Full Frontage of Properties

All water main extensions shall extend to and across the full width of the property served with water. No property shall be served with City water unless the main is extended to the extreme boundary limit of the property line extending the full length of the front footage of the property. Provisions shall be made wherever appropriate in any project for looping all dead end or temporary dead end mains. Provisions for stubs shall be made to serve adjacent properties[27].

5.3.3.3 Sizing of Water Mains

All water mains shall be sized based on fire flow requirements, and densities/land uses anticipated in the City's Comprehensive Plan and Water System Plan. A hydraulic analysis is required to confirm adequate system design. The analysis shall be used to verify flow demands and pressure availability for the proposed project. The analysis shall demonstrate the effect the proposed project will have on the existing distribution system. The hydraulic analysis shall include, as a minimum, the following:

1. Under peak hour demands (excluding fire demands), the water distribution system shall maintain pressures above 30 pounds per square inch (psi) at the service meters.
2. Under maximum day demand plus fire demands, the water system shall maintain pressures above 20 psi at the service meters.
3. Velocity in any water main shall not exceed 8 feet per second (fps) under any condition.
4. Water system layout shall be designed to minimize dead ends. Looping water lines is a standard practice to eliminate dead ends.
5. The minimum size of water mains with fire hydrants in a residential area shall be 8-inch diameter. Short segments of smaller mains may be allowed for water quality reasons provided that fire flow requirement can be met through other larger mains.
6. The minimum sizing for water mains with fire hydrants in the City's Central Business District, Urban Center, Commercial and Industrial Corridors, and Sunset Reinvestment Strategy Area shall be 12-inch diameter or larger depending on fire flow demands[28].

5.3.3.4 Requirements for Looping of Water Mains

When the required fire flow for a development is over 2,500 gallons per minute (gpm), the fire hydrants shall be served by a water main that loops around the building (or complex of buildings) and reconnects back into a distribution supply main. All fire hydrants shall be served by a municipal or quasi-municipal water system, or as otherwise approved by the Renton Regional Fire Authority (RFA)[29].

[26] Source: City of Renton Resolution 2164, Renton Comprehensive Plan, Water System Plan.
[27] Sources: City Ordinances 3541, 2849, Renton Development Regulations 4-6-010, Water System Plan.
[28] Sources: Renton Development Regulations, Water System Plan, DOH Water System Design Manual.
[29] Sources: City Ordinance 4007, Renton Development Regulations, Water System Plan.

5.3.3.5 Design of Water Main Extension

All water main extensions must be designed by a professional engineer, registered with the State, and shall conform to the latest City design criteria, development regulations, other City adopted standards, and sound engineering practices.

Plans must be submitted to the City for review and approval prior to the issuance of utility construction permits. Plan review fees shall be paid to the City at the time of the submittal of the plans. All water mains shall be sized based on fire flow requirements, densities/land uses anticipated in the City's Comprehensive Plan and Water System Plan[30].

5.3.3.6 Construction of Water Main Extension

All extensions of City water mains and related appurtenances must be constructed by a licensed and bonded contractor, or by City forces, and shall conform to the latest City construction and development regulations and standards and other City adopted standards and approved project civil plans. The applicant/owner/developer/contractor must pay all permits fees and related charges, obtain the required permits, and construct the new water mains, at its own costs[31].

5.3.3.7 Oversizing of Water Main Extension

The City reserves the right, upon the approval of the Council, to participate in the installation of any oversized water line extensions or additional water or extra improvements related to such installations. In general, subject to Council's approval, the City may pay for the difference in material costs between the required main sized and the larger main size[32].

5.3.3.8 Water Main Extension - Exception

The City may defer compliance with Renton water utility standards in the case of temporary or emergency water service. All temporary and emergency waivers must be approved by the Public Works Administrator[33].

5.3.3.9 Water Service and Water Meter Ownership/Responsibility

The City shall own and maintain the service line from the main line to the meter, the meter and setter, and the meter box. The property owners shall own and maintain the private water service line and other facilities such as pressure-reducing valves, backflow prevention assemblies, etc. beyond the City's water meter. For fire sprinkler systems, the City's ownership will end at the connection point or connecting valve to the water main. The City shall own the detector meter on the backflow prevention assembly[34].

5.3.3.10 Requirement for Water Meters

Any person desiring to have premises connected to the City water system shall make application for water meters and pay all required fees. All fire sprinkler systems connected to the City water system shall have meters or detector-meters and shall have required backflow prevention assemblies. New water meters, additional water meters, larger water meters, landscape

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[30] Sources: Renton Comprehensive Plan, Water System Plan, City Development Regulations.

[31] Sources: Renton Comprehensive Plan, Water System Plan, City Development Regulations.

[32] Sources: City Ordinance 2434, Renton Comprehensive Plan, Water System Plan, Development Regulations.

[33] Source: Water System Plan.

[34] Sources: City Development Regulations, Water System Plan, Water Standard Details.

irrigation meters, fire protection meters and detector meters, will trigger water system development charges[35].

5.3.3.11 Water Main Extension by Developers

All water main extensions including fire hydrants, valves, water services stubs, meters, and related appurtenances, with the exception of private fire sprinkler lines and systems, shall be conveyed, at no cost, to the City for ownership, maintenance and operations, after the City's acceptance of the water main extensions. As-built plans, easements and bill of sales shall be provided to the City for the conveyance of the water mains, hydrants, water meters, and related appurtenances.

5.3.3.12 Latecomer Agreements

The City has discretionary power to grant latecomer's agreements to owners and developers for pro rata portion of the original costs of water main extensions. The authority to approve a latecomer's agreement is vested in the Council. The latecomer's agreement can be granted for a period up to but not exceeding 15 years and no term extension will be granted[36].

5.3.4 System Reliability and Emergency Management Plan

5.3.4.1 Service Reliability

The City has built in redundancies in the operation and in the construction of capital improvements of its water system, including reservoirs, pumps, pressure reducing stations, and transmission and distribution mains, to maintain service reliability. The City has water system interties with SPU and emergency interties with neighboring water purveyors to provide water service during emergencies. All new water facilities added to the system that require electrical power shall be provided with backup emergency electrical power with automatic start and automatic transfer to and from commercial power. The power source may be an electrical generator or storage batteries. Existing facilities requiring electrical power that do not have on-site emergency electrical power with auto-start / auto transfer shall have such capabilities added as part of the Capital Improvement Plan (CIP) within the next 10 years.

Emergency backup power for sources and booster pump stations (BPSs) shall be capable of operating at full load without being refueled for at least 36 hours. Battery backup power for Supervisory Control and Data Acquisition (SCADA) Remote Telemetry Units (RTUs) and Master Telemetry Units (MTUs) shall be capable of providing power for at least 8 hours of continuous operation without needing a recharge or replacement.

Wells and BPSs that do not have emergency power with automatic start and automatic transfer to and from commercial power are not considered reliable, because they cannot be relied upon to provide water during a fire. If at some time in the future installed storage is adequate to meet fire flow demands, then this policy could change.

Each BPS shall be equipped with redundant, reliable pumps so as to meet the MDD with only reliable pumps and the largest pump serving the pressure zone out of service[37].

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[35] Sources: Municipal Water Law, City Ordinances, City Development Regulations, Water System Plan.

[36] Sources: City Ordinance 4443, Renton Municipal Code 9-5.

[37] Sources: WAC 246-290-420, DOH Water System Design Manual, Council Discretion, Water System Plan.

5.3.4.2 Emergency Preparedness

The City has an adopted Comprehensive Emergency Management and Hazard Mitigation Plan developed in accordance with Federal Emergency Management Agency (FEMA) standards, to address issues related to continuity of water service, long-term system recovery and to ensure the orderly and full restoration of the water system after an emergency. The City is continually updating its Water System Emergency Response Plan as part of its operations program, and as new facilities are brought into operation.

5.3.4.3 Vulnerability Assessment

The City has completed a Security Vulnerability Assessment of its water system in compliance with the Public Health Security and Bioterrorism Preparedness Act of 2002 as directed by United States Environmental Protection Agency (USEPA). The City has phased in the design and construction of the recommended security upgrades as part of the CIP[38].

5.3.4.4 Multiple Sources of Supply

The City will develop supplies that, when combined, meet the DOH demand criteria. The City will maintain and execute data collection strategies and record keeping procedures that quantify the average day and peak day demands of each customer class. The City will develop reliable supplies that meet the anticipated MDD (based on customer demand patterns, weather, and growth) with the largest of the supply sources not included[39].

5.3.5 Fire Protection Policies

5.3.5.1 Fire Protection Responsibility

The City shall continue to maintain and upgrade its water system infrastructure to deliver adequate water for fire protection to all residential, commercial, industrial customers, schools and other public facilities served with City water[40]. The City shall continue to perform routine maintenance on all of its fire hydrants and valves to keep them in working order. The City shall continue to replace its old and undersized water mains with adequate size mains to provide the required level of fire protection.

5.3.5.2 Fire Flow Requirements for New Construction

New development, redevelopment, subdivisions, and tenant improvements projects within the City will be required to provide the minimum fire flow requirements as established by Renton RFA. It is the developer's responsibility to install, at its own cost, all water system facilities including off-site and on-site main line extensions and upgrades to meet the required fire flow demand and applicable City's development regulations and standards. If the off-site improvements result in regional benefit, the developer may request the City to cost participate in the construction of the improvements. If the off-site improvements benefit other adjacent properties, the developer may request a latecomer agreement to recoup equitable costs from future development of properties within the latecomer boundary which can benefit from the improvements.

[38] Source: WAC 246-290-221, -222, -230 & -235, DOH Water System Design Manual.
[39] Source: RCW 90.54.180, 90.42.005, WAC 246-290-420, Comprehensive Plan Policy U-11, Water System Plan.
[40] Source: Renton Comprehensive Plan Policy U-12.

5.3.5.3 Fire Flow Requirements for Existing Construction

Existing structures are not required to upgrade the City's water system infrastructure to meet current fire flow and development standards. Redevelopment of existing structures, including remodeling, expansions, additions, change of occupancy and use can trigger the requirements for upgrades to the water system. The City is not obligated to upgrade existing system to meet current codes. As part of its CIP the City continues to systematically replace its old and undersized water mains to bring them to current standards with a goal to provide a minimum fire flow of 1,000 gpm (at 20 psi residual pressure), and to install fire hydrants at 500 feet spacing, throughout the distribution system.

5.3.5.4 Fire Flow Quantity

The minimum fire flow requirements for one- and two-family dwellings having a fire flow calculation area that does not exceed 3,600 square-feet shall be 1,000 gpm for 1 hour at 20 psi residual pressure. Fire flow requirements for one- and two-family dwellings larger than 3,600 square-feet shall be at least 1,500 gpm for 2 hours and shall be determined by the Renton RFA[41].

The baseline fire flow requirement for multi-family, commercial, and industrial buildings is 3,000 gpm for 3 hours. Fire flow quantities and fire flow durations above this baseline shall be determined by the Renton RFA.

5.3.5.5 Fire Flow Storage

The City's fire flow storage policies are described in the Facilities Policies Section 5.3.7.

5.3.5.6 Fire Hydrants

All fire hydrants shall be equipped with Storz adapters on the pumper ports.

All fire hydrant feed lines shall be equipped with gate valves (foot valves).

The minimum size of feed lines to fire hydrants shall be 6-inch diameter. Fire hydrant lines over 50 feet long shall be 8-inch diameter.

5.3.6 Financial Policies

5.3.6.1 Fiscal Stewardship

The Water Utility will follow financial policies and criteria adopted by the Council. Water Utility funds and resources shall be managed in accordance with applicable laws, standards, City financial and fiscal practices and policies. The financial criteria include rate stabilization, establishment of fund balance and operating reserves, maintaining the desired debt service coverage.

5.3.6.2 Enterprise Fund – Self-Sufficient Funding

The Water Utility shall be operated as a self-supporting enterprise fund. Revenues to the Water Utility primarily come from customer charges from water sales, system development charges, plan review and inspection fees. Detailed information on the City's financial program are presented in Chapter 10[42].

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[41] Sources: Renton Municipal Code 4-5-070(C), International Fire Code Appendix B.

[42] Source: Council Discretion, Water System Plan.

5.3.6.3 Rate Stabilization

The City's financial goal is to minimize and stabilize the long-term, life-cycle cost of service. Rates and additional charges shall be cost-based to recover current, historical, and future costs associated with the City's water system and services[43].

5.3.6.4 Operating Reserve

An operating reserve provides a liquidity cushion. It protects the financial viability of the utilities from the risk of short-term variation in revenues and expenses – primarily caused by seasonable fluctuations in billing, unanticipated operating expenses or lower than expected revenue collections. Target funding levels are generally expressed in number of days' operating and maintenance (O&M) with the minimum requirement varying with the expected risk of unanticipated needs or revenue volatility. Industry practice ranges from 30 days to 120 days of O&M. The City's goal (used in the financial analysis – see Chapter 10) is to stabilize the Water Utility funds and maintain an operating reservoir of 24 percent annual operating expenses for operation of the water system for 90 days. This is also consistent with the City's latest rate study.

5.3.6.5 Debt Service

The City's goal is to maintain a desired reserve for debt service coverage of 1.25 times the annual financial obligations[44].

5.3.6.6 Bonds vs. Cash Expenditures

- All non-CIP shall be paid for by rates.
- All system reinvestment, maintenance, replacement and rehabilitation projects shall be paid for by rates.
- CIP projects for new infrastructure to accommodate growth or to increase system capacity can be paid for using bonds[45].

5.3.6.7 Comprehensive Planning

Comprehensive plans for water systems should be updated every 10 years, using a 20-year or greater planning horizon, as required by State law and financial policies shall be reviewed and updated as needed. The City has a 6-year CIP which is updated with each biennial budget cycle.

5.3.6.8 Equitable Rates

The City's rates and charges shall be equitable to recover costs from customers commensurate with the benefits they receive and to provide an adequate and stable source of funds to cover the current and future cash needs of the City Water Utility. Rates shall be developed using the cash basis to determine the total revenue requirements of the Water Utility. Rates should be calculated for the service area as a whole[46].

5.3.6.9 Outside-City Rates

For customers residing outside the city limits, water rates are 1.5 times the residential city rates[47].

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[43] Source: Council Discretion.
[44] Source: Council Discretion.
[45] Source: Council Discretion.
[46] Source: Council Discretion, Water System Plan.
[47] Sources: Council Discretion, City Ordinance 4461, Renton Municipal code 8-4-32(A).

5.3.6.10 Discounted Rates

The City shall provide a senior and/or disabled citizen discount on City water rates[48].

5.3.6.11 Other Fees and Charges

Owners of properties that have not been assessed or charged an equitable share of the cost of the City's water system shall pay, prior to connection to the system, one or more of five charges:

1. System development charge.
2. Special assessment charge.
3. Latecomer's fees.
4. Inspection/approval fees.
5. Water meter installation fees[49].

5.3.6.12 Ancillary Charges

Customers should be charged for supplemental, special purpose services through separate ancillary charges based on the cost to provide the service. Ancillary charges create more equitable fees and increase operating efficiency for services to customers. Revenue from ancillary charges should be used to offset operations and maintenance costs[50].

5.3.6.13 Inflation Rate

The inflation rate should be based on information provided by the Finance Department.

5.3.7 Facilities Policies

5.3.7.1 System Pressure

The existing facilities will be operated and new facilities constructed to ensure compliance with DOH and Insurance Services Organization (ISO) criteria for maximum and minimum pressure. The City will provide the minimum water pressure requirement established by DOH at 30 psi at the service meter during MDD and during peak hour demand conditions, not including a fire or emergency.

The City's goal is to provide a minimum of 40 psi at the highest domestic water plumbing fixture or at the highest fire sprinkler head, except during emergency conditions.

The City's goal is also to provide a maximum of 110 psi at the service meter to prevent over pressurization of water uses fixtures and appliances. Current building codes require the installation of individual pressure reducing valves (PRVs) by property owners beyond the water meter where system pressures exceed 80 psi.

During a failure of any part of the system, the maximum pressure shall not exceed the normal pressure rating of the pipe, generally 150 psi[51].

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[48] Sources: Council Discretion, Renton Municipal Code 8-4-31(C).
[49] Source: City Development Regulations.
[50] Sources: Council Discretion, Water System Plan.
[51] Source: WAC 246-290-230, Insurance Services Organization (ISO), Council Discretion, Water System Plan.

5.3.7.2 Velocity

The existing facilities will be operated and new facilities constructed to minimize damage from excessive pipeline velocities. When adding to the distribution system or replacing components of the distribution system, water mains shall be sized such that:

- Under normal conditions, the velocity of water in a transmission main shall be less than 4 fps during demand periods.
- Under emergency conditions, such as a fire, the velocity of water in a transmission main shall be less than 8 fps. Fire flow planning and modeling will use a de-rating procedure that limits fire flow velocities to 8 fps[52].

5.3.7.3 Storage

The existing storage facilities will be operated and new storage facilities constructed to comply with DOH criteria and good engineering practice. Storage within the distribution system must be of sufficient capacity to supplement transmission supply when peaking demands are greater than the source pumping capacity (equalizing storage) and still maintain sufficient storage for a fire or other emergency condition. Equalizing, fire suppression, and stand-by storage are provided in addition to operational storage.

Location of storage facilities should be in areas where they will satisfy the following requirements:

- Minimize fluctuations in system pressure during normal demands.
- Maximize use of the storage facilities during fires and peak demands.
- Improve the reliability of the supply for the water system[53].

Equalizing Storage

The bottom of the equalizing storage component must be located at an elevation which produces no less than 30 psi at all service connections throughout the pressure zone under peak hour demand conditions, assuming all sources are in service. Equalizing storage requirements shall be determined using the following equation:

ES = 150 min x (PHD – MDD)

Where

ES is equalizing storage volume.

PHD is peak hour demand and is calculated based on maximum day diurnal curves developed for each operational area, and MDD is maximum day demand.

The analysis shall compare the cost of designing and constructing storage versus the cost of purchasing wholesale water from SPU, including the cost of upgrading and / or adding intertie connections to the SPU transmission mains.

Fire Suppression Storage

For fire flow supplied via gravity storage, the bottom of the fire suppression storage component shall be located at an elevation which produces no less than 20 psi at ground level at all points in

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[52] Source: DOH Water System Design Manual, Renton RFA, ISO, Council Discretion, Water System Plan.
[53] Source: WAC 246-290-235, Council Discretion, Water System Plan, Renton RFA.

the zone under peak hour demand condition, assuming the largest source or booster pump to the zone is out of service.

The fire suppression storage criteria available from the ISO were considered in the study. The quantity of fire flow storage provided will approach these requirements as closely as possible, considering economic factors and other design criteria.

Sufficient storage for a fire condition is the product of the fire protection water demand and the required duration as determined by Renton RFA.

Standby Storage

The stand-by storage component or the fire suppression storage component, whichever volume is smaller, can be excluded from the zone's total storage requirement (also known as "nested" storage) provided that the elevation of the bottom of effective storage is no less than that elevation which produces 20 psi at the meter at all points in the zone under peak hour demand conditions, assuming the largest source or booster pump to the zone is out of service.

The calculation of the standby storage volume requirements shall use the following equation:

SS = 200 gallons/ERU

Where

SS is standby storage volume

ERU is the number of equivalent residential units in the zone

5.3.7.4 Pipelines and Water Services

New water transmission and distribution pipelines and facilities shall be designed and constructed to comply with DOH criteria, American Water Works Association (AWWA) standards, the City's latest design criteria, and good engineering practice.

Where possible, transmission and distribution mains shall be looped to increase reliability and decrease head losses. The preferred pipe material for distribution mains is ductile iron.

In residential areas, the grid of distribution mains shall consist of ductile iron mains at least 8 inches in diameter. In commercial, industrial, Central Business District, and other areas with high fire flow demand, the grid of the distribution system shall consist of 12-inch or larger ductile iron mains. All 6-inch and smaller dead-end mains shall terminate with a blow-off assembly.

All 8-inch and larger mains shall terminate with a fire hydrant.

Distribution system design assumes that only adequately sized service lines will be used. All residential service lines will be copper and 1-inch or larger in diameter. The meter shall be minimum 3/4-inch by 5/8-inch with adapters to fit a 1-inch meter setter. In all other cases, the service line from the main line to the meter shall be the same size as the meter.

All water service lines shall conform to the plumbing code. Connections to the system shall comply with the City's cross connection control standards (Appendix L). In general, the standard protection for commercial and industrial connections is the use of reduced pressure backflow assemblies (RPBAs).

Valve installations shall meet the following criteria:

- Zone valves shall be located at all pressure zone interfaces to allow future pressure zone re-alignment without the need for additional pipe construction.
- Isolation valves shall be located wherever necessary to allow individual pipelines to be shut down for repair or installing services. Four valves shall be provided per cross, and three valves per tee.
- Isolation valves should be spaced along water mains at intervals not to exceed 400 feet.
- Air/vacuum release valves shall be placed at all high points or "crowns" in all pipelines.
- Individual PRVs are recommended where the service connection pressure exceeds 80 psi, in accordance with the UPC. Individual PRVs must be installed on the customer's property downstream of the water meter and the customer is responsible for the proper operation and maintenance of the PRV. The PRVs protect customers from high pressures in the case of failure of a pressure-reducing station.
- Check valves are recommended for all service lines in the City. Check valves prevent hot water tanks from emptying into the transmission main when the main is empty and prevent contamination of the system mains due to possible cross connections in the customer's service. Meter setters equipped with check valves are required by the City on all new customer service lines.

5.3.7.5 Booster Pump Stations

The existing booster facilities will be operated and new booster facilities constructed to comply with DOH criteria and good engineering practice.

All existing and future booster stations should be modified/constructed to comply with the following minimum standards:

- All structures should be non-combustible, where practical.
- All buildings should have adequate heating, cooling, ventilation, insulation, lighting, and workspaces necessary for on-site operation and repair.
- Underground vaults should be avoided where possible due to the increased potential of flooding, electrocution, and other hazards.
- Sites should be fenced to reduce vandalism and City liability where appropriate.
- Each station shall be equipped with a flow meter and all necessary instrumentation to assist personnel in operating and troubleshooting the facility.

Emergency power capability (auto-start/auto-transfer) shall be provided to each BPS. Booster stations should be placed wherever necessary to fulfill the following criteria:

- Provide supply redundancy to a pressure zone.
- Improve the hydraulic characteristics of a pressure zone.
- Reduce the cost of water supply.
- Improve water quality (i.e., increase circulation)[54].

5.3.7.6 Pressure Reducing Stations

The existing PRV facilities will be operated and new PRV facilities constructed to comply with DOH criteria and good engineering practices.

[54] Source: WAC 246-290-200, DOH Water System Design Manual, Water System Plan.

All PRVs should be placed in vaults that are large enough to provide ample work space for field inspection and repair of the valves. Vaults should be tall enough to allow operating personnel to stand erect. Vaults should drain to daylight or be equipped with sump pumps to prevent vault flooding.

Each PRV station shall have a larger main (lead) PRV for fire flow demand and a smaller (lag) PRV for anticipated domestic demand. The smaller (lag) PRV shall have a meter connected to the telemetry/SCADA system.

Pressure-relief valves should be provided on the low-pressure side of the PRV to prevent system over-pressuring in case of a valve failure. High-pressure alarms should be transmitted to the central control cabinet to alert operating personnel of the PRV failure.

When pressure at the service line connection point is such that the plumbing code dictates that water service requires a PRV (e.g., 80 psi) the customer is required to install, own, operate and maintain the PRV. The PRV shall be installed on the customer side of the water service[55].

5.3.7.7 SCADA Telemetry System

The control and alarm system will be maintained and updated as necessary to optimize all policy goals. Controls must be capable of optimizing the operation of the water system's components in response to reservoir levels, system pressures, abnormal system conditions, electrical power rate structure, and water costs[56].

5.3.7.8 Construction Standards

All new water system infrastructure shall be designed and constructed to comply with DOH criteria, AWWA standards, the City's latest design criteria, and good engineering practice.

5.3.7.9 Standard Useful Life for Design

- Distribution system pipes – 80 years.
- Electrical equipment – 10 to 20 years (varies by type).
- Mechanical equipment – 10 to 20 years (varies by type).
- Structures – building shell – 50 years.
- Structures – water storage – 50 years.
- SCADA hardware and software – 10 years (technical obsolescence).
- Human Machine Interface (HMI) hardware and software - 5 years (physical limit / technical obsolescence).

5.3.7.10 Facilities Maintenance

All City water facilities and related equipment will be maintained so that they perform at the level of service necessary to meet all operational policies and service delivery goals. Equipment breakdown are given highest maintenance priority and repairs should be made as soon as possible to restore the established level of service and for continuity of operation.

Equipment should be scheduled to be replaced or upgraded before they become obsolete or when spare parts are no longer available. Worn parts should be repaired, replaced, or rebuilt before they represent a high failure probability. A preventive maintenance schedule shall be

[55] Source: WAC 246-290-200, DOH Water System Design Manual, Water System Plan.
[56] Source: DOH, Water System Plan.

established for all facilities, equipment, and processes. Spare parts shall be stocked for all equipment items whose failure will impact the ability to meet other policy standards.

All maintenance personnel shall be trained in the procedures and techniques necessary to efficiently perform their job descriptions. The City ensures that Water Maintenance staff obtained the required State water works certifications by WAC 246-292, such as for Water Distribution Managers and/or Water Treatment Operators, to maintain and operate the City's water system.

Maintenance shall be performed by the water maintenance staff and supervised by the Field Superintendent. Written records and reports will be maintained on each facility and item of equipment showing operation and maintenance history[57].

5.3.7.11 Joint Use Facilities

The City will participate in regional projects to the extent that the level of service is not compromised or the cost of service inequitable. All joint-use facilities must comply with City policy and design standards. Joint-use facilities which supply a portion of the City that cannot be supplied from other sources in the event the joint-use facility is out of service will be maintained by the City. Joint-use facilities will be pursued only in those areas that improve reliability or operating costs[58].

5.3.8 Organizational Policies

5.3.8.1 Structure

The Water Utility will be structured to provide the best level of service at the least cost. Utility staff level is established by the Council based on financial resources and desired level of service to be provided by the City.

The Water Utility shall be part of the following divisions:

- Public Works /Utility Systems/ Water Utility Engineering for the planning, management, design, and construction of the City water system and the development and updates of policies and design standards.
- Public Works Maintenance Services/ Water Maintenance for the operation and maintenance of the City water system.
- Community and Economic Development/Plan Review and Permitting for the review, permitting, and inspection of developers' extensions of City water system.
- Finance & Information Technology/Fiscal Services for financial and utility billing services, cost accounting, and fund activity reporting.

5.3.8.2 Project Review Procedures

The City submits projects for new sources, water treatment facilities, booster pump stations, reservoirs, and the recoating of the interior of existing reservoirs to DOH for review and approval as per WAC 246-290-110, -120 and -130.

City staff reviews and approves projects for water main replacements and water main extensions including related fittings, blocking valves, air and vacuum valves, pressure regulating and relief valves, fire hydrants, service connections and meters, and cross connection control devices. City

[57] Source: Water System Plan.
[58] Source: DOH, Council Discretion, Water System Plan.

staff reviews and approves projects for the maintenance and repair of water treatment facilities, booster pump stations, and reservoirs (except for the recoating of the interior of reservoirs). City staff reviews and approves projects for the installation, maintenance, and repair of control, telemetry, and SCADA systems of the drinking water system.

The Water Utility Engineering Manager reviews project plans for compliance with DOH and City design and construction standards including compatibility with the objectives of the Plan. The Water Utility Engineering Manager consults with Renton RFA staff and the Water Maintenance Managers as part of the review. The review addresses separation from sanitary sewers, other non-potable conveyance systems, and sources of contamination; service pressures; fire flow volumes, velocities, and pressures; cross connection control; thrust block and anchoring requirements; corrosion control and protection; air and vacuum control; meter and service line sizes; PRV requirements; operations and maintenance considerations (blocking valves, blow-offs, etc.); construction considerations (cleaning with polypigging, pressure testing, chlorination, flushing, and bacterial testing); etc. Some reviews include hydraulic modeling by the Water Utility staff. The City requires that the plans include applicable standard details and that the plan notes repeat key provisions of the City specifications for the construction and testing of water distribution system mains and appurtenances. Plans must be signed and stamped by a Washington State licensed professional engineer. The Water Utility Engineering Manager indicates his approval of the plans by signing and dating the construction drawing originals within a City approval block[59].

5.3.8.3 Requirements for Outside Parties

The policies pertaining to water distribution system facilities and financing are listed above and are applicable to both City CIP projects and private developer projects. Normally during the planning phase of a Developer-project, a pre-application conference is held with the Developer's engineer. Members of the Water Utility engineering staff, Renton RFA staff, and Development Services staff participate in the meeting. Based upon the preliminary information about the proposed project the City staff reviews with the Developer's engineer anticipated requirements for the project: main sizes and main extents, fire flow, looping, pressure control and pressure issues, construction practices, etc. The City's design standards and policies regarding water main extensions by developers and related requirements are described in Appendix K of this Plan[60].

Fire flow requirements are determined by Renton RFA. The City Water Utility first determines sufficient water rights are available. Then, the City Water Utility will determine the available fire flow using its computer simulated hydraulic model of the City water distribution system. The minimum allowable system pressure during fire flow analysis is 20 psi at the fire location and 30 psi throughout the rest of the distribution system. New developments or redevelopment of existing sites are required to meet the minimum City fire flow requirements. The Developer is responsible for the design and installation of all necessary water main improvements to provide the required fire flow including off-site and on-site water mains. The change of use of existing buildings or areas may also require the installation of the water main improvements.

[59] Source: DOH, Water System Plan.
[60] Source: DOH, Water System Plan.

Chapter 6

WATER SUPPLY, WATER RIGHTS, AND WATER QUALITY

To meet water demands, the City of Renton (City) has developed its own independent water supply sources as well as designed interties with adjacent purveyors to purchase wholesale water. This chapter describes the City's sources of supply, including the condition and capacity of its sources; the water rights associated with its sources; and the water quality requirements for its sources. This chapter also provides a summary of the City's Wellhead Protection Program (WHPP).

The City will maintain its capability to supply a growing population and control water rates by:

1. Placing additional emphasis on water conservation via customer education, incentive programs, and rates that encourage conservation.
2. Protecting the water quality of existing sources from adverse development impacts in the capture zones.
3. Continuing "beneficial use" of its well supply and protecting the legal integrity of the existing water rights.
4. Negotiating with adjacent utilities for emergency supply.
5. Participating in regional water supply organizations.

Water quality policies and programs to protect existing groundwater supply sources are among the City's highest priorities. To ensure public health protection, the City has established a monitoring program that covers operational parameters, regulatory requirements, and aquifer management.

6.1 Water Supply Sources

The City's normal supply is derived from four water sources: the Downtown Wellfield, Springbrook Springs, the Maplewood Wellfield, and Seattle Public Utilities (SPU) supply interties. The City also has an emergency backup well (Well EW-3R), a backup well (Well PW-5A), and emergency supply interties with adjacent purveyors. These supply sources are described in the sections below and are shown on the water system map included in Appendix F, System Maps. The SPU source of supply is described under Section 6.5 - Interties.

6.1.1 Cedar Valley Aquifer

The primary source of the City's municipal water supply is the Downtown Wellfield, which draws water from the deltaic portion of the Cedar Valley Aquifer (also referred to as the deltaic aquifer). The Cedar Valley Aquifer has been designated a Sole Source Aquifer (SSA) by the United States Environmental Protection Agency (USEPA) since 1988. The aquifer boundaries correspond to the aerial extent of the post-Vashon alluvium of the lower Cedar River Valley.

In the vicinity of the wellfield constructed in downtown Renton, the aquifer consists of coarse-grained sediments deposited at the mouth of the prehistoric Cedar River during the last glacial period. The average water table is approximately 23 feet below ground surface (bgs) and the average aquifer thickness is roughly 70 feet in the vicinity of the wellfield. This shallow aquifer is highly susceptible to contamination since there is no confining layer between the land surface and the water table to retard the downward migration of hazardous chemical spills or other releases of contaminants.

6.1.1.1 Aquifer Characteristics

Soils overlying the aquifer are silt, sand, and gravel while the aquifer itself is comprised of coarser, very permeable sandy gravel. Aquifer transmissivity is estimated to range from about 1 to 2.3 million gallons per day per foot (mgd/ft).

The transmissivity and specific yield of the City's wells located in that Cedar Valley Aquifer are summarized in Table 6.1.

Table 6.1 Wells Transmissivity and Specific Yield Summary

Well Name	Transmissivity (mgd/ft)	Specific Yield (cf/cf)
RW-1, RW-2, RW-3	1.00	0.025
PW-8	1.30	0.030
PW-9	2.30	0.020

Notes:
(1) Source: Analysis Report for the City of Renton Cedar River Valley Aquifer Test, RH2 Engineering, 1987.
Abbreviation: cf - cubic feet.

The hydraulic conductivity is on the order of 2,500 feet per day (ft/day) assuming an average transmissivity for all the Cedar Valley Aquifer wells of 1.3 mgd/ft. Recharge is local, both from direct precipitation and subflow.

The Washington State Department of Health (DOH) contamination susceptibility rating of wells located in the Cedar Valley Aquifer is moderate to high.

6.1.1.2 Downtown Wells

The City operates six production wells (RW 1, RW 2, RW 3, PW 8, PW 9, and EW-3R) in the Cedar Valley Aquifer. Wells RW-1, RW-2, and RW-3 each have a pumping capacity of 2,200 gallons per minute (gpm) and are screened at depths ranging from 50 to 105 feet bgs. Well EW-3R may be used in case of an emergency. Its capacity is 1,600 gpm and it is screened from 40 to 70 feet bgs. Wells PW-8 and PW-9 have pumping capacities of 3,500 and 1,200 gpm, respectively. The wells are screened at depths ranging from 50 to 105 feet bgs. Further detail is available in Chapter 2 – Existing System.

6.1.2 Springbrook Springs

Approximately 15 percent of City's current water supply comes from Springbrook Springs, located at the southern city limits. A water-bearing sand and gravel layer enclosed in a thick sequence of glacial till intercepts the surface of the hillside at Springbrook Springs.
Two infiltration galleries collect and channel water into the transmission pipeline. Flow measured at the Springbrook treatment building varies over the year with the highest flow rates occurring during the summer months. The City is able to maintain a maximum flow of 1,050 gpm into the distribution system via a throttling valve. Section 6.4 of this chapter describes recommendations and potential changes to the operation of the throttling valve to allow higher flow from Springbrook Springs.

The capture area has been estimated by combining the surface area draining to Springbrook Springs with the estimated groundwater recharge area. The latter is based on well driller reports for wells in the vicinity of the spring.

The DOH contamination susceptibility rating of Springbrook Springs is moderate to high.

6.1.3 Maplewood Production Aquifer

The Maplewood Production Aquifer is located east of the downtown area under the Maplewood Golf Course. It serves as a redundant source of supply for the vulnerable Cedar Valley Aquifer.

6.1.3.1 Aquifer Characteristics

This aquifer is believed to extend northward into hydrostratigraphically correlated zones beneath the North Uplands. It ranges from 70 to 120 feet thick and is encountered from approximately 135 to 345 feet below the golf course.

The Maplewood Production Aquifer is confined with evidence of some leakage. Gradients are predominantly upward. Estimated transmissivities range from 49,000 to 76,000 gallons per day per foot (gpd/ft) with corresponding hydraulic conductivity ranging from 94 to 128 ft/day. Recharge is believed to occur predominantly from the North Uplands while discharge occurs in the Cedar Valley via upward flow to the alluvial aquifer east of the bedrock narrows. Other recharge and discharge points may exist.

The DOH contamination susceptibility rating of the Maplewood Aquifer is low.

6.1.3.2 Maplewood Wells

The City has three Maplewood Wells (PW-11, PW-12, and PW-17), which have pumping capacities of 2,500 gpm, 1,600 gpm, and 1,500 gpm, respectively. These wells are screened at depths ranging from 284 to 344 feet bgs.

The City has a permit for a water right at this location for a new Well 10. The City has no current plan to develop this well.

6.1.4 Well PW-5A

Well PW-5A is located near the northern city limits east of Lake Washington. This backup well has a pumping capacity of 1,500 gpm and is completed in a sand and gravel aquifer zone approximately 280 to 390 feet bgs (about -42 to -152 feet mean sea level). The aquifer zone is overlain by stratified glacial deposits of fine to coarse sand and gravel layered with silt and clay.

The capture zone for Well PW-5A is not known, but there are some indications that the well may be withdrawing from the Maplewood Aquifer.

The DOH contamination susceptibility rating of Well PW-5A is low.

6.2 Condition of Supply Sources

The City's wells are generally in very good condition. The City has capital improvement and maintenance programs to upgrade and maintain its sources in good condition and to comply with water quality criteria. Chapter 8 – Operation and Maintenance summarizes City maintenance activities.

6.3 Supply Management

The City manages each water supply source within the limitations of the instantaneous water right quantity (Qi) and annual water right quantity (Qa) established by the Washington State Department of Ecology (DOE). In general, the City's sources are equipped with capacity to deliver the full certificated City water rights (or in the case of the Maplewood Wells – the permitted Qi flows) to the distribution system. Without obtaining authorization from DOE to use the Maplewood Wells to provide additional instantaneous flow as originally intended, not all of this installed capacity can be utilized. For the current planning period, the City plans to use the Maplewood Wells as alternate sources only and to revisit the terms of these water right authorizations during the next planning period. The combined withdrawals from the Cedar Valley Aquifer sources and the Maplewood Aquifer sources will not exceed the total certificated Qi of 11,400 gpm for the Downtown Wells and total certificated Qa of 14,809 acre-feet per year (ac-ft/yr) for all sources. Springbrook Springs will be used at its full available supply during the planning period.

At present, Well PW-5A is only used for backup supply because of the water quality issues mentioned in Chapter 2 of this Plan.

During the current planning period the City anticipates that on infrequent occasions the demand will exceed the Qi water rights of the Cedar Valley sources and Springbrook Springs. During these periods the City plans to meet the demand by purchasing wholesale water from SPU.

6.4 Water Rights Analysis

6.4.1 General Conditions

The State Water Code, as outlined in Title 90 of the Revised Codes of Washington (RCW), states that all surface and ground waters of the state are the property of the public. It is, therefore, the policy of the state to promote the use of the public waters in a fashion that provides the maximum benefit arising from both diversionary uses of the state's public water and the retention of waters within the streams and lakes in sufficient quantity and quality to protect in-stream and natural values and rights.

> (90.03.005 RCW): The state takes responsibility for determining who, among the various competing basin stakeholders, is allowed to use, divert, or consume the water.

When an application to obtain water rights is submitted to the DOE, the date of receipt of this application establishes the priority of the water right. Prior to the development of a source of supply, a permit is issued by DOE to construct, develop, and test the supply source. A water right may then be issued following a thorough review process, a determination of the amount of supply that is put to beneficial use, and the impacts on the various other basin stakeholders. This water right establishes the priority use of the water and becomes an appurtenance to the property.

The City has developed independent water sources in order to maintain greater control over the management and costs of its water supply. Through the development of independent sources of supply, the City strives to protect public health, ensure adequate water supply to meet the requirements of its customers, and support the economic prosperity of the City.

Consistent with DOE's procedures for issuing water rights, all of the City's water rights specify a Qi and a maximum Qa. Copies of the City's water rights certificates and permits are in Appendix M.

6.4.2 Existing Water Rights

The City has 13 water right certificates and 4 permits. A summary of the City's existing water rights for municipal supply is presented in Table 6.2. The total instantaneous flow rate from the certificated rights is 15,152 gpm. Certificated additive (primary) annual water rights are 14,809.5 ac-ft/yr. Certificated non-additive (previously termed supplemental) annual water rights are 7,539 ac-ft/yr.

Well 4 is currently inactive, as is Well PW-5A which is only used as backup due to water quality issues. These sources authorize total primary water right allocations in the amount of 1,670 gpm and 2,593.5 ac-ft/yr, which is being exercised through the use of supplemental sources.

The City's water rights authorize total primary allocations in the amount of 15,152 gpm and 14,809.5 ac-ft/yr.

The water right for Well EW-3R (GWC 5836-A) was transferred to the new wells RW-3, RW-1, and RW-2. However, in accordance with the water right certificate, Well EW-3R continues to be maintained should it be needed to intercept contaminants that could affect the other wells. Well EW-3R can also be used as an emergency supply after notifying DOE, in the event that the City's other sources fail.

In 2011, the City requested an additional development extension of the Maplewood Wellfield and was granted until September 30, 2021 to finalize the rights and file the Proof of Appropriation forms. The City continues to operate the sources consistent with the past arrangement with DOE to not exceed the total Qi and Qa authorized by the Cedar Valley sources; however, the final disposition of these permits has not been resolved.

6.4.3 Forecasted Water Rights

The City does not anticipate applying for any new water rights or changes to its existing water rights. In 1997, the City applied for a change of place for several of its water rights, but since then it has withdrawn those applications. The City's forecasted water rights are the same as its existing water rights.

Springbrook Springs have both a surface water certificate and groundwater certificate, which, if added together would put the withdrawal amount to 2,082 gpm. The City currently has a throttling valve and is maintaining the flow at the Qi value of 1,050 gpm (groundwater certificate value). The City has the ability to increase the withdrawal amount with the infrastructure currently in place, and will, on an as needed basis, withdraw up to the combined value of 2,082 gpm.

The City plans to use the Maplewood wells as alternate sources only and to revisit the terms of these water right authorizations perfecting water right certificates during the next planning period.

Table 6.2 Water Rights Status

Permit Certificate or Claim No.	Tracking #	Name of Rightholder or Claimant	Priority Date	Source Name / No.	Primary or Supplemental	Existing Water Rights		
						Qi (gpm)	Qa_A (ac-ft/yr)	Qa_{NA} (ac-ft/yr)
SWC 463	S1-*02983C	City of Renton	May 17, 1930	Springbrook Creek	Primary	1,032	1,650	
G1-20605C	G1-20605C	City of Renton	May 3,1973	Infiltration Gallery (Springbrook Springs)	Primary	1,050	1,680	
GWC 886-D	G1-*00816S	City of Renton	Jan 1, 1944	RW-1	Primary	1,040	1,676	
GWC 5838-A	G1-*08042C	City of Renton	Apr 14, 1966	RW-1	Supplemental	960		1,536
GWC 887-D	G1-*00817S	City of Renton	Jan 1, 1944	RW-2	Primary	1,040	838	
GWC 5835-A	G1-*08040C	City of Renton	Apr 14, 1966	RW-3	Supplemental	1,600		2,560
GWC 5836-A	G1-*08041C	City of Renton	Apr 14, 1966	RW-1, 2, 3	Supplemental	1,960		3,136
GWC 6775-A	G1-*09349C	City of Renton	Apr 1, 1968	PW-8	Primary	3,000	4,532	307
GWC 6776-A	G1-*09985C	City of Renton	Jan 21, 1969	PW-8	Primary	500	800	
G1-24191C	G1-24191C	City of Renton	Oct 18, 1982	PW-9	Primary	1,300	1,040	
GWC 3591-A	G1-*03040C	City of Renton	Feb 18, 1953	PW-5A	Primary	1,300	2,000	
GWC 5834-A	G1-*08039C	City of Renton	Apr 14,1966	PW-5A	Primary	200	320	
GWC 884-D	G1-*00814S	City of Renton	Nov 1, 1942	Well 4	Primary	170	273.5	
G1-24781-P	G1-24781P	City of Renton	Jan 2, 1986	PW-11	Supplemental	1,600		1,792
G1-25396-P	G1-25396P	City of Renton	Feb 13, 1989	PW-11	Supplemental	900		1,008
G1-24782-P	G1-24782P	City of Renton	Jan 2, 1986	PW-12	Supplemental	1,600		1,792
G1-25397-P	G1-25397P	City of Renton	Feb 23, 1989	PW-17	Supplemental	1,500		1,680
			Total			**20,752**	**14,809.5**	**13,811**
			Total Certificated			**15,152**	**14,809.5**	**7,539**
			Certificated Currently Online			**12,450**	**10,566**	**7,539**

6.5 Water Supply Interties

In the coming years, as the limits of water rights are encountered, the City plans to purchase more water from SPU to meet its needs. The City and SPU have a wholesale supply contract (renewed in 2011), which provides an additional supply source for the City through 2062. The City has nine metered interties with the SPU transmission mains (including the two Boeing Plant meters), which are available to serve wholesale water to the City. The City's interties are summarized in Table 6.3 and described in detail in Chapter 2 as part of the supply sources. Most interties receive summer peaking supply, with the greatest supply from pressure-reducing valve (PRV) 24 / SPU Bow Lake Pipeline Sta. #196. The City plans to meet its water demand needs that cannot be met by way of its own sources of supply and/or via storage by purchasing water from SPU.

Table 6.3 Maximum Flow Rates Status - Interties

Intertie Name / Identifier	Name of Purveyor Providing Water	Maximum Intertie Flow		Type of Service
		Maximum Instantaneous Flow Rate (gpm)	Maximum Annual Volume (ac-ft/yr)	
Tiffany Park / SPU Sta. #39	SPU	1,050	1,694	Summer Peaking
Fred Nelson / SPU Sta. #34	SPU	925	1,492	Summer Peaking
PRV 24 / SPU Bow Lake Pipeline Sta. #196	SPU	2,800	4,516	Summer Peaking
PRV 28 / SPU Sta. #33	SPU	700	1,129	Supply/Summer Peaking
PRV 35 / SPU Sta. #38	SPU	700	1,129	Supply/Summer Peaking
PRV 6 / SPU Sta. #37	SPU	320	516	Summer Peaking
SPU Sta. #36	SPU	700	1,129	Summer Peaking
Boeing Plant Feed – East SPU Sta. #179	SPU	1,950	3,145	Boeing
Boeing Plant Feed – West SPU Sta. #180	SPU	1,950	3,145	Boeing
PRV 23 Tukwila	City of Tukwila	1,250	2,016	Emergency
PRV 25 Kent	City of Kent	1,950	3,145	Emergency
Dimmitt BPS (operated by Skyway)	Skyway	1,600	4,516	Emergency
Total		**15,895**	**27,572**	

Note:
Abbreviation: BPS: booster pump station; Skyway – Skyway Water and Sewer District.

6.6 Water Right Self-Assessment

A water right self-assessment was made based on all water right permits, claims, and certificates. The self-assessment compares the current and 20-year projected water demand to determine the adequacy of the City's water rights. The self-assessment also considers Table 6.4. The City currently has sufficient water rights.

If the City does not pursue additional treatment for Well PW-5A, does not redevelop Well 4, and does not expand capacity of the Springbrook Springs water right, the available annual water right will be 10,566 ac-ft (equivalent to 9.43-mgd average day demand [ADD]), and the City could face a source capacity issue that would result in exceeding this usable annual water.

The City plans to address the forecast difference between Qa water rights and annual demand by purchasing water from SPU. To address the forecast difference between Qi water rights and demand, the City plans to construct additional storage and purchase water from SPU. Additionally, the City will further evaluate the timing of capital improvements to address the water quality problems of Well PW-5A.

The details of the supply and pumping analysis are presented in Section 6.13.

6.7 Water Quality Plan and Treatment

The City is defined as a Group A Community Public Water System. The City must comply with the drinking water standards of the federal Safe Drinking Water Act (SDWA) and DOH standards under Washington Administrative Code (WAC) 246-290. The City's water quality is in compliance with all state and federal water quality and reporting requirements.

The City maintains water quality within its system through the following approaches:

1. Routine system flushing within its distribution system in order to maintain satisfactory water quality.
2. A main replacement program to eliminate dead end mains and replace aging cast iron, asbestos cement, and steel pipes.
3. In-line chlorine and fluoride analyzers at all sources for continuous monitoring.
4. Installation of pH meters at all sources in order to better manage pH and as a result reduce corrosion within the distribution system.
5. Cross-connection prevention.

It is recommended that the City take the following actions as part of its water quality planning programs:

- The City should continue to track proposed new water quality rules and regulations being considered by the USEPA and DOH in order to plan for any impacts on its water system.
- The City should continue to implement its corrosion control treatment improvements as necessary to reduce levels of corrosion within the distribution system and private plumbing.

6.7.1 Raw Water Quality

A review of the City's raw water quality testing records indicates that overall source water quality is excellent with only minor aesthetic problems caused by ammonia, iron, manganese, and hydrogen sulfide at Maplewood and corrosivity concerns at Springbrook Springs and Downtown. Even though the aesthetic components do not affect public health, the City provides treatment to improve aesthetic quality in terms of odor and discoloration. Corrosion treatment reduces health risks associated with potential leaching of lead and copper from piping, but also improves aesthetics as well.

6.7.2 Treatment

The City's water treatment is described in detail in Chapter 2 as part of the supply sources. Table 6.4 summarizes the current source treatment goals and effectiveness.

The City upgraded the treatment systems at both Springbrook Springs in 2013 and the Downtown Wells in 2010 to modernize the disinfection systems and add sodium hydroxide for pH adjustment to reduce the corrosivity of the water. Water treatment improvements at the Maplewood Wells were completed in 2006 to remove hydrogen sulfide, manganese, and ammonia. The Maplewood Treatment Plant is currently able to deliver up to 3,000 gpm to the distribution system, with provisions to allow additional filters that would increase the capacity to 5,500 gpm.

For regular use of Well PW-5A, treatment for ammonia, iron, manganese, and hydrogen sulfide is required. There is no plan to provide additional treatment for Well PW-5A within the next 20 years. Adding treatment to Well PW-5A will be examined during the next planning period.

6.7.3 Water Quality Monitoring

The City has implemented a comprehensive and proactive water quality monitoring program. It includes monitoring for operations, regulatory monitoring to meet the requirements of the federal SDWA and monitoring to manage the City's aquifers. Operational monitoring is used to verify the City's water facilities are functioning effectively to deliver high quality drinking water, and includes measuring chlorine and fluoride concentrations, pumping rates for each production well, and pH measurements as part of the corrosion control program. Regulatory monitoring includes analytical testing for microbial pathogens, organic and inorganic chemicals, disinfection byproducts, and radionuclides. The sampling is performed at locations and at frequencies required by state and federal regulations. Aquifer monitoring is used to identify contamination and to track water levels in the aquifers.

Table 6.4 Source Treatment

Facility	Sources Treated	Treatment Type	Treatment
Liberty Park CT Pipe 1	Wells RW-1, RW-2 and RW-3	Chlorination (gaseous chlorine)	4-log virus inactivation (CT=6) and measurable chlorine residual (at least 0.2 mg/L)
Liberty Park Wellhouse RW-1-2-3	Wells RW-1, RW-2 and RW-3	Fluoridation	0.7 mg/L
Liberty Park CT Pipe 2	Emergency Well EW-3R	Chlorination (gaseous chlorine)	4-log virus inactivation (CT=6) and measurable chlorine residual (at least 0.2 mg/L)
Liberty Park Wellhouse EW-3R	Emergency Well EW-3R	Fluoridation	0.7 mg/L
Cedar River Park CT Pipe	Wells PW-8 and PW-9	Chlorination (gaseous chlorine)	4-log virus inactivation (CT=6) and measurable chlorine residual (at least 0.2 mg/L)
Cedar River Park Fluoridation Facility	Wells PW-8 and PW-9	Fluoridation	0.7 mg/L
Corrosion Control Treatment Facility (CCTF)	All Downtown Wells	pH adjustment using sodium hydroxide	Corrosion control to meet requirements of the Lead and Copper Rule (LCR)
Springbrook Springs CT Pipe	Springbrook Springs Infiltration Galleries	Chlorination (gaseous chlorine)	4-log virus inactivation (CT=6) and measurable chlorine residual (at least 0.2 mg/L)
Springbrook Springs Treatment Facility	Springbrook Springs Infiltration Galleries	pH adjustment using sodium hydroxide	Corrosion control to meet requirements of the LCR
Springbrook Springs Treatment Facility	Springbrook Springs Infiltration Galleries	Fluoridation	0.7 mg/L
Maplewood Treatment Plant	Wells PW-11, PW-12 and PW-17	Chlorination (sodium hypochlorite)	4-log virus inactivation (CT=6) and measurable chlorine residual (at least 0.2 mg/L)
Maplewood Treatment Plant	Wells PW-11, PW-12 and PW-17	Chlorination (sodium hypochlorite)	Convert ammonia to nitrogen gas (monochloramine less than 0.02 mg/L, dichloramine = 0-mg/L, trichloramine = 0-mg/L)
Maplewood Treatment Plant	Wells PW-11, PW-12 and PW-17	Dissolved oxygen plus granular activated carbon	Convert hydrogen sulfide to hydrogen sulfate (dissolved hydrogen sulfide less than 0.001 mg/L)
Maplewood Treatment Plant	Wells PW-11, PW-12 and PW-17	Greensand filters using chlorine (sodium hypochrorite) as the oxidant	Remove iron and manganese (no staining)
Maplewood Treatment Plant	Wells PW-11, PW-12 and PW-17	Fluoridation	0.7 mg/L
Wellhouse PW-5A(1)	Well PW-5A	Fluoridation	0.7 mg/L
Wellhouse PW-5A	Well PW-5A	None	Similar treatment as Maplewood

Note:
(1) This well currently serves as a backup to other sources.
(2) Abbreviations: CT - contact time; LCR - Lead and Copper Rule; mg/L - milligrams per liter.

Water quality sampling is the responsibility of the Water Maintenance Services Division and is carried out on a daily basis by a team of Water Treatment Operators. In addition to ensuring that water treatment and maintenance are performed effectively, the Water Maintenance Services Division is responsible for ensuring that monitoring is carried out and for managing water quality data and records both for routine and special monitoring programs.

A detailed description of the water quality sampling methods, the sampling locations, sampling frequency, and record keeping procedures are listed in the Drinking Water Quality Monitoring Program included as Appendix N. The estimated costs for the City's water quality monitoring are included in Chapter 8 - Operations and Maintenance.

6.8 State and Federal Regulatory Requirements

This section presents the water quality standards of the DOH and USEPA through the SDWA. The SDWA, which was enacted in 1974 (and amended in 1986 and 1996), is the main federal law that establishes standards for drinking water quality for public water systems. The DOH has adopted the federal drinking water regulations under WAC 246-290 and has accepted primary responsibility (or “primacy”) for enforcement of water quality monitoring and reporting. All existing and anticipated drinking water regulations that apply to the City are summarized in the following subsections and shown in Table 6.5.

6.8.1 Revised Total Coliform Rule

The Revised Total Coliform Rule (RTCR), which replaced the 1989 Total Coliform Rule, requires monitoring to demonstrate that a water system is minimizing the risk of bacterial growth. Drinking water samples must be collected for bacteriological analysis from representative points in the distribution system at regular time intervals. The number of water samples is dependent upon the population being served by the system. Currently, testing for bacteria (total coliforms) is conducted weekly, with a total of 100 samples required each month. Over the past 6 years, the City has collected approximately 7,000 coliform samples (post-treatment) and only 2 have come back positive for total coliforms. Follow-up actions were taken following the detections, but repeat samples showed no indication of contamination. The City is required to have a Coliform Monitoring Plan that identifies coliform monitoring locations and sampling procedures. The City’s Coliform Monitoring Plan is included as Appendix A of the Drinking Water Quality Monitoring Plan, which can be found in Appendix N.

6.8.2 Stage 1 and 2 Disinfectants/Disinfection Byproducts Rules

Because the City uses chlorine for disinfection, it needs to meet the requirements of the Stage 1 and Stage 2 Disinfectants/Disinfection Byproducts Rules (D/DBPR). In general, the City’s high-quality source water and applied treatment result in low concentrations of disinfection byproducts, which are produced from the reactions between chlorine and natural organic matter. Based on the low levels of trihalomethanes and haloacetic acids, which are the two most common disinfection byproducts, the City is approved for reduced monitoring. D/DBPR compliance monitoring is described in detail in the City’s Stage 2 Disinfectants and Disinfection Byproducts Monitoring Plan, which is included as Appendix B of the Drinking Water Quality Monitoring Plan.

Table 6.5 Existing and Future Requirements of the Safe Drinking Water Act

Regulation	Effective / Compliance Dates	Regulation Summary and City Status
Existing Requirements		
RTCR	Effective February 2013. Compliance by April 2016.	The City meets the requirements of this rule.
Groundwater Rule	Effective January 2007. Compliance by November 2010.	The City meets the requirements of this rule.
Arsenic Rule	Effective February 2002. Compliance by January 2006.	The City meets the requirements of this rule.
Radionuclides Rule	Effective December 2003. Compliance by December 2006.	The City meets the requirements of this rule.
LCR	Effective June 1991 with minor revisions in 2000.	The City meets the requirements of this rule.
Inorganic Chemicals	Various	The City meets the requirements of the rules regulating these contaminants.
Organic Chemicals	Various	The City meets the requirements of the rules regulating these contaminants.
Stage 1 D/DBPR	Effective December 1998. Compliance by January 2004.	The City meets the requirements of this rule.
Stage 2 D/DBPR	Effective January 2006. Compliance by October 2012.	The City meets the requirements of this rule.
LCR Short-term Revisions	Effective October 2011	The City meets the requirements of this rule.
Fluoride	Effective May 2016	The City reduced fluoride treatment target to 0.7 mg/L in accordance with new DOH rule.
UCMR3	Effective May 2012. Compliance Period 2013 to 2015.	UCMR3 monitoring was completed in 2014 and 2015.
UCMR4	Effective December 2016. Compliance Period 2018 to 2020.	UCMR4 monitoring was completed in 2018 and 2019.
Consumer Confidence Report Rule	Effective December 2012	The City meets the requirements of this rule.
Public Notification Rule	Effective May 2000	The City meets the requirements of this rule.
Future Requirements		
Perchlorate	In February 2011, USEPA decided to regulate perchlorate	The City is monitoring the development of the rule. The City tested all of its sources for perchlorate in 2002 and 2003 (and Maplewood Wellfield in 2009). All samples were non-detect.

Regulation	Effective / Compliance Dates	Regulation Summary and City Status
PFAS	DOH began rulemaking for PFAS in drinking water in late 2017	The City tested all of its sources for 6 PFAS chemicals as part of UCMR3 sampling in 2014 and 2015. All samples were non-detect.
Strontium	USEPA is considering issuing a regulatory standard based on UCMR3 results	The City is monitoring the development of a national primary drinking water regulation for strontium.
LCR Long-Term Revisions	USEPA is considering additional revisions to the LCR	The City is monitoring the development of the rule revisions.
UCMR5	Anticipating final rule in 2021, with a compliance period of 2023 to 2025.	

Note:
Abbreviations: UCMR3 / UCMR4 / UCMR5 - Unregulated Contaminant Monitoring Rules 3, 4, and 5; PFAS - per- and polyfluoroalkyl substances.

6.8.3 Groundwater Rule

The Groundwater Rule builds on the Total Coliform Rule by addressing the health risks of microbial pathogens (bacterial and viral) in community public water systems that use groundwater sources. The City has 4-log virus treatment (99.99 percent inactivation) at each source of supply and conducts routine compliance monitoring. The City also conducts periodic sanitary surveys to address system deficiencies at risk of microbial contamination.

6.8.4 Arsenic Rule

The Arsenic Rule was adopted by the DOH as a revision to the arsenic maximum contaminant level (MCL) under WAC 249-290-310. The City samples for arsenic during the inorganic chemical analysis and all samples were non-detect for arsenic during the last monitoring period.

6.8.5 Radionuclides Rule

The City conducts periodic monitoring (once every 6 years) for radiological contaminants (radionuclides) at each source after treatment. During the last monitoring period (June 2016), all samples were non-detect for Gross Alpha particles and Radium 228.

6.8.6 Inorganic Chemical Analysis

Inorganic contaminants are metals, salts, and other non-carbon compounds that can be naturally occurring in the environment or are present as a result of human activities such as urban stormwater runoff or industrial wastewater discharges. Physical properties of inorganic chemicals that affect water quality are also included in the analysis such as hardness, turbidity, color, conductivity, and total dissolved solids. The City is required by DOH to take samples for inorganic chemical analysis at each source after treatment. The complete inorganic chemical and physical analysis includes the primary and secondary chemical and physical drinking water contaminants specified in WAC 246-290. Based on historically low levels, the City has been approved by DOH for reduced monitoring (once every nine years) with the exception of nitrate, which is monitored annually. The City also has a permanent waiver for asbestos monitoring from DOH. During the last monitoring period, no samples exceeded the MCLs for inorganic chemicals.

Fluoridation of the City's water supply began in 1985 after Renton citizens voted for fluoride treatment. In 2016, the City adjusted its fluoride target level to 0.7 mg/L with an operating tolerance of 0.5 to 0.9 mg/L as recommended by both DOH and Centers for Disease Control and Prevention (CDC). During the last 6 years, no samples have exceeded the MCL for fluoride.

6.8.7 Organic Chemical Analysis

Volatile organic chemicals (VOCs) are carbon-containing substances that easily become vapors or gases under typical room temperature. Some VOCs are hydrocarbons that are associated with petroleum fuels and solvents. VOCs are divided into regulated and unregulated VOCs. There are currently 21 regulated VOCs that have been determined to pose a significant risk to human health. This group does not include organic pesticides, herbicides, or insecticides, which are regulated separately as synthetic organic chemicals (SOCs). There are currently 33 regulated SOCs.

The City is required by DOH to take samples for organic chemical analyses at each source after treatment. Based on historically low levels, the City has been approved by DOH for reduced monitoring (once every 6 years for VOCs and once every 9 years for herbicides). The City has also been granted waivers for pesticides and soil fumigants. State-wide waivers have been issued for insecticides, dioxin, diquat, endothall, glyphosate, polychlorinated biphenyls (PCBs), ethylene dibromide (EDB), and dibromochloropropane (DBCP).

Recent chemical analyses of the City's supply sources show no contamination from VOCs or SOCs. The City must test for trihalomethanes at all wells once a year since they are chlorinated. During the last monitoring period, low levels of trihalomethanes were detected in the samples, but were significantly below the MCL for total trihalomethanes.

6.8.8 Lead and Copper Rule

Action levels were established for lead and copper under the 1991 LCR. The goal of the LCR is to protect public health by minimizing lead and copper levels at consumers' taps, primarily by reducing water corrosivity within the distribution system. The 2007 Short-Term Revisions to the LCR enhanced monitoring, treatment, lead service line replacement, public education, and customer awareness.

The City's source water contains no significant amounts of lead and copper. However, potential health risks come from the leaching of lead and copper from the distribution system components and private plumbing. The City reduces the risk of leaching by continuously treating its source water to raise the pH of the water. Additional details on these facilities are provided in the Corrosion Control section.

LCR sampling was most recently conducted in 2016. There were 41 samples tested for lead and copper from residential water taps. All of the samples tested had levels far below the action levels for both lead and copper. A detailed description of the 2016 LCR sampling is provided in Appendix N, Drinking Water Quality Monitoring Program.

Although the LCR has resulted in substantial reductions in lead in drinking water, the EPA is proposing additional revisions to improve the rule and strengthen public health protections. Proposed revisions to the LCR include requirements for accelerated lead service line replacement programs, improved optimal corrosion control treatment requirements, incorporating a lower trigger level for lead, point of use filters, improving sampling procedures, increased transparency and information sharing, and public education.

6.8.9 Unregulated Contaminant Monitoring Rule

The SDWA establishes periodic monitoring of contaminants that are suspected to be in drinking water, but not yet subject to drinking water regulations. This is the fourth cycle of monitoring for unregulated contaminants (UCMR4). Because the City uses groundwater supply sources, UCMR4 monitoring consists of 20 unregulated chemical contaminants: two metals, eight pesticides plus one pesticide manufacturing byproduct, three brominated haloacetic acid disinfection byproducts groups, three alcohols, and three semivolatile organic chemicals.

The City submitted a Groundwater Representative Monitoring Plan proposing three representative sampling locations (Springbrook Springs, Downtown Wellfield, and Maplewood Wellfield). The monitoring plan was approved by USEPA in January 2018. The City performed UCMR4 sampling in October 2018 and April 2019. Unregulated contaminants that were detected during these UCMR4 sampling events will be reported in the 2019 and 2020 Water Quality Reports. While these contaminants do not have established drinking water standards, the data collected during UCRM4 provides a basis for potential future regulatory actions to protect public health.

6.8.10 Consumer Confidence Report Rule

The Consumer Confidence Report (CCR) is an annual water quality report that a community public water system is required to prepare for its customers. Each year, the report documents regulated contaminants detected during the water system's most recent monitoring period (within five years), and the concentrations of these detected contaminants compared to regulatory standards. The report must also include the health effects related to violations of the maximum contaminant levels. The information in the report is provided to help consumers make informed decisions about their drinking water. The City's Water Quality Monitoring Reports are electronically available at:
https://rentonwa.gov/city_hall/public_works/utility_systems/water_quality_report

6.8.11 Public Notification Rule

The Public Notification Rule requires public water systems to notify their consumers of drinking water violations or situations that may pose a risk to public health. Public notification is intended to ensure that consumers will know if there is a problem with their drinking water. There are three categories of public notification:

- Tier 1 (Immediate Notice) – Notification within 24 hours.
- Tier 2 (Notice as Soon as Practical) – Notification as soon as possible, but within 30 days.
- Tier 3 (Annual Notice) – Up to a year to provide notification.

The City has not had a drinking water violation in the last 6 years requiring public notice. The City has a detailed public notification procedure summarized in the Coliform Monitoring Plan included in Appendix N.

6.8.12 Future Regulations

The City is monitoring the developments surrounding the following potential rules and rule changes:

- Revisions to the LCR are being monitored and changes to the City's LCR activities will be made if necessary.
- Proposed Strontium Monitoring – not anticipated to effect the City.
- Proposed PFAS Monitoring – not anticipated to effect the City.
- Proposed Perchlorate Monitoring – not anticipated to effect the City.

6.9 Corrosion Control Program

6.9.1 Corrosion Protection: Source of Supply

In the past, there were relatively high copper levels, and occasionally high lead levels, at home taps because of the relatively low pH of Cedar Valley Aquifer and Springbrook Springs water supplies. In 2017, the raw water pH ranged from 6.6 to 6.9 for the Downtown Wells and about 6.9 to 7.1 for Springbrook Springs. Water with pH less than 7.2 is aggressive in leaching copper and lead from water mains and private plumbing.

As a result of the low pH levels, the City has added corrosion control treatment to its Downtown Wells and Springbrook Springs. Sodium hydroxide is added to these sources to raise the pH to between 7.3 and 8.1.

The pH of the raw water from the Maplewood Wells is approximately 8.1 and that of the treated water is about the same. Well PW-5A water has a pH of approximately 8. The Corrosion Control Recommendation Report (March 1995) found that no additional corrosion control treatment processes are required for these sources.

6.9.2 Corrosion Protection: Distribution Mains

The City uses Aqua Mag® blended phosphates in areas of the distribution system that contain a high number of unlined cast iron water mains. It acts to control the corrosion of the interior surfaces of water mains. The City uses sampling stations to monitor pH levels in the distribution system. In 2017, the pH averaged 7.7 at these stations.

Since about 1976 the City has required that all water mains installed in the City be cement-lined ductile iron pipe. Additionally, since 1980, the City has required that water mains installed in high resistivity soils be wrapped in polyethylene. Beginning in 1994, the City specifications have required that all water mains be wrapped in polyethylene. These requirements were established to reduce the internal and external corrosion of water mains.

In a few of the locations where the City's water mains are within the influence area of other utility lines that are protected with impressed current cathodic protection systems, the City's water mains are electrically bonded and/or protected with sacrificial anodes. Test stations are installed. Testing is random and infrequent at this time.

6.9.3 Corrosion Protection: Steel Reservoirs and CT Pipeline

Three of the City's seven steel reservoirs are protected with impressed current cathodic protection systems (Mt Olivet, Highlands 565, and Rolling Hills 590). The West Hill reservoir has an active impressed current cathodic protection system installed. The seven reservoirs are inspected by a corrosion control consultant approximately every five years. The inspections consist of examining the protective coatings as well as the cathodic protection systems. The interior and exterior protective coatings are repaired and/or replaced as recommended by the consultant. Impressed current systems are checked annually. Adjustments and maintenance actions are made to the impressed current systems based upon the consultant's recommendations. The CT Pipeline used to provide primary disinfection for wells RW-1, RW-2, and RW-3 has an impressed current cathodic protection system installed but there has not been a need to energize it.

6.10 Wellhead Protection Program

The 1986 amendments to the federal SDWA mandated that every state develop a WHPP to protect ground waters that serve as drinking water sources for public water supplies. In 1994 DOH adopted WAC 246-290, which directed Group A public water systems using wells or springs to implement wellhead protection measures. The City prepared its WHPP, which was approved by DOH in December 1999. Updates to the City's WHPP were completed under this Plan and the changes to the WHPP are included as Appendix J.

DOH stipulates that local WHPPs shall, at a minimum, include the following elements:

- A completed susceptibility assessment.
- A delineated wellhead protection area for each well, wellfield, or spring.
- An inventory of contamination sources located in the wellhead protection area that have the potential to contaminate wells or springs.
- Documentation that delineation and inventory findings are distributed to property owners and regulatory agencies.
- Contingency plans for providing alternate sources of drinking water in the event that contamination does occur.
- Coordination with local emergency responders for appropriate spill response measures.

Compliance with WHPP requirements is part of a broader City effort referred to as the "Aquifer Protection Program." The Aquifer Protection Program was established in 1988 when the Renton City Council designated Aquifer Protection Areas (APAs) with the intent of safeguarding the City's supply sources. The APAs that were initially delineated in 1988 were redefined during this WHPP update to be consistent with the capture zones, which were delineated using the City's Groundwater Model. As part of its Aquifer Protection Program, the City has enacted aquifer protection regulations within the APAs to protect the aquifers used as potable water supply sources from contamination by hazardous materials. The regulations include restrictions on hazardous material quantities, storage, and handling; land use restrictions; facility operating standards; construction activity standards; fill quality standards; and other measures intended to prevent contamination.

Other components of the Aquifer Protection Program include public education, aquifer water quality and level monitoring, coordination with emergency responders, and coordination with surrounding land use authorities on groundwater protection issues.

6.11 System Reliability

The City continues to meet its responsibility to its customers and as a water purveyor by addressing the reliability of the water system through the quality and condition of its facilities described earlier in this chapter; through system redundancy; and through the development and implementation of its Vulnerability Assessment and its Water Shortage Response Plan.

6.11.1 Reliability Efforts

The City continues to provide reliable water service to its existing customers and plan for long-term reliability of its system for its sources and its distribution network. The City's primary supply is from its Downtown Wells and Springbrook Springs. Emergency Well EW-3R can be used in the event that the normal supply wells are unavailable. In addition to the Cedar Valley Aquifer, the City can supply its system from two different sources within its service area, the Maplewood Aquifer (not additive) and Well PW-5A.

In 2007 the City added emergency electrical generation facilities to supply power to Wells RW-1, RW-2, and RW-3 and to Mt. Olivet and North Talbot BPSs. See Chapter 2 - Existing System and Chapter 9 - Capital Improvements Program for further discussion of existing and planned emergency backup power.

In addition to its own sources of supply, the City also has 10 existing interties with four neighboring water utilities: seven from SPU, one from Tukwila, one from Kent, and one from Skyway (plus two 10-inch supply lines to the Renton Boeing Plant from SPU).

The City is also actively participating in and is studying other options to increase supply reliability. These options include the City's ongoing Conservation Plan, a future aquifer recharge study, and the continuing examination of opportunities for the use of reclaimed water.

6.11.2 Water Shortage Response Planning

The City developed a Water Shortage Response Plan in 1989 to meet its responsibility for planning for emergencies or other short- or long-term shortages that may occur. The updated Water Shortage Response Plan is included in Appendix O.

6.12 System Wide Water Supply Planning

The City has been decisive and progressive in its water supply planning. The City has pursued its independent acquisition of water sources in order to maintain control over this utility, which is vital to the public health and economic well-being of its customers. An important consideration has also been concerning the cost of water supply and the desire to keep water rates low and competitive with neighboring systems and with the region as a whole.

The City's supplies were evaluated to identify if they provide adequate capacity is available to serve future demands. Reliable and redundant supplies were evaluated on maximum day demand (MDD) with the largest pump or source out of service. For the purpose of this study, the term "reliable" refers to a non-emergency source of supply that has backup power.

The City has more than sufficient supplies to meet the system wide MDD through 2039, as shown in Table 6.6. The City-owned supplies are sufficient to meet the system-wide MDD through 2029, with a small amount of SPU supply required by 2039. Note, only SPU reliable supplies (i.e. with back-up power) are included in this analysis.

The City currently purchases wholesale supply from SPU to address operational challenges in providing supply to some areas of the system. The following section addresses considers supplying each operating area to evaluate and address these challenges, if necessary.

Table 6.6 System-wide Supply Comparison

			2019	2029	2039
		TOTAL MDD (gpm)	**9,646**	**11,125**	**12,306**
Source	Well	Status	Qi (gpm)		
Springbrook Springs		Active	1,050	1,050	1,050
Downtown Wellfield	Well RW-1	Active	2,200	2,200	2,200
Downtown Wellfield	Well RW-2	Active	2,200	2,200	2,200
Downtown Wellfield	Well RW-3	Active	2,200	2,200	2,200
Downtown Wellfield	Well PW-8	Active	3,500	3,500	3,500
Downtown Wellfield(1)	Well PW-9	Active	1,200	1,200	1,200
Well PW-5A	Well PW-5A	Backup	NA	NA	NA
Maplewood Wellfield	Well PW-11	Active	2,500	2,500	2,500
Maplewood Wellfield	Well PW-12	Active	500	500	500
Maplewood Wellfield	Well PW-17	Active	0	0	0
Downtown Wellfield	Well EW-3R	Emergency	NA	NA	NA
City Supply Total			**15,350**	**15,350**	**15,350**
SPU Supply Interties Total		Active	**7,195**	**7,195**	**7,195**
Total Reliable Capacity			**22,545**	**22,545**	**22,545**
Largest Pump/Supply Capacity	Well PW-8		3,500	3,500	3,500
Total Reliable Capacity with Largest Pump/Supply Capacity offline			**19,045**	**19,045**	**19,045**
SURPLUS/(DEFICIT)			**9,399**	**7,920**	**6,739**

Note:
(1) Reliable pump capacity for Well PW-9 is only 1,200 gpm.

6.13 Operational Water Supply Planning

The City's supplies and pump stations were evaluated to ensure adequate capacity is available to serve future demands. The City's criteria identified in Chapter 2 is to provide sufficient reliable sources / pumps to provide the MDD for each operational area with the largest pump or source out of service. This section describes the capacity of the existing system and system recommendations to meet the City's criteria.

6.13.1 Operational Areas

For the purpose of evaluating supply and pumping capacity, the City's water distribution system was divided into seven different operational areas, which feed a total of 16 pressure zones. Table 6.7 summarizes the various operational areas and their associated pressure zones. Figure 6.1 provides an overview of the City's operational areas and pressure zones.

Table 6.7 Operational Areas and Pressure Zones

Operational Area	Pressure Zone
Valley 196	Valley 196
West Hill 495	West Hill 300 West Hill 495 Earlington 370
Highlands 435	Highlands 435 Kennydale 320 Kennydale 218
Highlands 565	Highlands 565
Rolling Hills 490	Rolling Hills 490 Scenic Hill 370 East Talbot Hill 300
Rolling Hills 590	Rolling Hills 590 Rolling Hills 395
Talbot Hill 350	Talbot Hill 350 Talbot Hill 270 West Talbot Hill 300

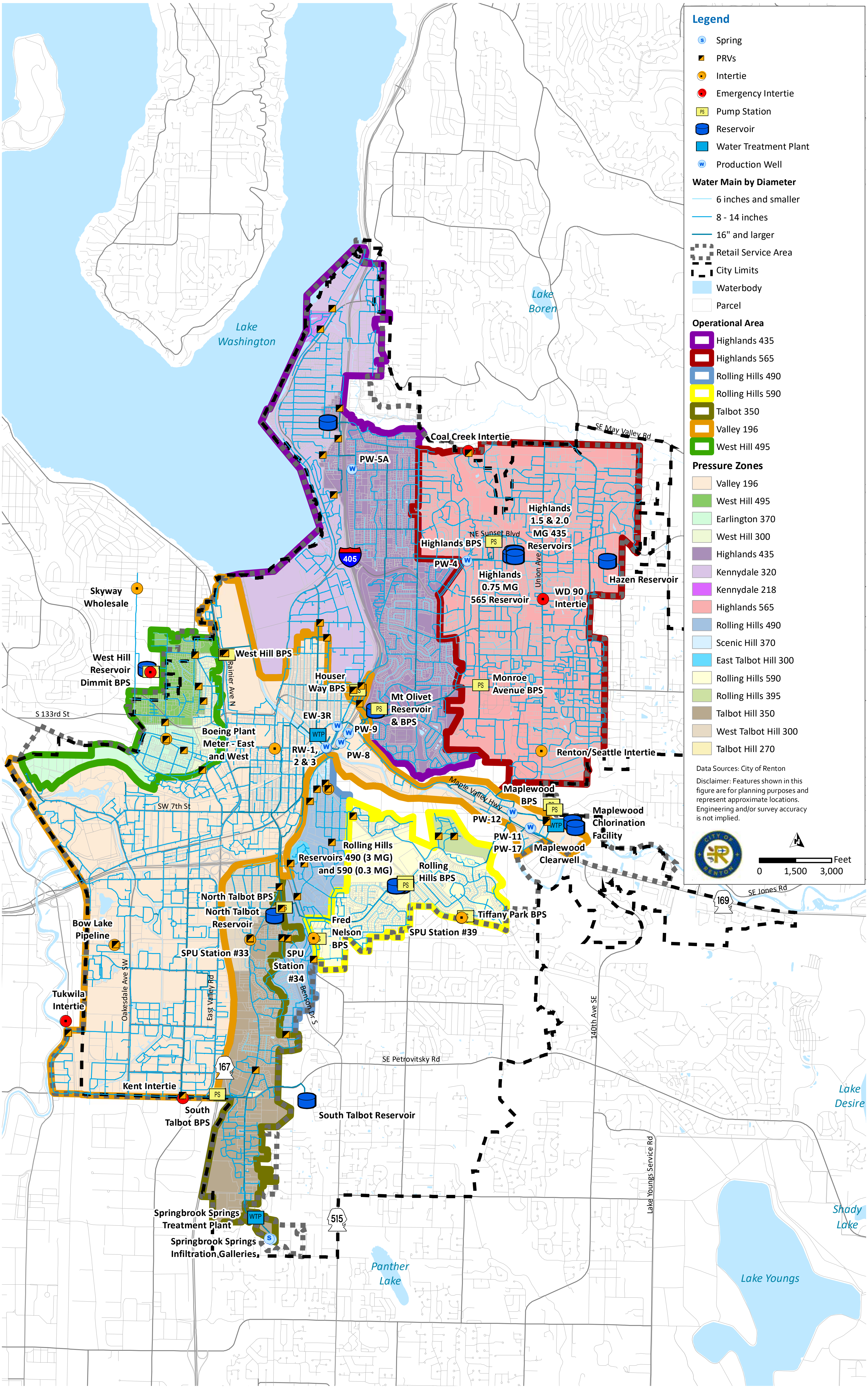


Figure 6.1 Operational Areas

6.13.2 Existing System

The supply and pumping analyses only account for non-emergency supply sources. The emergency sources are identified in this section, but not included in the analysis tables. The supply and pumping capacity of each operational area was compared to the projected MDD for planning years 2019, 2029, and 2039. Demands were developed for this Plan in Chapter 3. The following sections summarize results for each operational area identified above. Results are summarized in the following sections.

6.13.2.1 Valley 196 Operational Area

The Valley 196 Operational Area sources and source capacities are outlined in Table 6.8.

The total reliable supply capacity of the Valley Operational Area is 15,150 gpm. Well PW-8 is the largest source capacity within the Valley Operational Area, bringing the total reliable capacity with the largest pump / supply capacity offline to 11,650 gpm.

In addition to serving the Valley 196 Operational Area, the Valley sources also provide source capacity to all the higher zones with the exception of the West Hill 495 Operational Area. For this analysis, the West Hill 495 Operational Area is assumed to be served by the Dimmitt BPS and the SPU Bow Lake Intertie as described in Section 6.5. Note, emergency supplies to Kent through PRV 25 and to Coal Creek through PRV 53 were not considered in this analysis.

Table 6.8 Valley 196 Operational Area Source Capacities

Source	Maximum Capacity (gpm)	Reliable Capacity(1) (gpm)	Emergency Source?
Well RW-1	2,200	2,200	No
Well RW-2	2,200	2,200	No
Well RW-3	2,200	2,200	No
Well PW-8	3,500	3,500	No
Well PW-9	1,200	1,200	No
Springbrook Springs	1,050	1,050	No
PRV 24 / SPU Bow Lake Pipeline Sta. #196	2,800	2,800	No
Well EW-3R	1,600	n/a	Yes
PRV 23 / Tukwila Intertie	1,250	n/a	Yes

Note:
(1) Reliable capacity considers backup power.

The comparison with the reliable sources capacity is summarized in Table 6.9. As shown in the table, the available source capacity within the Valley Operational Area is sufficient to provide MDD to the customers in the Valley Operational Area and the higher Operational Areas that rely on the Valley sources.

Table 6.9 Valley 196 Operational Area Source Capacity Analysis

Demands / Sources (gpm)	2019	2029	2039
Projected MDD (Operational Area + Offsite)			
Valley 196	2,924	3,215	3,493
Highlands 435	2,118	2,701	3,049
Highlands 565	2,368	2,736	3,125
Rolling Hills 490	451	479	514
Rolling Hills 590	472	500	542
Talbot Hill 350	694	729	785
Total MDD	**9,027**	**10,360**	**11,508**
Available Reliable Capacity			
Springbrook Springs	1,050	1,050	1,050
Well RW-1	2,200	2,200	2,200
Well RW-2	2,200	2,200	2,200
Well RW-3	2,200	2,200	2,200
Well PW-8	3,500	3,500	3,500
Well PW-9(1)	1,200	1,200	1,200
PRV 24 / SPU Bow Lake Pipeline Sta. #196	2,800	2,800	2,800
Total Reliable Capacity	**15,150**	**15,150**	**15,150**
Largest Pump/Supply: Well PW-8	3,500	3,500	3,500
Total Reliable Capacity with Largest Pump/Supply Offline	**11,650**	**11,650**	**11,650**
Surplus/(Deficit)	**2,623**	**1,290**	**142**

Note:
(1) Reliable pump capacity for Well PW-9 is only 1,200 gpm.

6.13.2.2 West Hill 495 Operational Area

The West Hill 495 Operational Area sources and source capacities are outlined in Table 6.10.

Table 6.10 West Hill 495 Operational Area Source Capacities

Source	Maximum Capacity (gpm)	Reliable Capacity(1) (gpm)	Emergency Source?
West Hills BPS	2,200	1,000	No
Dimmitt BPS	1,600	n/a	Yes
PRV 28 / SPU Sta. #33(2)	700	700	No
PRV 35 / SPU Sta. #38	700	700	No

Notes:
(1) Reliable capacity considers backup power.
(2) PRV-28 / SPU Station #33 serves the Talbot Hill 350 and the West Hill 495 Operational Areas for summer peaking supply. For this analysis, it is assumed that the flow from SPU Station #33 serves the West Hill 495 Operational Area.

The total reliable source / pump capacity of the West Hill 495 Operational Area is 2,400 gpm. Pump 3 at the West Hill BPS is the largest pump within the Operational Area, bringing the total reliable capacity with the largest pump / supply capacity offline to 1,400 gpm. In addition to the West Hill 495 Operational Area demands, the Operational Area sources must also provide source capacity for Skyway Wholesale.

A comparison of the projected MDD and the source capacity for the West Hill 495 Operational Area is presented in Table 6.11 and demonstrates that there is sufficient capacity to meet the MDD in the West Hill 495 Operational Area in 2019, 2029, and 2039.

Table 6.11 West Hill 495 Operational Area Source Capacity Analysis

Demands / Sources (gpm)	2019	2029	2039
Projected MDD for West Hill 495 (Operational Area + Offsite)	618	764	799
Projected MDD for Skyway Wholesale (Operational Area + Offsite)	112	126	142
Total MDD	**730**	**890**	**941**
Available Reliable Capacity			
West Hill BPS	1,000	1,000	1,000
PRV 28 / SPU Sta. #33	700	700	700
PRV 35/ SPU Sta. #38	700	700	700
Total Reliable Capacity	**2,400**	**2,400**	**2,400**
Largest Pump/Supply: Pump 3 at West Hill BPS	1,000	1,000	1,000
Total Reliable Capacity with Largest Pump/Supply Offline	**1,400**	**1,400**	**1,400**
Surplus/(Deficit)	**670**	**510**	**459**

6.13.2.3 Highlands 435 Operational Area

The Highlands 435 Operational Area sources and source capacities are outlined in Table 6.12.

Table 6.12 Highlands 435 Operational Area Source Capacities

Source	Maximum Capacity (gpm)	Reliable Capacity(1) (gpm)	Emergency Source?
Mt. Olivet BPS	4,350	4,350	No
Houser Way BPS	4,100	4,100	No
Well PW-5A	1,500	1,250	No

Note:
(1) Emergency Sources are not considered a reliable source for the supply and pumping analysis.

The total reliable source / pump capacity of the Highlands 435 Operational Area is 9,700 gpm. Pump 2 at the Houser Way BPS is the largest pump within the Operational area, bringing the total reliable capacity with the largest pump / supply capacity offline to 7,650 gpm. In addition to the Highlands 435 Operational Area demands, the Operational Area sources must also provide source capacity for the Highlands 565 Operational Area.

The comparison of the Highlands 435 sources to the Highlands 435 and 565 demands is summarized in Table 6.13. As shown in the table, the available source capacity within the Operational Area is sufficient to fulfill the MDD of the Highlands 435 Operational Area for 2019, 2029, and 2039.

Table 6.13 Highlands 435 Operational Area Source Capacity Analysis

Demands / Sources (gpm)	2019	2029	2039
Projected MDD for Highlands 435 (Operational Area + Offsite)	2,118	2,701	3,049
Projected MDD for Highlands 565 (Operational Area + Offsite)	2,368	2,736	3,125
Total MDD	**4,486**	**5,437**	**6,174**
Available Reliable Capacity			
Mt. Olivet BPS	4,350	4,350	4,350
Houser Way BPS	4,100	4,100	4,100
Well PW-5A	1,250	1,250	1,250
Total Reliable Capacity	**9,700**	**9,700**	**9,700**
Largest Pump/Supply: Pump 2 at Houser Way BPS	2,050	2,050	2,050
Total Reliable Capacity with Largest Pump/Supply Offline	**7,650**	**7,650**	**7,650**
Surplus/(Deficit)	**3,164**	**2,213**	**1,476**

6.13.2.4 Highlands 565 Operational Area

The Highlands 565 Operational Area sources and source capacities are outlined in Table 6.14.

Table 6.14 Highlands 565 Operational Area Source Capacities

Source	Maximum Capacity (gpm)	Reliable Capacity(1) (gpm)	Emergency Source?
Highlands BPS	3,900	3,900	No
Monroe Ave BPS	2,500	0	No
Maplewood BPS(2)	2,400	1,550	No

Notes:
(1) Emergency Sources are not considered a reliable source for the supply and pumping analysis.
(2) The Maplewood system can either serve the Highlands 565 Operational Area or the Rolling Hills 590 Operational Area. For this analysis, it is assumed that it serves the Highlands 565 Operational Area.

As discussed in Section 6.3, the City operates the Downtown Wells and Maplewood Wells such that withdrawals do not exceed the total Qi authorized for the Downtown Wells (11,400 gpm). It was assumed that for the Valley Operational Area, Well PW-8 was out of service (3,500 gpm). The total reliable capacity used by the Valley Operational Area for this analysis was 9,700 gpm, which leaves sufficient capacity within the authorized water rights for 1,550 gpm from the Maplewood system.

The total reliable source / pump capacity of the Highlands 565 Operational Area is 5,450 gpm. Pump 5 at the Maplewood BPS is the largest pump within the Operational Area, bringing the total reliable capacity with the largest pump / supply capacity offline to 3,900 gpm. The Highlands 565 Operational Area demands also include the PRV-53 / Coal Creek Utility District projected emergency demands (1,250 gpm), but these emergency demands were not included in the pumping and source capacity analysis.

The comparison of the source capacity and demands for the Highlands 565 Operational Area are summarized in Table 6.15. As shown in the table, the Operational Area has sufficient source capacity for 2019, 2029, and 2039.

Table 6.15 Highlands 565 Operational Area Source Capacity Analysis

Demands / Sources (gpm)	2019	2029	2039
Projected MDD for Highlands 565 (Operational Area + Offsite)	2,368	2,736	3,125
Total MDD	**2,368**	**2,736**	**3,125**
Available Reliable Capacity			
Highlands BPS	3,900	3,900	3,900
Monroe Ave BPS	0	0	0
Maplewood BPS	1,550	1,550	1,550
Total Reliable Capacity	**5,450**	**5,450**	**5,450**
Largest Pump/Supply: Pump 5 at Maplewood PS	1,550	1,550	1,550
Total Reliable Capacity with Largest Pump/Supply Offline	**3,900**	**3,900**	**3,900**
Surplus/(Deficit)	**1,532**	**1,164**	**775**

6.13.2.5 Rolling Hills 490

The Rolling Hills 490 Operational Area sources and source capacities are outlined in Table 6.16.

Table 6.16 Rolling Hills 490 Operational Area Source Capacities

Source	Maximum Capacity (gpm)	Reliable Capacity(1) (gpm)	Emergency Source?
North Talbot BPS	4,183	4,183	No
SPU Station #36(2)	700	n/a	No
PRV-6 / SPU Sta. #37(2)	320	n/a	No

Notes:
(1) Emergency Sources are not considered a reliable source for the supply and pumping analysis.
(2) The SPU Stations were not included in the supply and pumping analysis, as they were not considered reliable (i.e. back-up power).

The total reliable source/pump capacity of the Rolling Hills 490 Operational Area is 4,183 gpm. Pump 1 at the North Talbot BPS is the largest pump within the Operational area, bringing the total reliable capacity with the largest pump/supply capacity offline to 2,433 gpm. In addition to the Rolling Hills 490 Operational Area demands, the Operational Area sources must also provide source capacity for the Rolling Hills 590 Operational Area.

The comparison of the source capacity and demands for the Rolling Hills 490 Operational Area are summarized in Table 6.17. As shown in the table, the Operational Area has sufficient source capacity for 2019, 2029, and 2039.

Table 6.17 Rolling Hills 490 Operational Area Source Capacity Analysis

Demands / Sources (gpm)	2019	2029	2039
Projected MDD for Rolling Hills 490	451	479	514
Projected MDD for Rolling Hills 590	472	500	542
Total MDD	**923**	**979**	**1,056**
Available Reliable Capacity			
North Talbot BPS	4,183	4,183	4,183
Total Reliable Capacity	**4,183**	**4,183**	**4,183**
Largest Pump/Supply: Pump 1 at North Talbot BPS	1,750	1,750	1,750
Total Reliable Capacity with Largest Pump/Supply Offline	**2,433**	**2,433**	**2,433**
Surplus/(Deficit)	**1,510**	**1,454**	**1,377**

6.13.2.6 Rolling Hills 590

The Rolling Hills 590 Operational Area sources and source capacities are outlined in Table 6.18.

Table 6.18 Rolling Hills 590 Operational Area Source Capacities

Source	Maximum Capacity (gpm)	Reliable Capacity(1) (gpm)	Emergency Source?
Rolling Hills BPS	5,000	5,000	No
Fred Nelson / SPU Sta. #34(2)	925	n/a	No
Tiffany Park / SPU Sta. #39(2)	1,050	n/a	No
Maplewood PS(3)	2,400	n/a	No

Notes:
(1) Emergency Sources are not considered a reliable source for the supply and pumping analysis.
(2) The SPU Stations were not included in the supply and pumping analysis, as they were not considered reliable (i.e. with back-up power).
(3) The Maplewood system can either serve the Highlands 565 Operational Area or the Rolling Hills 590 Operational Area. For this analysis, it is assumed that it serves the Highlands 565 Operational Area.

The total reliable source / pump capacity of the Rolling Hills 590 Operational Area is 5,000 gpm. Pump 1 at the Rolling Hills BPS is the largest pump within the Operational Area, bringing the total reliable capacity with the largest pump / supply capacity offline to 2,500 gpm. The comparison of the source capacity and demands for the Rolling Hills 590 Operational Area are summarized in Table 6.19. As shown in the table, the Operational Area has sufficient source capacity for 2019, 2029, and 2039. The City has sufficient redundant and reliable supply capacity with its own supplies, without relying on SPU for normal conditions.

Table 6.19 Rolling Hills 590 Operational Area Source Capacity Analysis

Demands / Sources (gpm)	2019	2029	2039
Projected MDD for Rolling Hills 590 (Operational Area + Offsite)	472	500	542
Total MDD	**472**	**500**	**542**
Available Reliable Capacity			
North Talbot BPS	5,000	5,000	5,000
Total Reliable Capacity	**5,000**	**5,000**	**5,000**
Largest Pump/Supply: Pump 1 at Rolling Hills BPS	2,500	2,500	2,500
Total Reliable Capacity with Largest Pump/Supply Offline	**2,500**	**2,500**	**2,500**
Surplus/(Deficit)	**2,028**	**2,000**	**1,958**

6.13.2.7 Talbot Hill 350

The Talbot Hill 350 Operational Area sources and source capacities are outlined in Table 6.20.

Table 6.20 Talbot Hill 350 Operational Area Source Capacities

Source	Maximum Capacity (gpm)	Reliable Capacity(1) (gpm)	Emergency Source?
South Talbot BPS(2)	3,500	3,500	No
North Talbot BPS	500	500	No
PRV-28 / SPU Sta. #33(2)	700	n/a	No

Notes:
(1) Emergency Sources are not considered a reliable source for the supply and pumping analysis.
(2) The South Talbot BPS has two 3,500-gpm fire pumps, but only one of these pumps can run at a time.
(3) PRV-28 / SPU Station #33 serves the Talbot Hill 350 and West Hill 495 Operational Areas. For this analysis, it is assumed that the flow from SPU Station #33 serves the West Hill 495 Operational Area.

The total reliable source / pumping capacity of the Talbot Hill 350 Operational Area is 4,000 gpm (since only one of the 3,500 gpm fire pumps can be run at one time). Pump 3 at the South Talbot BPS is the largest pump within the Operational Area, bringing the total reliable capacity with the largest pump / supply capacity offline to 4,000 gpm. The comparison of the source capacity and demands for the Talbot Hill 350 Operational Area are summarized in Table 6.21. As shown in the table, the Operational Area has sufficient source capacity for 2019, 2029, and 2039.

Table 6.21 Talbot Hill 350 Operational Area Source Capacity Analysis

Demands / Sources (gpm)	2019	2029	2039
Projected MDD for Talbot Hill 350	694	729	785
Total MDD	**694**	**729**	**785**
Available Reliable Capacity			
North Talbot BPS	500	500	500
South Talbot BPS(1)	3,500	3,500	3,500
Total Reliable Capacity	**4,000**	**4,000**	**4,000**
Largest Pump/Supply: Pump 3 at South Talbot BPS(1)	3,500	3,500	3,500
Total Reliable Capacity with Largest Pump/Supply Offline	**4,000**	**4,000**	**4,000**
Surplus/(Deficit)	**3,306**	**3,271**	**3,215**

Note:
(1) The South Talbot BPS has two 3,500-gpm fire pumps so when one pump is offline, the BPS can still pump 3,500 gpm.

6.13.3 System Recommendations

This analysis found that each of the operational areas had sufficient source / pumping capacity to meet the projected demands through 2039. The City has sufficient supply to serve its customers with solely its own supplies, with the exception of the West Hill 495 Operational Area. The City needs to rely on its interties with SPU in the West Hill 495 Operational area to provide the MDD demands in the planning period.

As discussed above the predicted range in time that the City's annual water rights will meet demand is large, whether or not Well PW-5A is available as a source affects that predicted range.

The City will pursue several different approaches to supplement its peak demand requirements (20-year and longer planning period). This includes expanded conservation efforts and strategies, additional storage, the purchase of wholesale water from SPU, perfecting additional Qi water rights (Maplewood Wells), and the possible use of other technologies such as reclaimed water and aquifer recharge.

The City actively participates with other water systems on regional planning, supply, and operating issues. For example, the City is a member of the East King County Regional Water Association and the Water Conservation Coalition of Puget Sound. Another example is the City's participation in the recent Puget Sound Regional Water Supply Outlook Study, which assessed the supply sources of the Central Puget Sound Region, explored ways that systems can support each other, and evaluated regional supply options to meet future needs. Under the City's new contract with SPU, the City will be participating in the Seattle Regional Supply System (SRSS) via its attendance and participation at SRSS Operating Board meetings.

6.13.4 Regional Water Supply Issues

The City draws its supply, primarily from aquifers in the lower reaches of the Cedar River Watershed. The Cedar Valley Aquifer in particular is relatively shallow. However, there is no evidence from studies conducted to date that the City's water use has an impact on flows in the Cedar River. The Muckleshoot Indian Tribe has an interest in the Cedar River and its fishery resources. The Tribe is concerned with low stream flows that can affect water quality. The City is monitoring the river as a condition of its water rights and will continue to cooperate with the other parties in the management of this resource.

SPU is the regional water purveyor for much of King County. It serves most of the cities and water districts in the vicinity of the City. The City itself has agreements with Seattle for supply as already discussed. In recent years, SPU has implemented a successful conservation program that has delayed the need for new sources.

The water utilities in the Puget Sound Region have individually and collectively addressed future sources of supply to meet their future needs. SPU has constructed a 120-mgd water filtration plant on its Tolt River source. This improvement in water quality meets current water quality standards and allows SPU to make better use of the Tolt River source to meet existing and future demands.

The City of Tacoma is the regional system to the south, serving much of Pierce County and some areas in south King County. Tacoma has completed construction of its second supply project. This involves a second supply pipeline from its Green River source which adds another 60 cubic feet per second of supply to the Tacoma system. The Tacoma Second Supply Project serves a number of water districts in south King County, some of which are also supplied by SPU. See: http://www.mytpu.org/tacomawater/water-system/supply/regional-water-supply/Default.htm

The Growth Management Act (GMA) requires cities in Washington State to prepare 20-year plans for their future development, including the provision of adequate water supply to support this growth. This has raised concerns with many water utilities because they are often not consulted when the land use planning and economic development decisions are made for GMA and many water systems are reaching the capacity of their sources and don't have the necessary future capacity to meet GMA projections. In addition, the process of obtaining water rights in Washington State has become extremely difficult and time-consuming because of concerns over instream flows and the suspected influence of groundwater withdrawals on stream flows.

The current situation has prompted water systems in the Central Puget Sound area to pursue new source development as a top priority. The Cascade Water Alliance was created several years ago with participation of many of the water systems in King County to pursue new regional supplies as an alternative, or in conjunction with SPU and Tacoma. Many of the same systems have also participated in the Puget Sound Outlook Study, which included water utilities in King, Pierce, and Snohomish Counties.

As a result of planning by individual water utilities and the efforts of the consortiums mentioned in the previous paragraphs, a number of regional projects have been proposed. The following list describes two of these regional solutions:

- The Cascade Water Alliance has purchased water rights formerly held by Puget Sound Energy for hydroelectric generation on the White River, including storage in Lake Tapps and is currently working to get approval to use Lake Tapps as a municipal water supply.

- The Snohomish River Regional Water Authority acquired a 36-mgd water right formerly used by Weyerhauser (S1-10617C) for its now abandoned plant in Everett. Various schemes have been proposed for delivering this water to utilities, including some in King County. Use of the water right continues to be under study.

The water supply situation is continually changing with alternatives proposed, studied, and sometimes put on the shelf. A number of other alternatives have been considered including the North Fork Tolt River, Snoqualmie Aquifer under the Middle Fork of the Snoqualmie River, the North Fork Snoqualmie River, direct withdrawal from Lake Washington, and even sources as far away as the Skagit River. At the present time, none of these appear to be in serious contention as the next source due to water rights or environmental, cost, or institutional issues.

As a participant in forums proposing new supplies, the City is keeping itself involved and informed of new developments. It will make decisions and act as appropriate to preserve its current supply and/or to participate with other utilities in new or alternative source development.

6.14 Recommended Water Supply Improvements

Recommended improvement projects for water supply can be grouped into the main areas of interties and reliability. Specific projects associated with the supply projects are included in Chapter 9.

It is recommended that the City maintain and/or renew its existing intertie agreements with adjacent utilities. The City does not anticipate applying for any new water rights or changes to its existing water rights, no new well is recommended. The City will utilize its reservoirs and interties with SPU to supply peaking demands.

System reliability can be improved through several approaches that include security and system redundancy. Security upgrades are incorporated into water facilities projects when appropriate. Ongoing security program costs are included in the City's CIP. As redevelopment occurs, the City can improve system reliability by considering options for new PRVs and other control valves that provide additional supply to zones.

Additional possible projects for improving supply reliability are aquifer recharge and the use of reclaimed water. The City has not investigated artificial aquifer recharge but plans to proceed with a study within the next 20 years to look at the feasibility of such a project. The use of reclaimed water has been attempted by the City with limited success to date. Feasible alternatives for using reclaimed water are not anticipated within the next 10 years. The City has completed the King County Water Reclamation Evaluation Checklist, which is provided as Appendix I.

Chapter 7

SYSTEM ANALYSIS

7.1 Introduction

This chapter summarizes potential future system deficiencies in the City of Renton's (City) water distribution and recommends improvements to the system. Carollo Engineers, Inc. (Carollo) evaluated the capacity of the pipelines using the City's updated and calibrated hydraulic model. Evaluations of the remaining utilities were conducted in Microsoft Excel.

Improvements identified in this chapter are summarized in the Capital Improvements Plan (CIP) in Chapter 9.

7.2 Operational Areas and Distribution System Assumptions

To evaluate storage and pumping capacities, the City's water distribution system was divided into 7 different operational areas that contain 16 pressure zones.

The City is currently in the process of implementing major distribution system improvements and changes to pressure zones. These improvements are either under design, in construction, or being operationally implemented. This new infrastructure and changes to the distribution system were assumed to be implemented for the purpose of the system analysis.

Improvements included the following:

- Construction of the new Highlands 445 Reservoir.
- Decommissioning of the existing Highlands 435 Pressure Zone (PZ).
- Creation of the Highlands 445 PZ (formerly Highlands 435 PZ).
- Construction of the new Kennydale 308 Reservoir.
- Creation of the Kennydale 308 PZ (formerly Kennydale 320 PZ).
- Extension of the Highlands 445 PZ boundary.

Figure 7.1 shows the distribution system and pressure zone boundaries used for the system analysis. This base map figure is different from the existing system figure in Chapter 3, which consists of infrastructure that existed until June 2018. The calibration of the hydraulic model also accounts for the system as of June 2018, instead of the system analysis infrastructure presented in Figure 7.1. Figure 7.2 illustrates the hydraulic profile for the system analysis, which includes all improvements stated above.

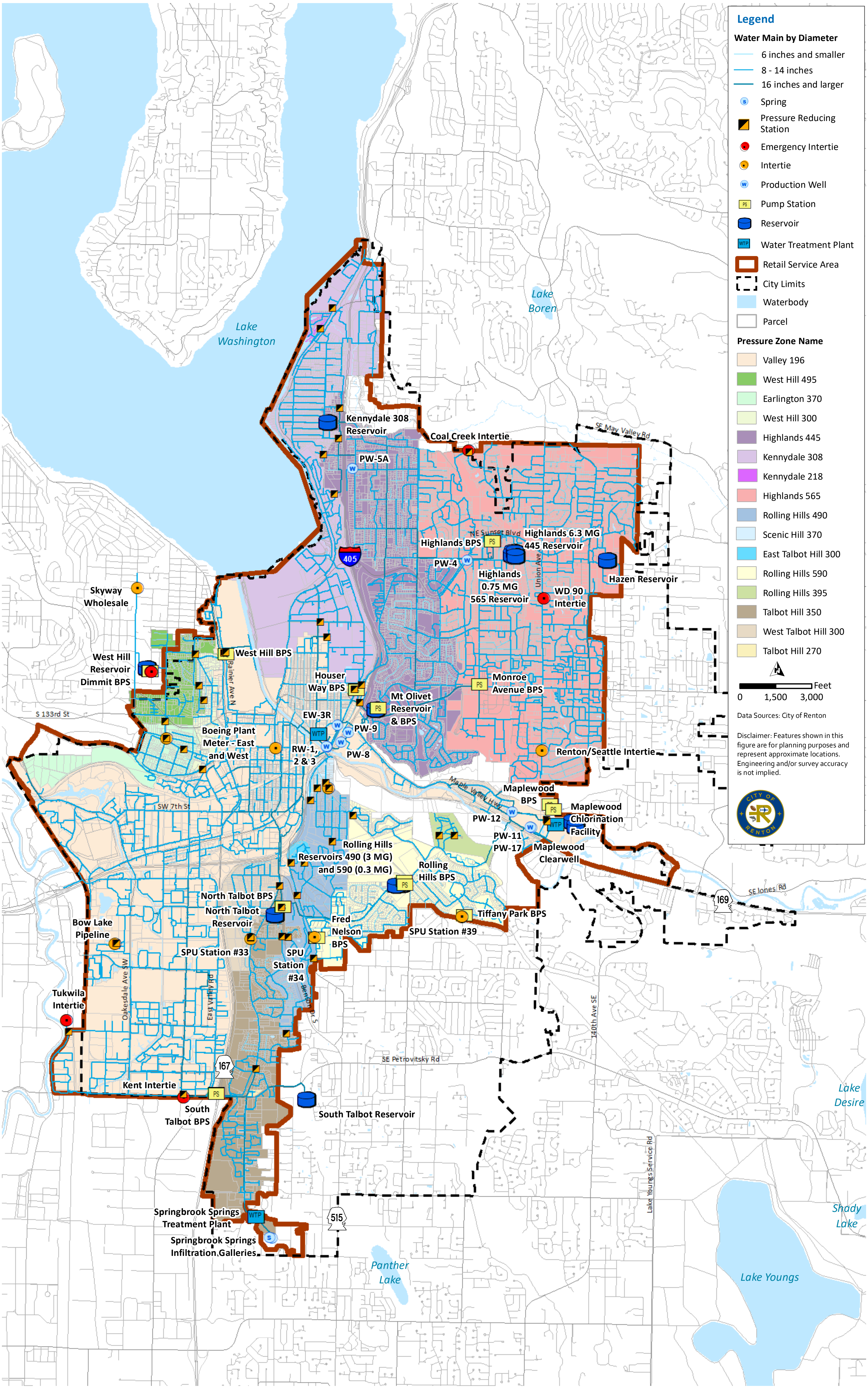


Figure 7.1 Water Facility Locations (System Analysis)

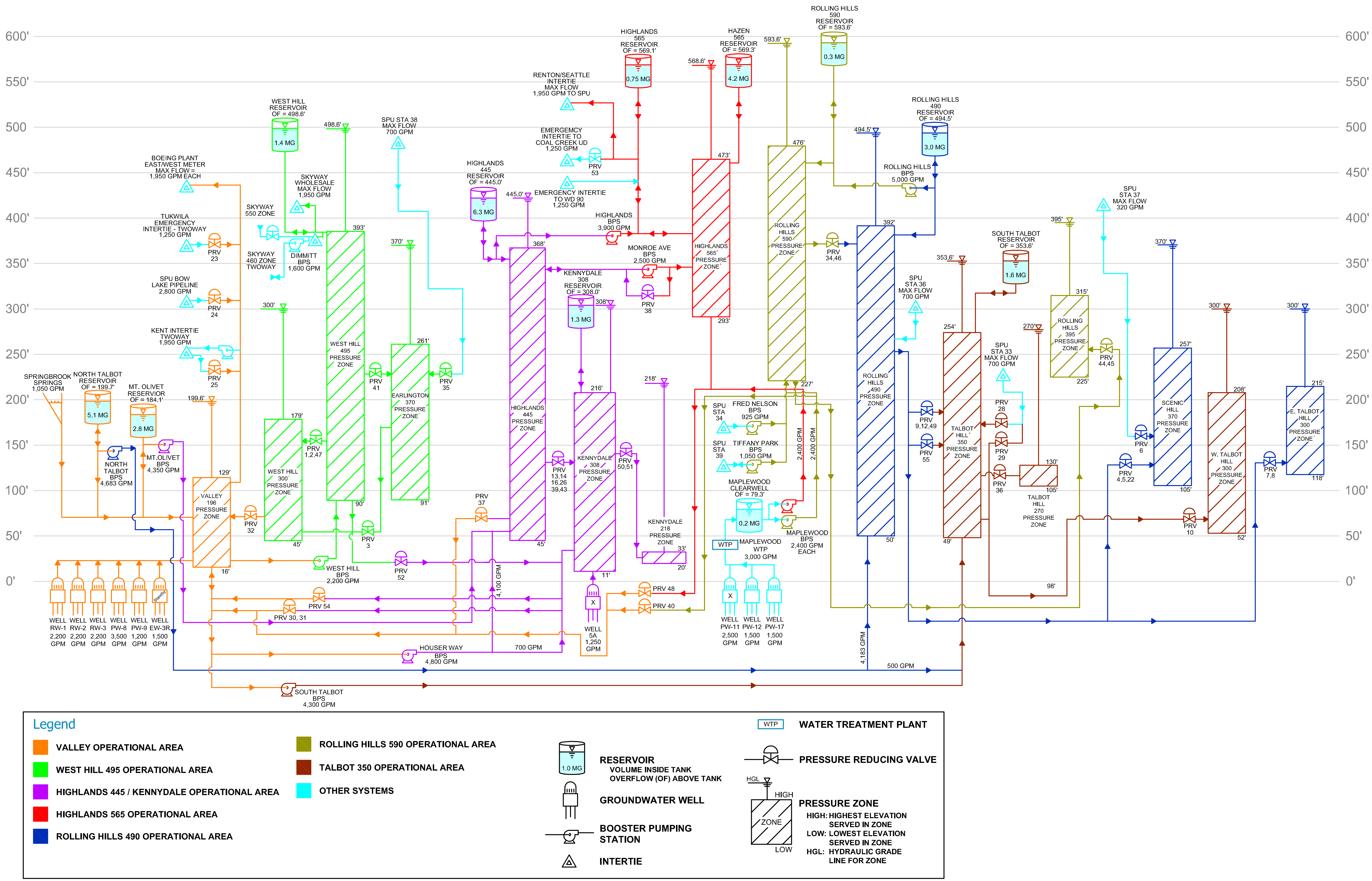


Figure 7.2 Hydraulic Profile (System Analysis)

Table 7.1 summarizes the various operational areas and their associated pressure zones used for the system analysis, including the new Highlands 445 and Kennydale 308 PZs.

Table 7.1 Operational Areas and Pressure Zones

Operational Area	Pressure Zone
Valley 196	Valley 196
West Hill 495	West Hill 300 West Hill 495 Earlington 370
Highlands 445	Highlands 445 Kennydale 308 Kennydale 218
Highlands 565	Highlands 565
Rolling Hills 590	Rolling Hills 590 Rolling Hills 395
Rolling Hills 490	Rolling Hills 490 Scenic Hill 370 East Talbot Hill 300
Talbot Hill 350	Talbot Hill 350 Talbot Hill 270 West Talbot Hill 300

7.3 Storage Analysis

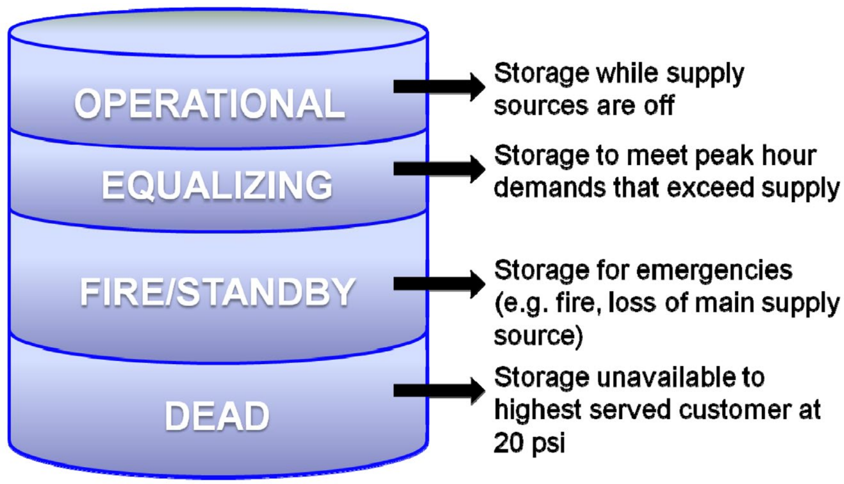
The City's reservoir storage requirements depend on the water system's configuration, seasonal and daily variation in water-use patterns, and the reliability of various water system components. The following section describes four components of storage, summarizes the existing system's capacity to meet the storage needs of each operational area, and makes recommendations to address any identified storage deficits.

7.3.1 Components of Storage

Water storage volumes are comprised of five components:

- Operational storage.
- Equalizing storage.
- Standby storage (SS).
- Fire-suppression storage (FSS).
- Dead storage.

Figure 7.3 schematically shows these components.



Note:
Abbreviation: psi - pounds per square inch

Figure 7.3 Illustration of Storage Components

7.3.1.1 Operational Storage

Operational storage is the volume of water used on a day-to-day basis to supply the water system while the sources of supply are in the "off" position. This volume is dependent on the sensitivity of the water level sensors controlling the pumps and is designed to prevent the pump motors from excessive starts and stops (cycling).

Summarized in Table 7.2, the operational storage volume for the City's reservoirs were determined from the hydraulic model' supply sources on and off settings.

Table 7.2 Operational Storage Volumes

Reservoir (Nominal Volume, MG)	Diameter (ft)	Height (ft)	Operational Band (MG)	Percent of Total Storage
North Talbot (5.0)	Varies	26.5	0.91	18%
Mt Olivet (3.0)	113.5	37.2	0.00	0%
West Hill (1.4)	48	103	0.22	15%
Highlands 435 (2.0)	Decommissioned			
Highlands 435 (1.5)	Decommissioned			
Highlands 445 (6.3)	233	20	0.56	9%
Kennydale 308 (1.3)	50	88	0.04	3%
Highlands 565 (0.75)	Varies	35	0.20	27%
Hazen (4.2)	80	111.8	0.36	8%
South Talbot (1.5)	100	27	0.13	9%
Rolling Hills 590 (0.3)	Varies	28	0.03	9%
Rolling Hills 490 (3)	119	36.5	0.36	12%

Note:
Abbreviations: ft – feet; MG – million gallons.

South Talbot Reservoir – 1.5 MG

7.3.1.2 Equalizing Storage

Equalizing storage is the total volume needed to satisfy the peak hourly demands (PHD) that exceed the supply system's capacity. The State of Washington Administrative Code (WAC) 246-290-253 requires that equalizing storage provide peak demands. Furthermore, WAC 246-290-230 (5) states as such:

> New public water systems or additions to existing systems shall be designed with the capacity to deliver the design PHD quantity of water at 30 pounds per square inch (psi) (210 kPa [kilopascals]) under PHD flow conditions measured at all existing and proposed service water meters or along property lines adjacent to mains if no meter exists, and under the condition where all equalizing storage has been depleted.

PHD is calculated using hourly demand data from the season of highest water consumption. For this plan, hourly demand data during the two-week period from July 1, 2018 to July 20, 2018 was averaged for each hour of the day for each operational area. The demand value for the hour of highest demand was considered PHD, while the average of the 24-hourly demands was the maximum day demand (MDD). Table 7.3 shows the PHD for each pressure zone based on peaking factor developed from Supervisory Control and Data Acquisition (SCADA) data recorded and hourly Advanced Metering Infrastructure (AMI) data provided by the City.

Table 7.3 Diurnal Summer Demand by Pressure Zone

Pressure Zone	2029 PHD (gpm)	2039 PHD (gpm)	Peaking Factor (PHD/MDD)
Valley 196	5,428	5,896	1.69
West Hills 300	182	203	1.54
West Hills 495	845	856	1.54
Earlington 370	150	171	1.54
Highlands 435	2,039	2,267	1.32
Kennydale 320	1,454	1,682	1.32
Kennydale 218	64	64	1.32

Pressure Zone	2029 PHD (gpm)	2039 PHD (gpm)	Peaking Factor (PHD/MDD)
Highlands 565	3,918	4,474	1.43
Rolling Hills 590	597	651	1.28
Rolling Hills 395	45	45	1.28
Rolling Hills 490	588	639	1.46
Scenic Hill 370	41	41	1.46
East Talbot Hill 300	71	71	1.46
Talbot Hill 350	1,045	1,105	1.71
Talbot Hill 270	48	71	1.71
West Talbot Hill 300	154	166	1.71
Total	**16,668**	**18,403**	

Notes:
(1) Peaking factors were developed for the existing pressure zones. At the time the SCADA data was recorded, the new Kennydale 308 and Highlands 445 PZs were not implemented.
Abbreviation: gpm – gallons per minute.

Equalizing volume requirements were calculated for each reservoir using the following equation and are summarized in Table 7.4:

150 min x (PHD – MDD)

where the PHD was calculated based on peak hour to max day peak factors measured for each operational area.

Table 7.4 Equalizing Storage Volumes

Operational Area	PHD / MDD(1)	2029 Equalizing Volume (MG)	2039 Equalizing Volume (MG)
Valley 196	1.69	0.330	0.361
West Hill 495	1.54	0.062	0.065
Highlands 445	1.32	0.128	0.145
Highlands 565	1.43	0.177	0.202
Rolling Hill 590	1.28	0.021	0.023
Rolling Hill 490	1.46	0.033	0.036
Talbot Hill 350	1.71	0.078	0.084

Note:
(1) PHD peak factor measured for each operational area.

7.3.1.3 Standby Storage and Fire-Suppression Storage

Standby Storage volumes are required to supply reasonable system demands during a system emergency, such as the disruption of the water supply caused by a transmission pipeline or equipment failure, power outage, valve failure, or other system interruptions (as discussed in Chapter 5). Table 7.5 shows the required standby storage for each operational area.

The Washington State Department of Health (DOH) Water System Design Manual recommends a minimum standby storage of no less than 200 gallons per Equivalent Residential Unit (gal/ERU).

Table 7.5 Standby Storage Volumes

Operational Area	ERUs			Standby Storage Volume (MG)		
	2019	2029	2039	2019	2029	2039
Valley 196	14,600	15,995	17,290	2.92	3.20	3.46
West Hill 495	1,693	1,910	2,070	0.67(1)	0.71(1)	0.74(1)
Highlands 445	10,575	13,385	15,060	2.12	2.68	3.01
Highlands 565	11,820	13,590	15,445	2.36	2.72	3.09
Rolling Hills 590	2,365	2,495	2,695	0.47	0.5.0	0.54
Rolling Hills 490	2,265	2,385	2,550	0.45	0.48	0.51
Talbot Hill 350	3,475	3,640	3,875	0.69	0.73	0.77

Note:
(1) Includes Standby Storage for the Skyway Water and Sewer District (Skyway).

Fire flow demand is the quantity of water required for firefighting as defined by applicable water system criteria and fire codes. Firefighting often places the largest demands on a water system because a high volume of water must be supplied over a short time. Such demands require each component of the system to operate at its optimal condition.

With that being said, the FSS level depends on maximum flow rates and duration. Water systems must have storage reservoirs that can meet fire flow requirements while maintaining 20 psi throughout the distribution system. Table 7.6 outlines the required maximum fire flow, duration, and FSS volume for each operational area.

Table 7.6 Required Maximum Fire Flow

Operational Area	Required Fire Flow (gpm)	Required Duration (hours)	Required FSS (MG)	Location
Valley 196	6,000	4	1.44	Boeing Plant
West Hill 495	3,000	3	0.54	Sky Lanai Apartments
Highlands 445	4,500	4	1.08	Southport Commercial Development
Highlands 565	4,500	4	1.08	Safeway/Highlands Shopping Center
Rolling Hills 590	5,000	4	1.20	Rolling Hills Apartments
Rolling Hills 490	5,000	4	1.20	Eagle Ridge Apartments
Talbot Hill 350	5,500	4	1.32	Valley Medical Center

Either standby storage or fire-suppression storage, whichever volume is smaller, can be excluded from each zone's total storage requirement (this is also known as "nested" storage). Table 7.7 outlines the nested standby storage and fire-suppression storage for each operational area.

Table 7.7 Nested Standby Storage and Fire-Suppression Storage

Operational Area	Volume (MG)			Controlling Factor (FSS or SS)(1)		
	2019	2029	2039	2019	2029	2039
Valley 196	2.92	3.20	3.46	Standby	Standby	Standby
West Hill 495	0.67	0.71	0.74	Standby	Standby	Standby
Highlands 445	2.12	2.68	3.01	Standby	Standby	Standby
Highlands 565	2.36	2.72	3.09	Standby	Standby	Standby

Operational Area	Volume (MG)			Controlling Factor (FSS or SS)(1)		
	2019	2029	2039	2019	2029	2039
Rolling Hills 590	1.20	1.20	1.20	Fire	Fire	Fire
Rolling Hills 490	1.20	1.20	1.20	Fire	Fire	Fire
Talbot Hill 350	1.32	1.32	1.32	Fire	Fire	Fire

7.3.1.4 Dead Storage

Dead storage volume is the volume at the bottom of the storage tank that cannot be used because it's physically too low to be withdrawn from the tank or, if withdrawn from the tank, would result in water pressures in the distribution system that are below the acceptable criteria of 20 psi during a fire or emergency situation. Storage volume is considered dead if it's located below the outlet pipe and cannot be used because of system hydraulic limitations or if it cannot be used because of water-quality problems associated with the volume in this lowest portion of the tank. One other major cause of dead storage in storage tanks is customer elevations. Water levels in tanks cannot be lowered more than 20 psi at the highest customer in the zone served by the tank. Figure 7.4 shows the elevation of the highest customer served by each reservoir.

Table 7.8 summarizes the dead volume calculations for each reservoir.

Table 7.8 Reservoir Dead Storage

Reservoir (Nominal Volume, MG)	Base Elevation (ft)	Maximum elevation served (ft)	Required elevation at 20 psi (ft)	Outlet Elevation (ft)	Dead Volume (MG)
North Talbot (5.0)	173.2	128.8	175.0	199.7	0.00
Mt Olivet (3.0)	146.9	128.8	175.0	184.1	2.13
Highlands 435 (1.5)	Decommissioned				
Highlands 435 (2.0)	Decommissioned				
Highlands 445 (6.3)	425.3	367.5	413.7	445.0	0.00
Kennydale 308 (1.3)	220.0	216.0	262.2	308	0.62
Highlands 565 (0.75)	534.1	472.5	530.7	569.3	0.00
Hazen (4.2)	457.5	472.5	530.7	569.3	2.75
Rolling Hills 590(0.3)	565.5	476	522.2	593.6	0.00
Rolling Hills 490(3)	458	392.4	438.6	494.5	0.00
West Hill (1.4)	395.6	392.9	439.1	498.6	0.59
South Talbot (1.5)	326.6	253.8	300.0	353.6	0.00

Note, there are two customers in the North Talbot/Mt Olivet area with higher service elevations than the one noted in Table 7.8. One property is a vacant lot (4521 Talbot Rd S) with a service elevation of 159 ft (the nearest model junction is J4367), while the other property is a single-family home located at 5218 Talbot Rd S with a service elevation of 140 ft (the nearest model junction is J6057). The City is in the process of moving these customers to the Talbot Hill 350 PZ; therefore, they are not included in the group of customers with the highest elevations in that service area.

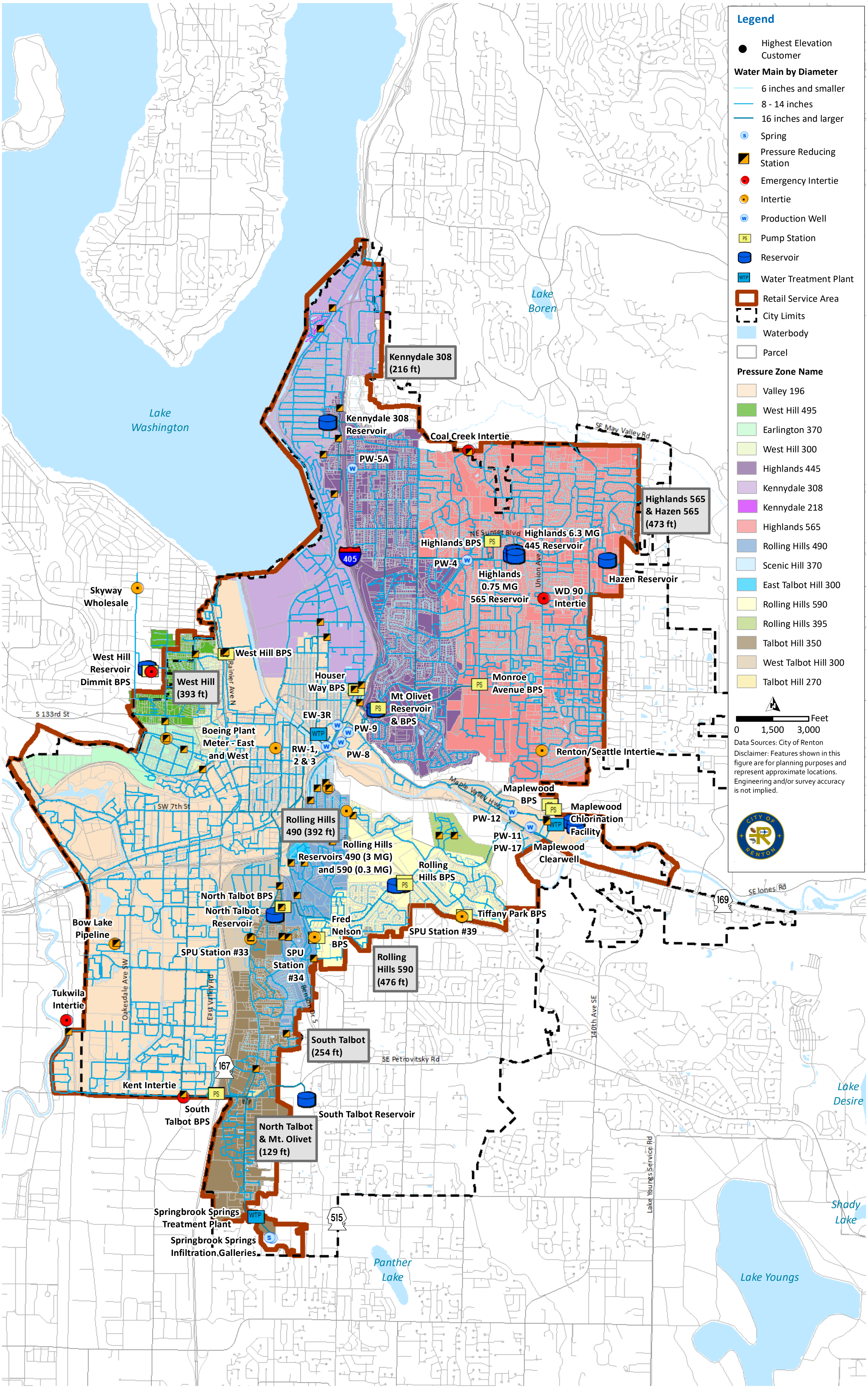


Figure 7.4 Highest Elevation Customers

7.3.2 Storage Analysis by Operational Area

The seven operational areas were evaluated as separate systems to ensure that each has the required usable operational, equalizing, fire, and standby storage volume, as summarized below.

Recommendations for operational areas that require storage improvements are offered subsequently in Section 7.3.3.

7.3.2.1 Valley Operational Area

Storage for the Valley Operational Area is contained within the North Talbot and Mt. Olivet Reservoirs, which have a combined total storage volume of 7.89 MG. According to the highest customer elevation, the available storage at 20 psi is 5.76 MG combined for the Valley. Table 7.9 summarizes the storage analysis for the Valley.

As shown in the analysis presented in Table 7.9, this area has sufficient storage through 2039 to serve its customers at 20 psi. However, the operational and equalizing storage must be available at a minimum of 30 psi for the highest resident served. The total available reservoir volume available at 30 psi is only 0.36 MG, which is 0.88 MG less than what is required in 2029 and 0.91 MG less than what is required in 2039.

Table 7.9 Valley Storage Analysis

	2029	2039
Required Storage Components (MG)		
Operational	0.91	0.91
Equalizing	0.33	0.36
Standby / Fire Suppression	3.20	3.46
Total Required Storage at 30 psi (MG)	**1.24**	**1.27**
Total Required Storage at 20 psi (MG)	**4.44**	**4.73**
Existing Storage (MG)		
Total Storage	7.89	7.89
Available Storage at 30 psi	0.36	0.36
Available Storage at 20 psi	5.76	5.76
Excess (Deficit) Existing Storage at 30 psi (MG)	**(0.88)**	**(0.91)**
Excess (Deficit) Existing Storage at 20 psi (MG)	**1.32**	**1.04**

7.3.2.2 West Hill 495 Operational Area

Storage for the West Hill 495 Operational Area is contained within the West Hill Reservoir, which has a total storage volume of 1.39 MG. According to the highest customer elevation, only 0.81 MG is available to the distribution system customers at 30 psi. The West Hill Reservoir also provides fire suppression storage and standby storage for Skyway based on the existing agreement with Skyway (Appendix D). It was assumed that no two simultaneous fires will occur in the West Hill 495 Operational Area and Skyway so the maximum fire flow requirement between the City and Skyway was considered. Table 7.10 summarizes the storage analysis for the West Hill 495 Operational Area.

With the existing reliable sources and reservoirs, this area does not have sufficient storage through 2039. The City currently operates the tank with a 16 ft operational band, which has a 0.22 MG operational storage volume (as shown in Table 7.10).

Table 7.10 West Hill 495 Storage Analysis

	2029	2039
Required Storage Components (MG)		
Operational	0.22	0.22
Equalizing	0.06	0.07
Standby / Fire Suppression	0.71	0.74
Total Required Storage at 30 psi (MG)	**0.28**	**0.28**
Total Required Storage at 20 psi (MG)	**0.99**	**1.03**
Existing Storage (MG)		
Total Storage	1.39	1.39
Available Storage at 30 psi	0.49	0.49
Available Storage at 20 psi	0.81	0.81
Excess (Deficit) Existing Storage at 30 psi (MG)	**0.22**	**0.21**
Excess (Deficit) Existing Storage at 20 psi (MG)	**(0.19)**	**(0.22)**

7.3.2.3 Highlands 445 Operational Area

Storage for the Highlands 445 Operational Area is contained within the two new reservoirs the City is currently building: Highlands 445 Reservoir and Kennydale 308 Reservoir. These reservoirs have a total capacity of 7.59 MG. According to the highest elevations in the operational area, Highlands 445 has a total available storage of 6.97 MG at 20 psi but only 2.58 MG at 30 psi. Table 7.11 summarizes the storage analysis for the Highlands 445 Operational Area.

With the existing reliable sources and reservoirs, this area has sufficient storage through 2039.

Table 7.11 Highlands 445 Storage Analysis

	2029	2039
Required Storage Components (MG)		
Operational	0.61	0.61
Equalizing	0.13	0.15
Standby / Fire Suppression	2.68	3.01
Total Required Storage at 30 psi (MG)	**0.74**	**0.75**
Total Required Storage at 20 psi (MG)	**3.41**	**3.77**
Existing Storage (MG)		
Total Storage	7.59	7.59
Available Storage at 30 psi	2.58	2.58
Available Storage at 20 psi	6.97	6.97
Excess (Deficit) Existing Storage at 30 psi (MG)	**1.85**	**1.83**
Excess (Deficit) Existing Storage at 20 psi (MG)	**3.56**	**3.20**

7.3.2.4 Highlands 565 Operational Area

Storage for the Highlands 565 Operational Area is contained within the Hazen and Highlands 565 Reservoirs, which together have a total storage volume of 4.95 MG. According to the highest customer elevations, available storage in the Highlands 565 equates to 1.20 MG at 30 psi and 2.20 MG at 20 psi. Additionally, because of significant headloss to some of the customers with high fire flow requirements, dead storage was increased by 16 feet. Table 7.12 summarizes the storage analysis for the Highlands 565 Operational Area.

Even with the existing reliable sources and reservoirs, this area does not have sufficient storage for all planning years until 2039 and will be by 1.26 MG in 2029 and 1.65 MG in 2039.

Table 7.12 Highlands 565 Storage Analysis

	2029	2039
Required Storage Components (MG)		
Operational	0.56	0.56
Equalizing	0.18	0.20
Standby / Fire Suppression	2.72	3.09
Total Required Storage at 30 psi (MG)	**0.74**	**0.76**
Total Required Storage at 20 psi (MG)	**3.46**	**3.85**
Existing Storage (MG)		
Total Storage	4.95	4.95
Available Storage at 30 psi	1.20	1.20
Available Storage at 20 psi	2.20	2.20
Excess (Deficit) Existing Storage at 30 psi (MG)	**0.46**	**0.43**
Excess (Deficit) Existing Storage at 20 psi (MG)	**(1.26)**	**(1.65)**

7.3.2.5 Rolling Hills 590 Operational Area

Storage for the Rolling Hills 590 Operational Area is contained within the Rolling Hills 590 Reservoir, which has an available storage volume of 0.3 MG. Table 7.13 summarizes the storage analysis for the Rolling Hills 590 Operational Area.

Like the Highlands 565 Operational Area, the Rolling Hills 590 Operational Area also does not have sufficient storage for all planning years until 2039. Existing storage is limited to 0.3 MG and required emergency and fire flow is four-times larger than the size of the tank providing water to the zone.

Additional storage is required in this operational area.

Table 7.13 Rolling Hills 590 Storage Analysis

	2029	2039
Required Storage Components (MG)		
Operational	0.03	0.03
Equalizing	0.02	0.02
Standby / Fire Suppression	1.20	1.20
Total Required Storage at 30 psi (MG)	**0.05**	**0.05**
Total Required Storage at 20 psi (MG)	**1.25**	**1.25**
Existing Storage (MG)		
Total Storage	0.30	0.30
Available Storage at 30 psi	0.30	0.30
Available Storage at 20 psi	0.30	0.30
Excess (Deficit) Existing Storage at 30 psi (MG)	**0.25**	**0.25**
Excess (Deficit) Existing Storage at 20 psi (MG)	**(0.95)**	**(0.95)**

7.3.2.6 Rolling Hills 490 Operational Area

Storage for the Rolling Hills 490 Operational Area is contained within the Rolling Hills 490 reservoir, which has an available storage volume of 3.04 MG. Table 7.14 summarizes the storage analysis for the Rolling Hills 490 Operational Area.

With the existing reliable sources and reservoir, this area has sufficient storage through 2039.

Table 7.14 Rolling Hills 490 Storage Analysis

	2029	2039
Required Storage Components (MG)		
Operational	0.36	0.36
Equalizing	0.03	0.04
Standby / Fire Suppression	1.20	1.20
Total Required Storage at 30 psi (MG)	**0.40**	**0.40**
Total Required Storage at 20 psi (MG)	**1.60**	**1.60**
Existing Storage (MG)		
Total Storage	3.04	3.04
Available Storage at 30 psi	2.73	2.73
Available Storage at 20 psi	3.04	3.04
Excess (Deficit) Existing Storage at 30 psi (MG)	**2.34**	**2.34**
Excess (Deficit) Existing Storage at 20 psi (MG)	**1.44**	**1.44**

7.3.2.7 Talbot Hill 350 Operational Area

Storage for the Talbot Hill 350 Operational Area is contained within the South Talbot reservoir, which has an available storage volume of 1.59 MG. Table 7.15 summarizes the storage analysis for the Talbot Hill 350 Operational Area.

With the existing reliable sources and reservoir, this area has sufficient storage for all planning years until 2039.

Table 7.15 Talbot Hill 350 Storage Analysis

	2029	2039
Required Storage Components (MG)		
Operational	0.14	0.14
Equalizing	0.08	0.08
Standby / Fire Suppression	1.32	1.32
Total Required Storage at 30 psi (MG)	**0.21**	**0.22**
Total Required Storage at 20 psi (MG)	**1.53**	**1.54**
Existing Storage (MG)		
Total Storage	1.59	1.59
Available Storage at 30 psi	1.59	1.59
Available Storage at 20 psi	1.59	1.59
Excess (Deficit) Existing Storage at 30 psi (MG)	**1.37**	**1.37**
Excess (Deficit) Existing Storage at 20 psi (MG)	**0.05**	**0.05**

7.3.3 Storage Recommendations

Storage deficits were identified in the following operational areas: the Valley, Highlands 565, West Hill 495, and Rolling Hills 590. The identified storage deficits can be mitigated by constructing additional storage or making changes to the operational strategy. In some cases, small improvements to the existing infrastructure, such as adding backup power to provide reliability, can better alleviate the storage deficiencies than adding storage.

All recommended projects are summarized in the sections below.

7.3.3.1 Valley Storage Recommendation

Storage analysis showed that although this area has sufficient storage at 20 psi, the Valley is deficient for all planning years until 2039 in supplying operational and equalizing volumes at 30 psi to the highest customers.

As mentioned before, to address this issue, the City is connecting high-elevation residents within the Valley 196 PZ to higher pressure infrastructure. These improvements will then provide adequate operating pressures and fire flow pressures to these high-elevation residents.

7.3.3.2 Highlands 565 Storage Recommendation

The Highlands 565 Operational Area does not have sufficient storage for all planning years until 2039. Excess storage located in the Highlands 445 Operational Area is sufficient to offset deficiencies in Highlands 565.

A backup power generator is recommended at the Monroe Avenue booster pump station (BPS) to allow storage to be provided from the Highlands 445 PZ to the Highlands 565 PZ, which will also improve pumping capacity in the long term. The City is already planning on adding a generator at Monroe BPS as part of constructing a new 6.3-MG reservoir in the Highlands 445 PZ.

7.3.3.3 West Hill 495 Storage Recommendation

Even with the existing reliable sources and reservoirs, the West Hill 495 Operational Area does not have sufficient storage through 2039.

Excess storage located in the Valley Operational Area is sufficient to offset deficiencies in the West Hill 495. The Valley Operational Area has 1.04 MG of excess storage available by 2039, which can be reliably pumped to the West Hill 495 Operational Area via the new West Hill BPS. The City is currently planning on expanding capacity of the West Hill PS and adding a generator at the West Hill BPS as part of the West Hill BPS Improvement Project.

Additionally, the City currently operates the tank with a 16 ft operational band, which equates to a 0.22-MG operational storage volume. It is recommended that the City update operational strategy and reduce the operational band thus decreasing the operational volume and helping to mitigate deficiencies.

7.3.3.4 Rolling Hills 590 Recommendation

As shown in the storage analysis, the Rolling Hills 590 Operational Area does not have sufficient storage for all planning years, being deficient by 0.95 MG by 2039. The City has a few options to mitigate this deficiency:

- Add backup power to the Maplewood BPS to increase pumping capacity from the Rolling Hills 490 PZ to the Rolling Hills 590 PZ, and add auto-start, auto-transfer, and backup power to the Rolling Hills BPS so that three pumps can be operated at the same time.
- Construct a new 1.5-MG standpipe for the Rolling Hills 590 Operational Area, replacing the existing 0.3-MG tank.

7.4 Distribution System Analysis

The calibrated InfoWater model of the City's distribution system was used to analyze the system for future planning years, and projected system demands were added for the 2019, 2029, and 2039 planning years. The hydraulic model was used to evaluate typical system conditions during diurnal operations and fire flow availability. Then, the model was updated and calibrated for both extended period simulation with temporary pressure loggers and steady state with hydrant flow tests.

Fire Hydrant Test – June 2018

Model calibration uses fire flow tests intended to stress the City's distribution system by creating a differential in pressure in the system.

Pressure Recording Equipment used during field testing

Pressure recording devices and pressure loggers were used to record pressures throughout the system during the flow tests

City crew used diffusers with flow readings to record flowing flow at the hydrants during each test.

Hydrant Set-up for one of the fire flow tests

Flowing water was typically routed to the closest stormwater catchments. Dechlorination equipment was used by City crew.

Flow Management during fire flow tests

Appendix P summarizes the calibration field plans and testing locations while Appendix Q details the model update and calibration steps and calibration results.

7.4.1 Evaluation Criteria

Chapter 5 discussed system policies and criteria in detail. Key parameters evaluated with the model were for the system pressure criteria during normal operations and fire flow testing of the system. During normal operations, the minimum pressure as set by the DOH during MDD and PHD was 30 psi at the service meter.

The City's goal is to provide a maximum of 110 psi at the service meter. The Building Code requires individual pressure-reducing valves (PRVs) to be installed by property owners when the meter pressure exceeds 80 psi.

7.4.1.1 Land-Use-Based Fire Flow Requirements

Table 7.16 summarizes the required fire flow and duration of this flow according to land use. During any fire event, the minimum pressure should be greater than 20 psi at the end of the fire in the entire distribution system. Figure 7.5 additionally shows the fire flow required at nodes throughout the system according to land use. Only junctions near hydrants were assigned a fire flow.

Table 7.16 Service Criteria for Required Fire Flow

Land Use	Required Flow (gpm)	Required Duration (hours)
Single family	1,000	2
Multifamily and Commercial/Industrial	3,000	3

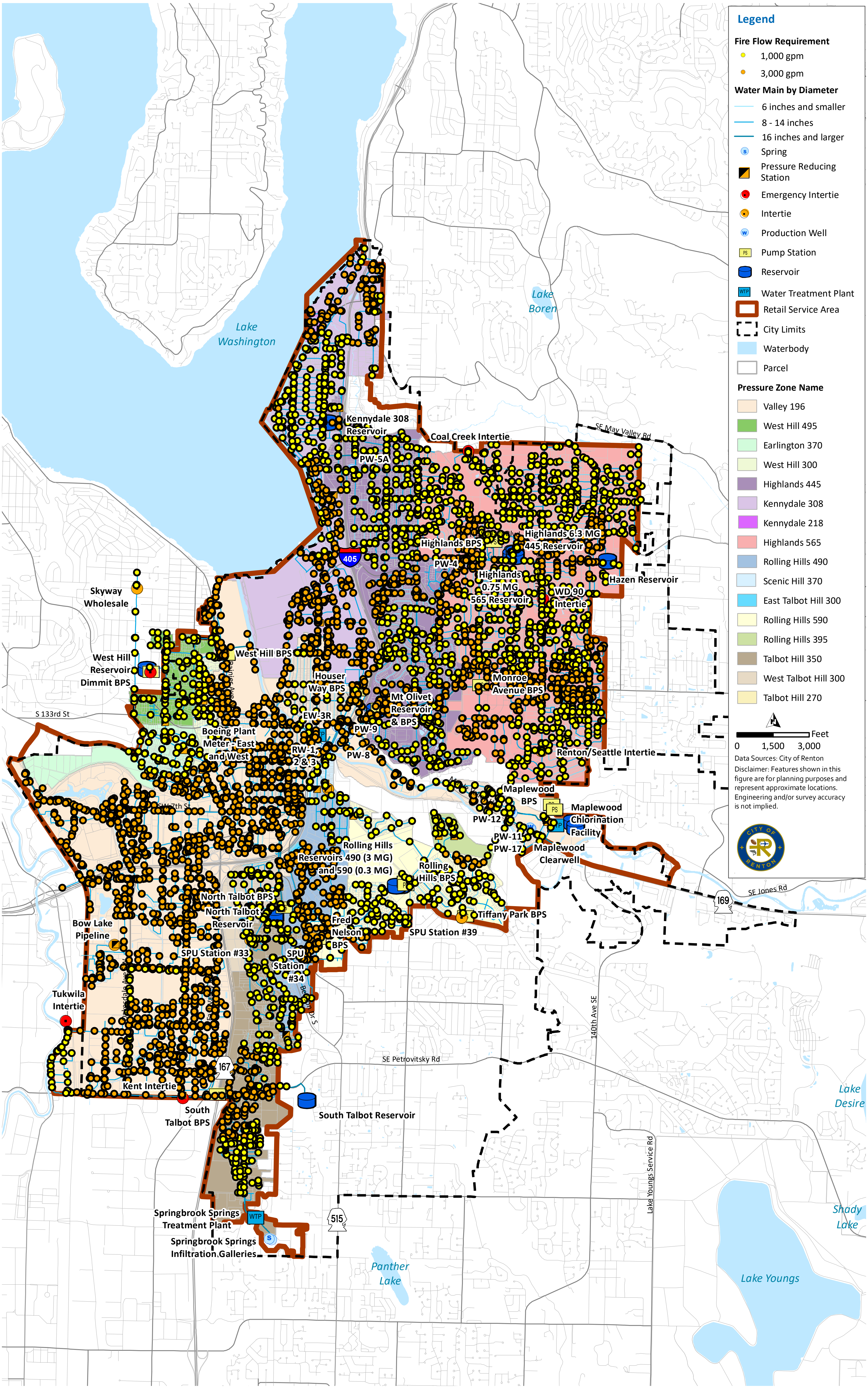


Figure 7.5 Fire Flow Requirements

7.4.1.2 Large Fire Requirements

Beyond the general fire requirements presented in Section 7.4.1.1, some locations have higher fire requirements as specified by the Renton Fire Marshal (RFA). Table 7.17 summarizes the largest of these fires for each zone, whose locations are also shown in Figure 7.6.

Table 7.17 Large Fire Requirements

Zone	Fire Flow Node ID	Large Fire Locations	Fire Flow (gpm)	Duration (hours)
196-1	J5297	4050 Maple Valley Highway (Maplewood Golf Course Clubhouse)	3,000	3
196-2	J2032	South of Martin Luther King Jr. Way & 68th Ave. S (Creston Point Apartments)	3,000	3
196-3	J3616	Northeast of S Carr Rd. & Talbot Rd. S	3,000	3
196-4	J2306	Park Ave. N, between N 6th St. & N 8th St. (Boeing Plant)	6,000	4
196-xx	J1008	400 S 2nd St (Renton High School)	5,000	4
196-xx	J3287	2201 SE Maple Valley Highway (Riviera Apartments)	4,000	4
300WH-5	J6841	NW 4th St. & Taylor Ave. NW (Sky Lanai Apartments)	3,000	3
300-6	J6379	Morris Ave. S & S 18th St.	1,500	2
320-8	J2613	N 29th St. & Park Ave. NE	1,500	2
320-9	J2345	East of Garden Ave. N & N 6th St. (Paccar Kenworth Plant)	3,000	3
320-xx	J2998	Lake Washington Blvd N & N Park Dr. (Southport Commercial Development)	4,500	4
320-xx	J1213	5021 Ripley Ln. N (Misty Cove Condominiums)	4,500	4
350-12	J5002	Talbot Rd. S & S 43rd St. (Valley Medical Center)	5,500	4
370-13	J3120	Southwest of SW Sunset Blvd & Earlington Ave. SW (Sunpointe Townhomes)	1,500	3
435-14	J4036	Kirkland Pl. SE & SE 4th St.	1,500	2
435-15	J1196	NE 27th St. & Camas Ave. NE	1,500	2
435-16	J1149	North of NE 10th Pl. & Sunset Blvd NE (Cypress Pine Apartments)	3,000	3
435-17	J2319	West of Monroe Ave. NE & NE 4th St. (Renton Technical College)	3,000	3
490-18	J3285	West of Jones Ave. S & S 7th St.	1,500	2
490-19	J758	S 18th St. between Eagle Ridge Dr. S & Grant Ave. S (Eagle Ridge Apartments)	5,000	4
565-22	J4727	Northwest of Hoquiam Ave. NE & NE 10th St. (Hazen High School)	3,000	3
565-23	J996	Northwest of NE 4th St. & Monroe Ave. NE (Renton Technical College)	3,000	3
565-24	J894	West of Union Ave. SE & SE 4th St. (Sunnydale Mobile Home Park)	3,000	3
565-25	J2425	Union Ave. NE & NE 4th St. (Safeway/Highlands Shopping Center)	4,500	4
590-26	J2087	Pierce Ave. SE & SE 19th Ct.	1,500	2
590-27	J1771	East of Benson Rd S & S 23rd St. (Fred Nelson Middle School)	3,000	3
590-28	J897	Royal Hills Dr. & Monroe Ave SE (Rolling Hills Apartments)	5,000	4

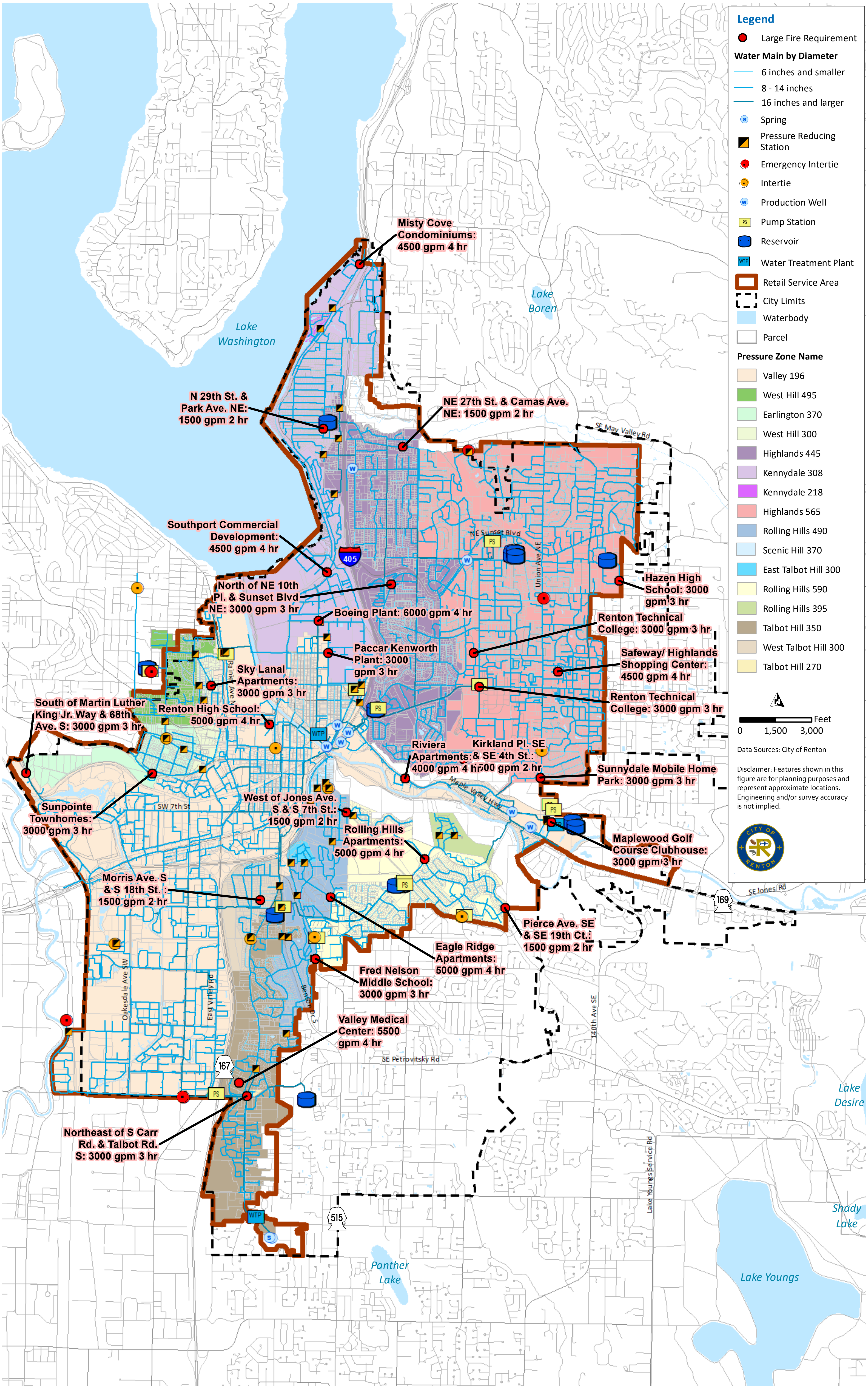


Figure 7.6 Large Fire Requirements

7.4.2 Pressure Results

The model was run in extended period simulation (EPS) for 1 week at average day demand (ADD) and MDD to evaluate general pressure-system conditions for the near-term and long-term planning years. This approach allows the sources, pumps, and tanks to operate as their SCADA and controls are set.

Using the criteria presented in the section above, the hydraulic model provides both maximum pressures and minimum pressures under ADD and PHD conditions, respectively.

Figure 7.6 shows the nodes with maximum pressures for ADD outside of the planning criteria in 2020. Planning years 2029 and 2039 showed similar results but was not included in this chapter. Although the City has no maximum pressure requirement, system pressure above 80 psi (in yellow) and 110 psi (in orange) are identified for informational purposes.

As seen in Figure 7.7, many high pressures exist in the system. Some of the pressure zones cover large-elevation ranges, leading to high pressures at lower elevations. In addition, BPSs commonly discharge into pressure zones near the bottom of a hill, forcing flow to the tank through the distribution system. This requires the hydraulic grade line (HGL) at the bottom of the hill to be higher than the tank overflow level at the top of the hill. In turn, this boosts the pressure in the lower elevations even higher during pumping than under static conditions as proven by tank overflow and meter elevation.

The City completed a rezone evaluation in 2015 that identified potential rezoning improvements to reduce the range of pressures in each zone by creating additional pressure zones. The City is still in the process of reviewing and deciding on the best action plan based on the rezone evaluation results.

Figure 7.8 identifies nodes with pressures lower than 30 psi during PHD. These results are for planning year 2039, which corresponds to the worst-case scenario with the highest demands. Of the low-pressure nodes (below 30 psi), some exist adjacent to the Springbrook transmission line. The City has been working on moving the customer connections to this line to the adjacent higher-pressure line. The model results had other low-pressure nodes near reservoirs; these nodes were excluded in the evaluation as service connections do not exist according to City staff.

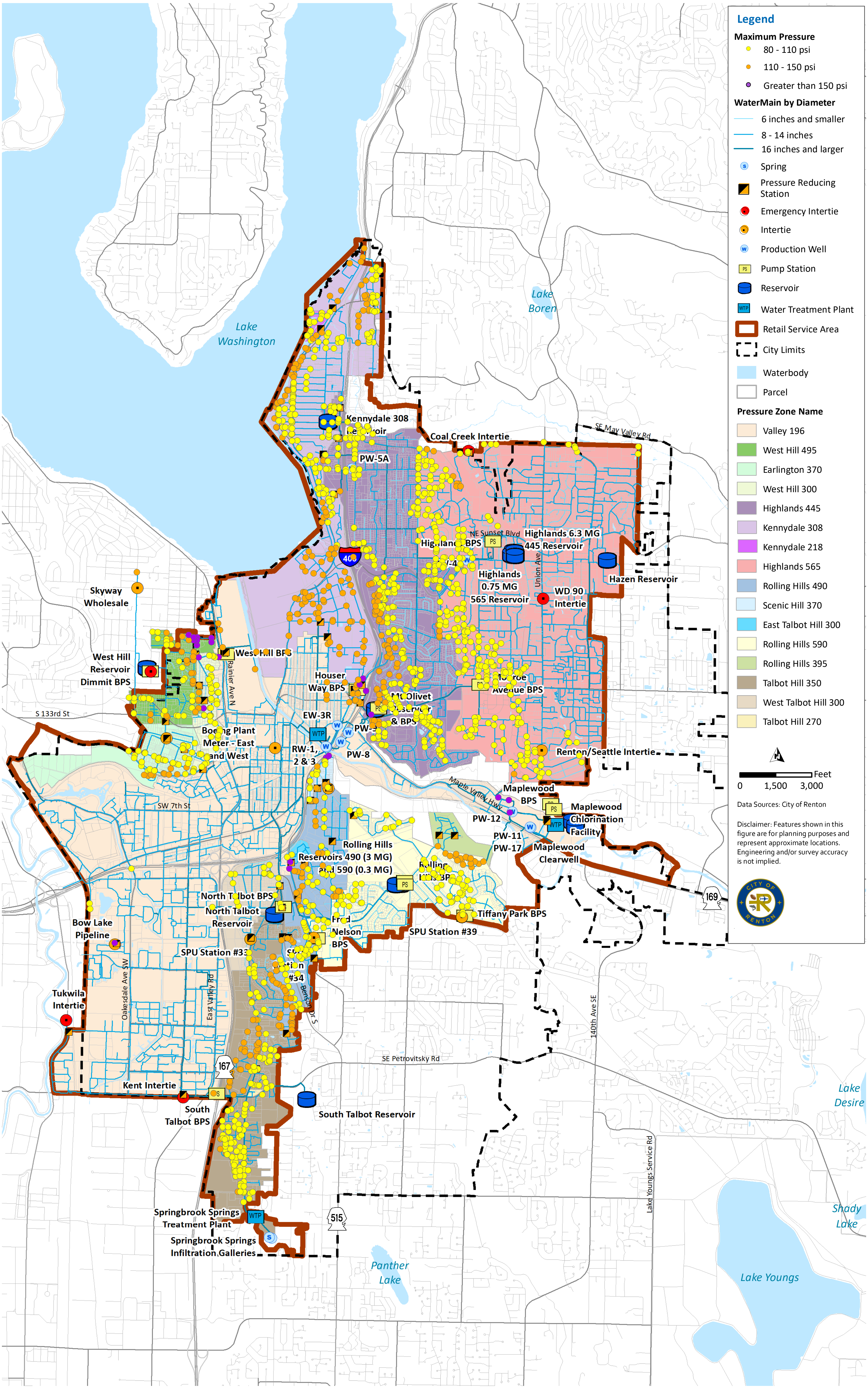


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Figure 7.7 Maximum Pressure under ADD Condition in Planning Year 2020 ADD without Improvements

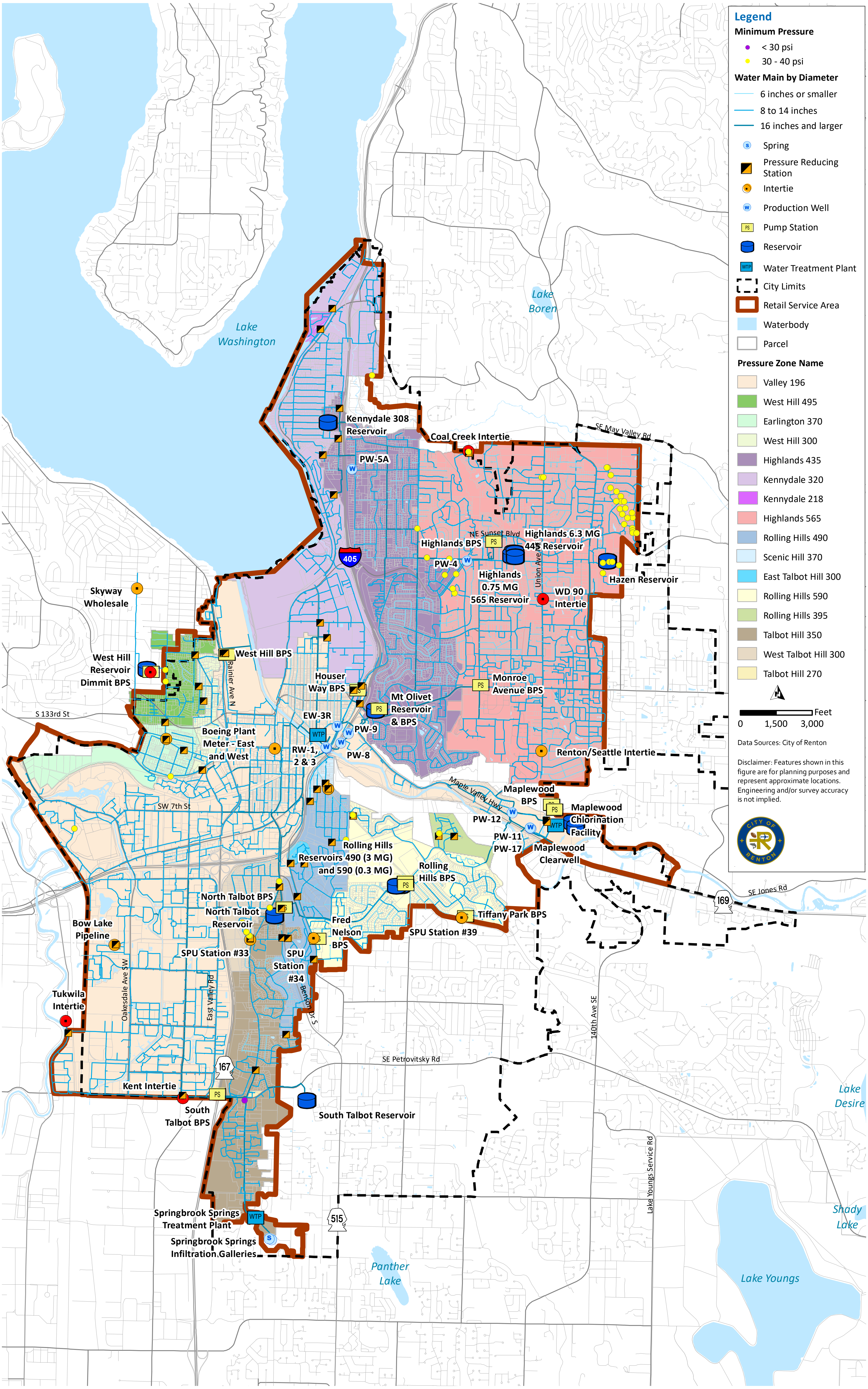

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Figure 7.8 Minimum Pressure under PHD Condition in Planning Year 2039 without Improvements

7.4.3 Velocity Results

The City's goal is to maintain velocities under 8 feet per second (fps) in distribution pipes during PHD. One segment of piping was found to exceed the velocity criteria in every planning year: this 8-inch line is located at Maple Valley Highway and Interstate 405 (I-405), where velocity reaches 9.5 fps, as shown in Figure 7.9. This section of pipe is surrounded by 12-inch pipes.

Figure 7.9 Maximum Velocity in Planning Year 2039 without Improvements

7.4.4 Fire Flow Analysis

Fire flows are typically the largest flows a system experiences and often a major factor in pipe sizing and network configurations. Using the fire flow test feature, the hydraulic model tested the fire capabilities at the 27 large fire locations. Specifically, it systematically simulated a fire at each model node representing a fire hydrant for each of the planning years. All system nodes with service connections were tested for a minimum pressure of 20 psi during the point fire demands. Table 7.18 summarizes the available fire flow at these locations in both 2029 and 2039.

Figure 7.10 shows the low-pressure node results from the fire flow analysis for the large fire locations. All of the locations have adequate fire flow available, except for one location at Northeast of S Carr Rd. and Talbot Rd. S.

The model was also used to perform a general system-wide fire analysis at 1,000 gpm and 3,000 gpm, testing all system nodes with service connections for 20 psi in both 2029 and 2039. Figure 7.11 shows nodes that do not meet the 20-psi requirement during required fire flows. Areas of particular susceptibility were dead-end mains, areas of older 4-inch and 6-inch asbestos cement (AC) piping networks, and areas near high elevation points in a pressure zone.

Table 7.18 Large Fire Results

Fire Flow Node ID	Large Fire Locations	Fire Flow (gpm)	Available Fire Flow in 2039 (gpm)
J5297	4050 Maple Valley Highway (Maplewood Golf Course Clubhouse)	3,000	8,461
J2032	South of Martin Luther King Jr. Way & 68th Ave. S (Creston Point Apartments)	3,000	3,796
J3616	Northeast of S Carr Rd. & Talbot Rd. S	3,000	1,644
J2306	Park Ave. N, between N 6th St. & N 8th St. (Boeing Plant)	6,000	16,455
J1008	400 S 2nd St (Renton High School)	5,000	11,894
J3287	2201 SE Maple Valley Highway (Riviera Apartments)	4,000	6,307
J6841	NW 4th St. & Taylor Ave. NW (Sky Lanai Apartments)	3,000	6,296
J6379	Morris Ave. S & S 18th St.	1,500	2,408
J2613	N 29th St. & Park Ave. NE	1,500	4,257
J2345	East of Garden Ave. N & N 6th St. (Paccar Kenworth Plant)	3,000	14,788
J2998	Lake Washington Blvd N & N Park Dr. (Southport Commercial Development)	4,500	15,592
J1213	5021 Ripley Ln. N (Misty Cove Condominiums)	4,500	6,137
J5002	Talbot Rd. S & S 43rd St. (Valley Medical Center)	5,500	19,289
J3120	Southwest of SW Sunset Blvd & Earlington Ave. SW (Sunpointe Townhomes)	1,500	5,701
J4036	Kirkland Pl. SE & SE 4th St.	1,500	4,229
J1196	NE 27th St. & Camas Ave. NE	1,500	2,911
J1149	North of NE 10th Pl. & Sunset Blvd NE (Cypress Pine Apartments)	3,000	7,111
J2319	West of Monroe Ave. NE & NE 4th St. (Renton Technical College)	3,000	11,293
J3285	West of Jones Ave. S & S 7th St.	1,500	4,717
J758	S 18th St. between Eagle Ridge Dr. S & Grant Ave. S (Eagle Ridge Apartments)	5,000	6,196
J4727	Northwest of Hoquiam Ave. NE & NE 10th St. (Hazen High School)	3,000	3,088
J996	Northwest of NE 4th St. & Monroe Ave. NE (Renton Technical College)	3,000	14,173
J894	West of Union Ave. SE & SE 4th St. (Sunnydale Mobile Home Park)	3,000	6,816
J2425	Union Ave. NE & NE 4th St. (Safeway/Highlands Shopping Center)	4,500	11,243
J2087	Pierce Ave. SE & SE 19th Ct.	1,500	2,919
J1771	East of Benson Rd S & S 23rd St. (Fred Nelson Middle School)	3,000	5,202
J897	Royal Hills Dr. & Monroe Ave SE (Rolling Hills Apartments)	5,000	7,968

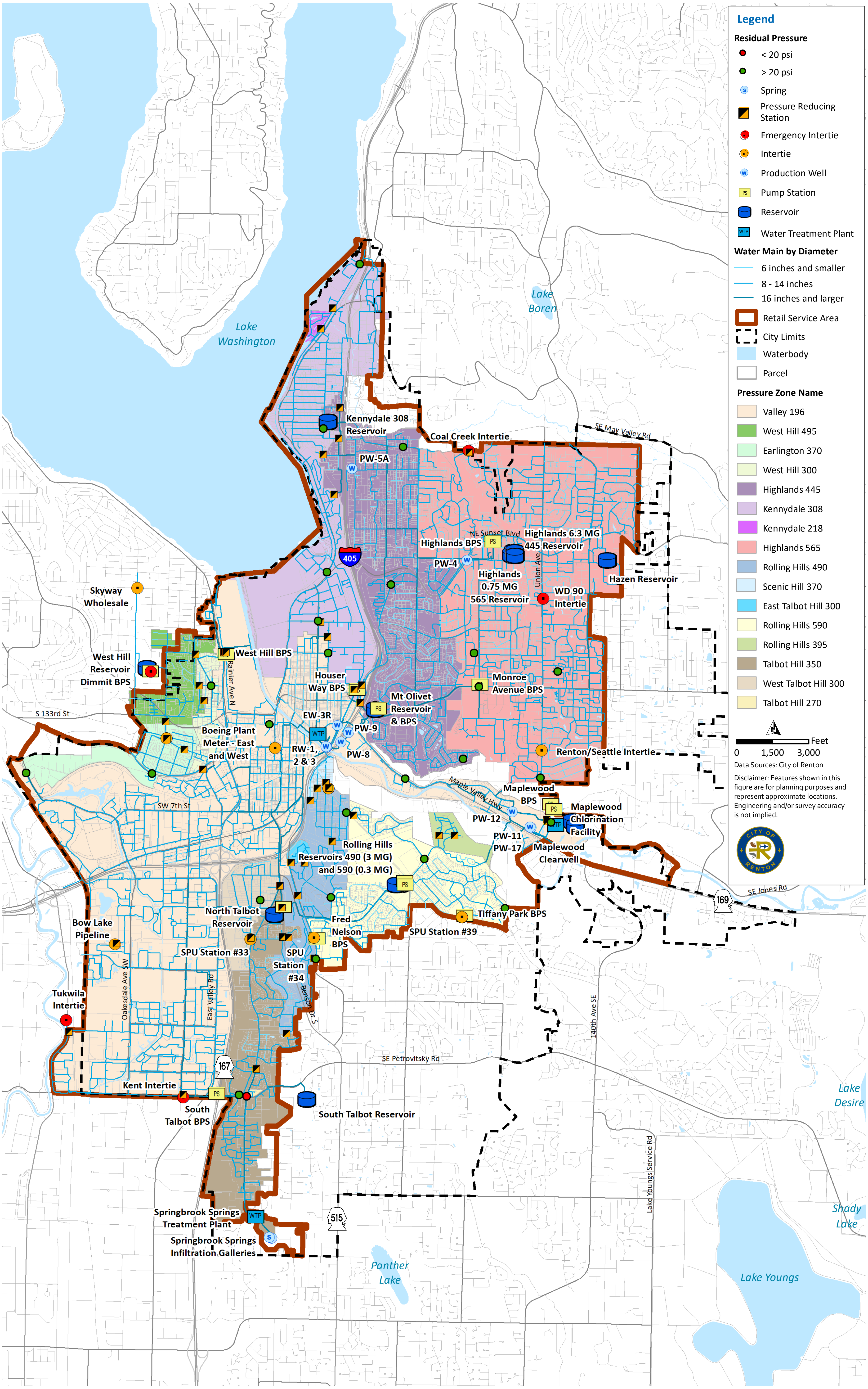

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Figure 7.10 Large Fire Locations Below Minimum Required Residual Pressure (less than 20 psi) during 2039 MDD and Fire Flow without Improvements)

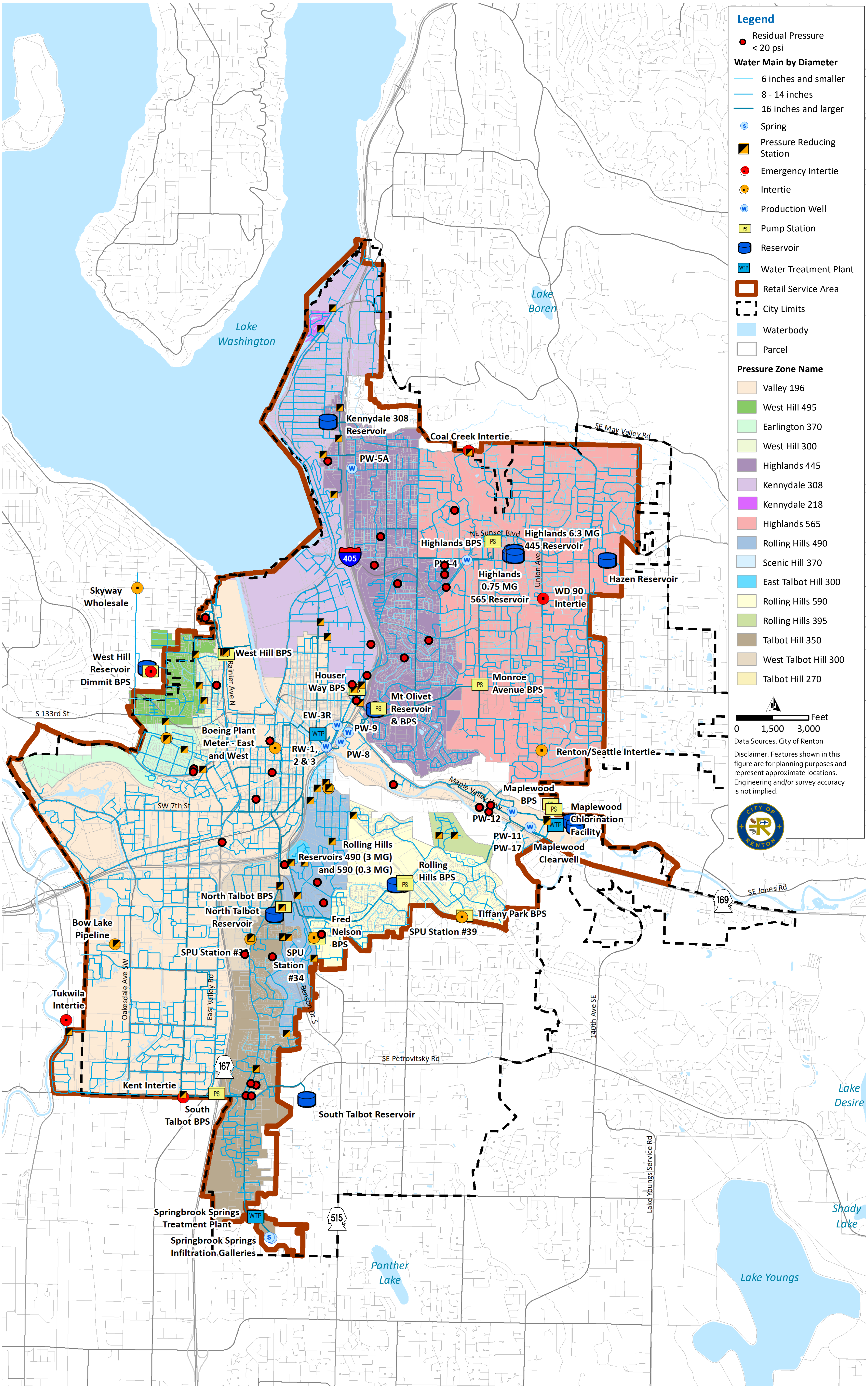

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Figure 7.11 Areas Below Minimum Required Residual Pressure (less than 20 psi) during 2039 MDD and Fire Flow without Improvements

7.4.5 Distribution System Recommendations

This section offers recommendations to meet the deficiencies identified in the previous section. Improvements include actions such as pipe upsizing, main looping, and modifying pressure zone boundaries. Each of the recommended improvements requires a further site-specific and project-level engineering analysis before implementation.

Recommendations are summarized by type of improvement in the following sections.

7.4.5.1 Projects to Address Low Peak-Hour Pressure

Some low-pressure nodes (below 30 psi) exist adjacent to the Springbrook transmission line. The City has been working to remove connections to this line and relocate them onto an adjacent higher-pressure line.

The model also found other low-pressure nodes near reservoirs; however, these nodes were excluded in the evaluation as City staff indicated that service connections do not exist at these sites.

Figure 7.12 shows the location of piping improvements to address remaining low-pressure nodes (see project PZ-01).

7.4.5.2 Projects to Address Excessive Velocity

One 8-inch line located at Maple Valley Highway and I-405 was found to exceed maximum velocity in the distribution system. This section of pipe is surrounded by 12-inch pipes and is recommended to also be upsized to 12-inch.

Project D-13 will upsize 70 ft of 8-inch to 12-inch.

7.4.5.3 Improvements to Address Fire Flow in Non-Dead-End Areas

Deficiencies identified in Section 7.4.4 and shown in Figure 7.10 require improvements to address fire flow deficiencies. The projects include upsizing 4-inch and 6-inch pipes and changing hydrant lateral connections. Detailed information on each recommended pipe improvement can be found in Table 7.19, where individual projects may be referenced based on Project Identification. Once implemented, these projects will eliminate the identified deficiencies.

Figure 7.13 shows the recommended improvements to address fire flow deficiencies in areas that do not include dead-end pipes.

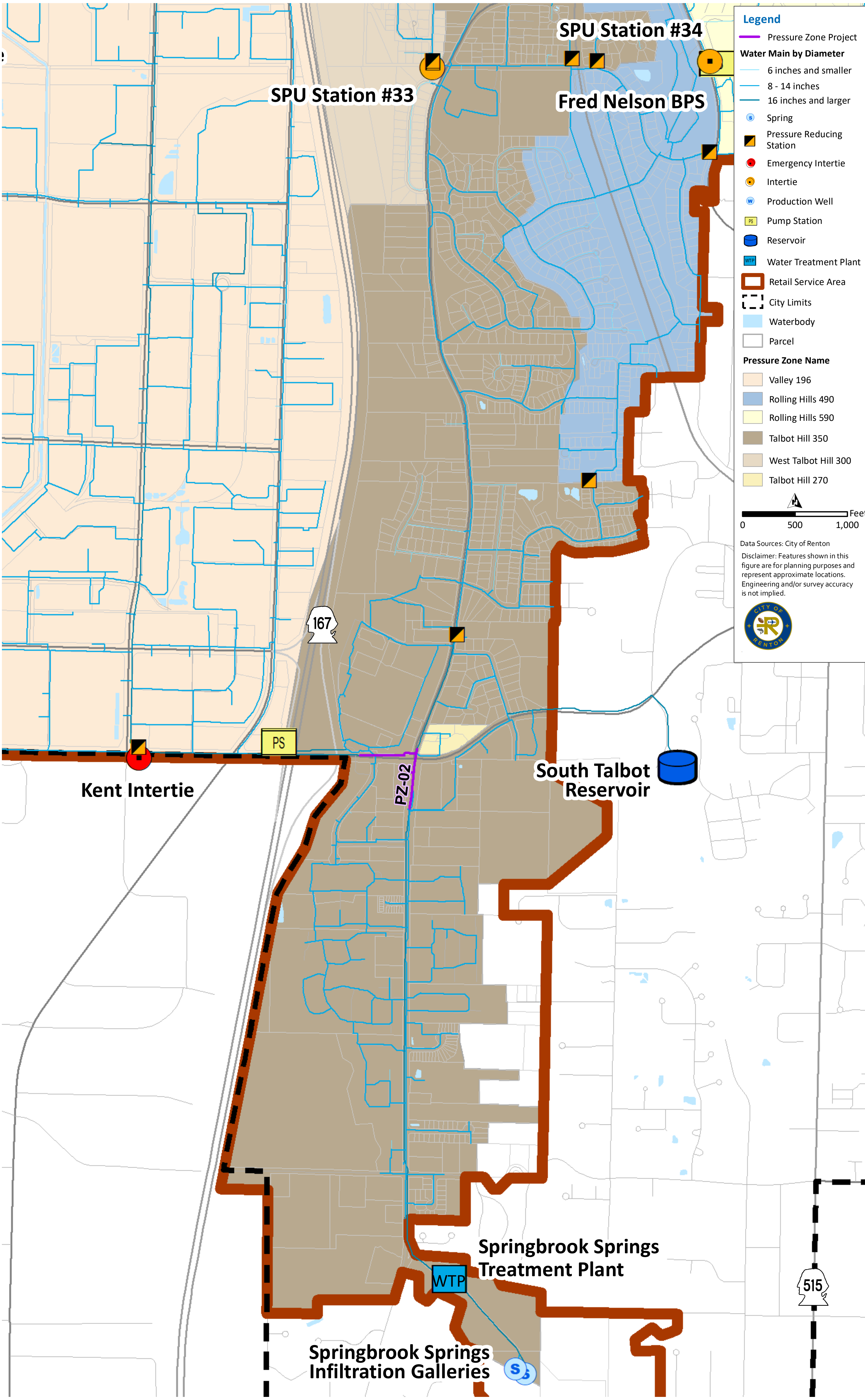


Figure 7.12 Low Pressure Recommended Improvements

Table 7.19 Recommended Piping Projects for Fire Flow Deficiencies

ID	Project Name	Improvement Type	Existing Pipe Dia. (in)	Proposed Pipe Dia. (in)	Location	Fire Flow Requirement (gpm)
D-01	NE 10th Place Pipe Upsize	Upsize Pipe	6	8	NE 10th Place between Sunset Blvd NE and Edmonds Ave NE	3,000
D-02	Ferndale Place NE Pipe Upsize	Upsize Pipe	4	8	Ferndale Pl NE between NE 7th St and Ferndale Ave NE	1,000
D-03	Windsor Heights Pipe Project	Upsize Pipe	4	8	Windsor Pl NE between Bronson Pl NE and Windsor Way NE	1,000
D-04	Sunset Blvd N Pipe Upsize	Upsize Pipe	6	8	Sunset Blvd N between N 3rd St and N 4th St.	3,000
D-05	Maplewood Place SE Pipe Upsize	Upsize Pipe	6	8	Maplewood Pl SE from SE 6th St to SE 7th Ave, SE 7th Ave.	3,000
D-06	NW 4th St Pipe Upsize	Upsize Pipe	6	8	NW 4th St between Taylor Ave NE and Hardie Ave NE.	3,000
D-07	SW Sunset Blvd at Crestview Apartments Pipe Upsize	Upsize Pipe / New PRV	6	12	SW Sunset Blvd at Crestview Apartments	3,000
D-08	Downtown Renton Pipe Project	Upsize pipe / Replace Pipe	4, 6	8	S 4th St between Burnett Ave S and Whitworth Ave S; Whitworth Ave S from Houser Way S to S 6th St, S 6th St from Whitworth Ave S to Morris Ave S.	3,000
D-09	Glenwood Ave NE Pipe Upsize	Upsize pipe	4	8	Glenwood Ave NE and NE 9th Pl	3,000
D-10	S 178th St Pipe Upsize	Upsize pipe	6	8	S 178th St from 98th Ave S south to end of street; Talbot Rd S between SE Carr Rd and S 177th St.	3,000
D-11	N 4th St Pipe Upsize	Upsize Pipe	6	8	N 4th St from Houser Way N west to end of pipe.	3,000
D-12	Hydrant Lateral Connection at Benson Condominium	Change hydrant lateral connection	n/a	n/a	Hydrant S-00110 at Benson Condominium (Benson Rd S)	3,000
D-14	Hydrant Lateral Connection on Sunset Blvd NE	Change hydrant lateral connection	n/a	n/a	Sunset Blvd NE at split to Houser Way Bypass.	3,000
D-15	S 17th St Pipe Upsize	Upsize pipe	4	8	S 17th St between Talbot Rd S and Morris Ave S.	1,000

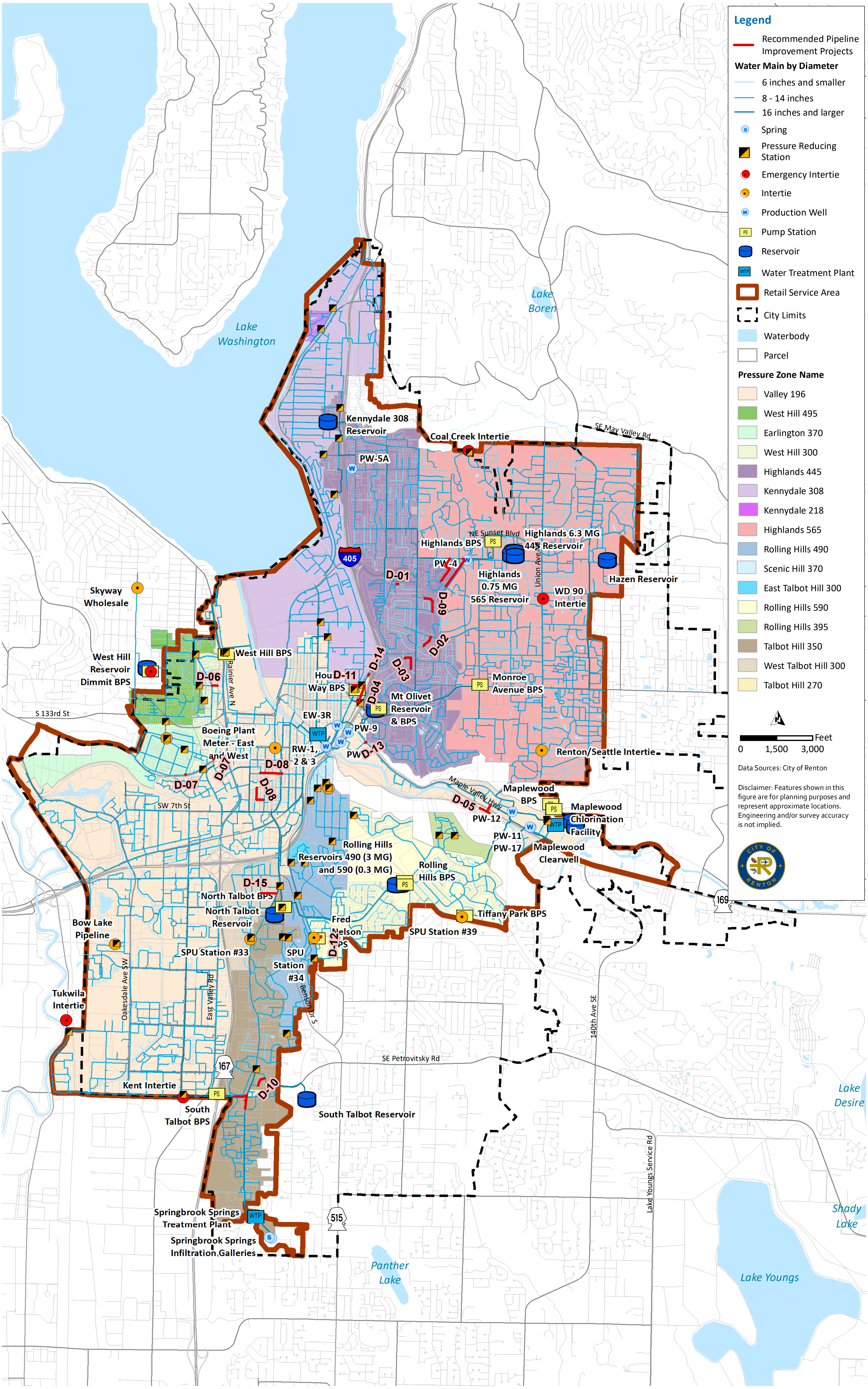


Figure 7.13 Recommended Pipeline Improvement Projects

7.4.5.4 Dead-end Pipes in Non-Single Family Areas

The City has multiple older 4-inch, 6-inch, or 8-inch diameter dead-end pipes in non-single-family areas that do not have the capacity to provide the City's fire flow requirements of 3,000 gpm. It is recommended that the City evaluate each case individually to determine how fire flows can be provided to each customer.

In some cases, a customer may be protected by multiple hydrants on different water mains. As long as the total fire flow from the multiple hydrants meets the fire flow requirement, no improvements are necessary in these cases.

In other cases where only one water main serves the customer, looping may be required or the dead-end main may need to be upsized to 12-inch to meet the fire flow requirements.

Figure 7.14 identifies the location of dead-end pipes that cannot meet their fire flow requirements of 3,000 gpm.

7.4.5.5 Dead-End Pipes in Single-Family Areas

The City also has multiple older 4-inch and 6-inch dead-end pipes in single-family areas that do not have the capacity to provide the City's fire flow requirements of 1,000 gpm. It is recommended that the City evaluate each case individually to determine how fire flows can best be provided to each customer.

The City has been programmatically moving hydrants from the dead-end to the closest main with 1,000 gpm. It is recommended that the City continue with this approach.

Figure 7.15 identifies the location of dead-end pipes that cannot meet their fire flow requirements of 1,000 gpm.

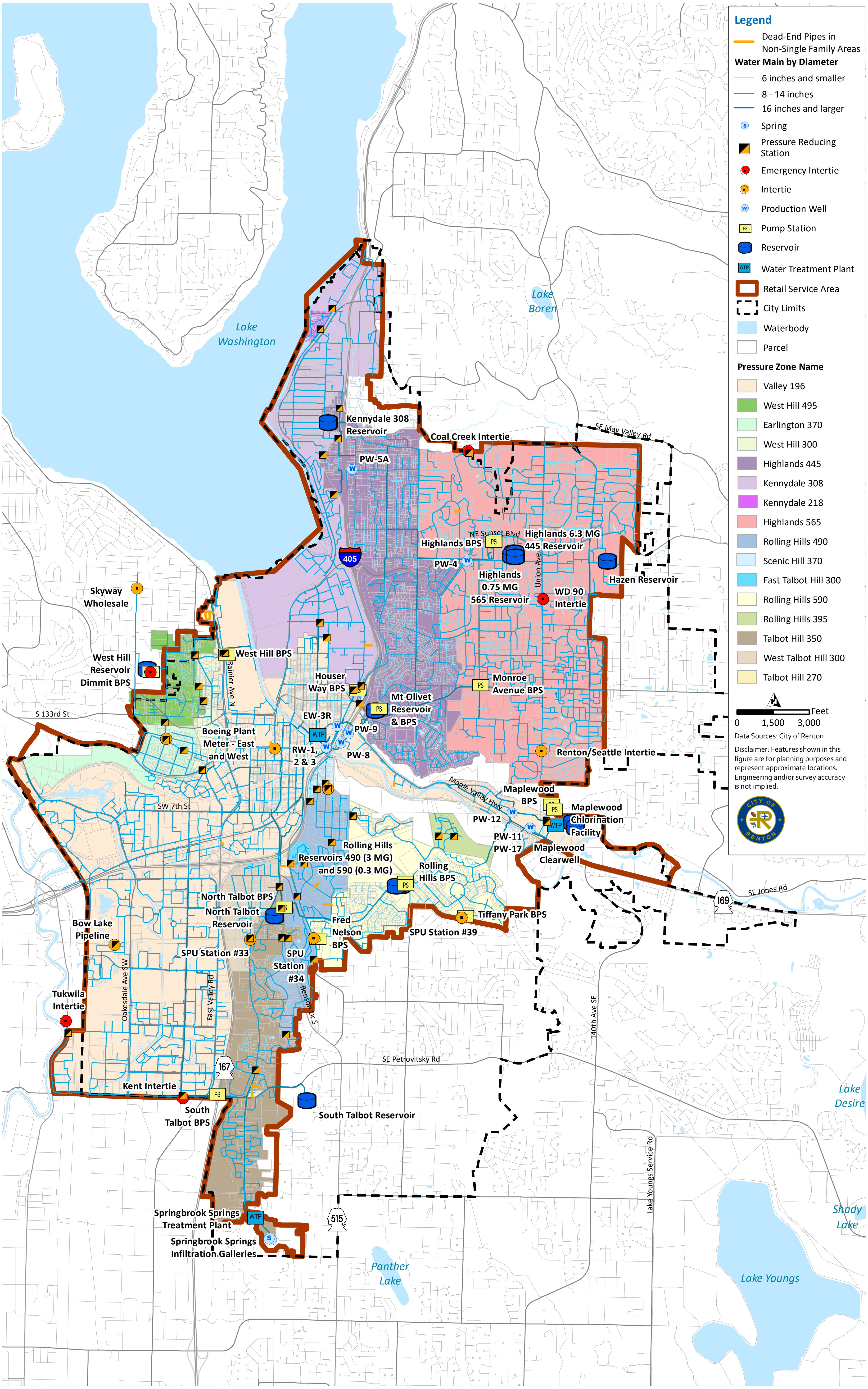


Figure 7.14 Dead-end Pipes in Non-Single Family Areas

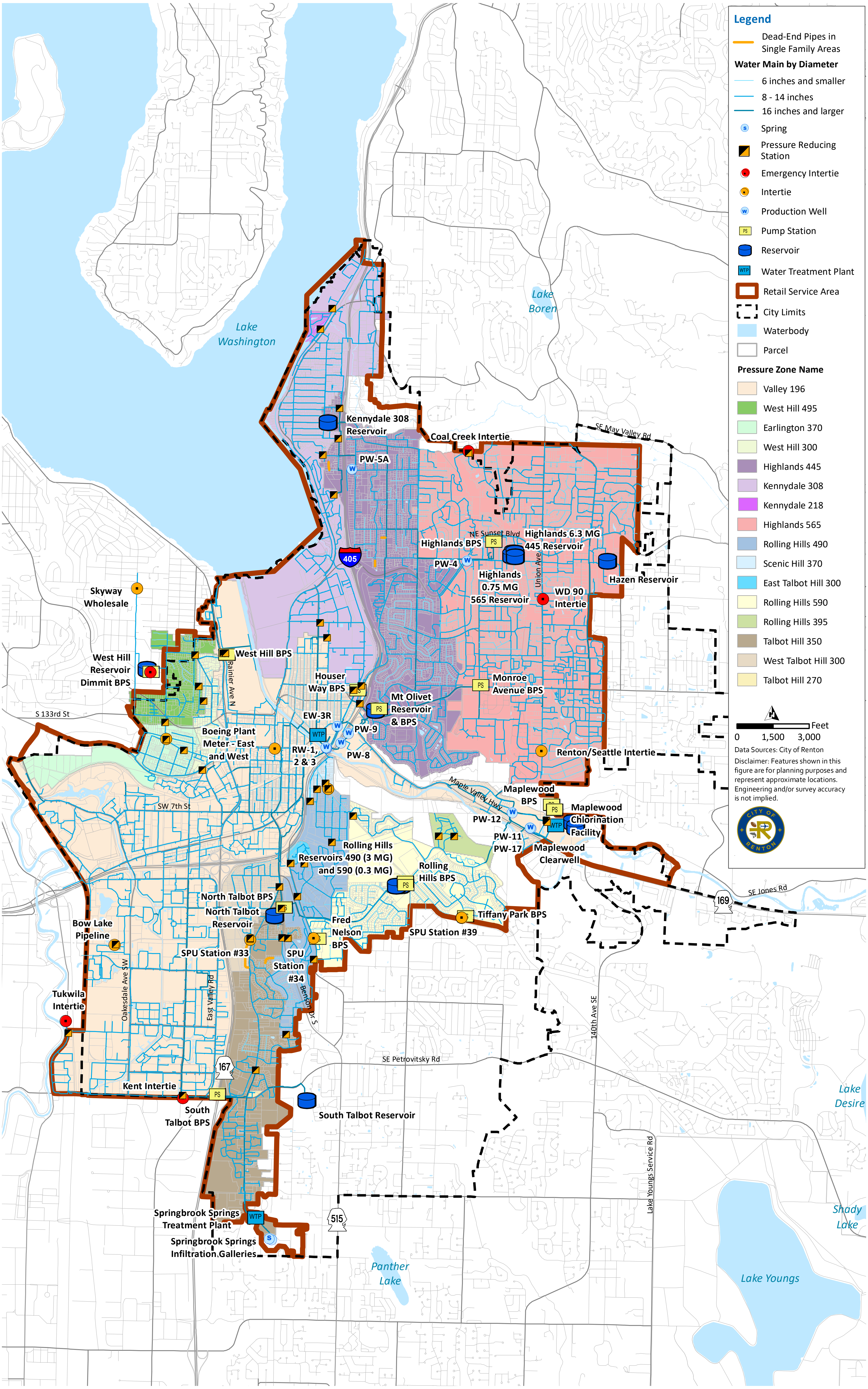


Figure 7.15 Dead-end Pipes in Single Family Areas

7.5 Limiting Capacity Analysis

The limiting capacity of the City's physical water system was determined for the 2039 planning year with the assumption that all recommended improvement projects will be online. The limiting capacity analysis uses the methodology described in DOH Water System Design Manual (2009) Worksheet 6-1 and Table 6-1. Table 7.20 describes the method used to calculate capacity for each component.

Table 7.20 Limiting Capacity Calculations

Water System Component	Equation / Notes
Sources (ADD)	N = $\frac{Reliable\ Source\ Capacity}{ADD\ ERU\ value}$ where Reliable source capacity = capacity of sources with backup power or generators
Sources (MDD)	N = $\frac{Firm\ Source\ Capacity}{MDD\ ERU\ value}$ where Firm source capacity = source capacity with largest source (Well 1) offline
Treatment	The City has designed treatment capacity with sufficiency capacity to serve its sources.
Equalizing Storage (ES)	N = $\frac{1}{C}[\left(\frac{1440}{MDD}\right)\left(\frac{ES}{150} + Q_s - 18\right) - F]$ where MDD = MDD, gpd/ERUs C = Coefficient associated with ranges of ERUs F - Factor associated with ranges of ERUs Q_s = Total source pumping capacity, gpm
Standby Storage (SB)	N = $\frac{SB_t}{(SB_i)(t_d)}$ where SB_t = total volume of water in standby storage component (gal) SB_i = Design level of standby storage to meet reliability considerations per ERU (gpd/ERU) t_d = time that storage is to be used (days)
Distribution	Not considered capacity limited because the City has planned projects to address all identified deficiencies and design standards confirm all new development meets City standards.
Transmission	Assumed to be addressed as part of source and pumping capacity.

Note:
Abbreviation: ERU – Equivalent Residential Unit; gpd/ERU – gallons per day per Equivalent Residential Unit.

The capacity of many water system components can be expressed as the number of ERUs that can be served. As described in Chapter 3, an ERU for the City's system is one that consumes 160 gallons per day (gpd) on an average demand day. On a maximum day, an ERU consumes 288 gpd. These values do not include distribution system leakage.

To determine how many ERUs the City's sources can serve on a maximum demand day, the supply to each operational area was divided by the MDD ERU value of 288 gpd. The MDD ERU value was also used to calculate the capacity of the City's equalizing storage in ERUs. The ERU capacity of standby storage was calculated by subtracting out each tank's equalizing storage and operational storage under 2039 demand conditions from its total available storage capacity.

The capacity of each operational area is either limited by source supply or standby storage. None of the service areas are limited by the amount of equalizing storage available. In total, based on sources, equalizing storage, and standby storage, the District's water system has a limiting capacity of approximately 89,160 ERUs. This is shown in Table 7.21.

As presented in Chapter 3, the City predicts serving approximately 60,860 ERUs in 2039. Considering sources, equalizing storage, and standby storage, the City's water system is anticipated to have sufficient capacity to meet expected growth within the 20-year planning period.

Fire suppression storage is not a function of ERUs and therefore is not represented in Table 7.21.

Table 7.21 Calculated Capacity in ERUs for Each Water System Component

Water System Component	System-wide
2039 ERU	60,860
Sources(1)	104,480
Treatment	104,480
Equalizing Storage	247,860
Standby Storage(2)	89,160
Limiting Capacity	89,160

Notes:
(1) Does not include SPU's interties used for summer peaking supply.
(2) Standby Storage available was calculated by subtracting 2039 required equalizing storage and operational storage from available storage above the 20 psi HGL.

7.6 Pipeline Condition Evaluation

7.6.1 Methodology

The pipe condition evaluation incorporates two types of data: remaining useful life (RUL) and maintenance-identified projects. As outlined in Section 7.5.3 below, the RUL analysis examined the pipe's material, installation year, and material's useful life to determine the year in which each pipe would reach its RUL. The pipes identified in this analysis serve as a starting point for the pipeline condition evaluation.

Additional pipeline condition projects have been identified by the City's Maintenance Department based on field observation, excessive maintenance, and staff general experience. These projects, in addition to the RUL analysis projects, make up the pipeline condition evaluation.

7.6.2 Maintenance Projects

The City's Maintenance Department identified nine water-main replacement projects, prioritizing them according to City needs, maintenance history, pipe age, and pipe type. Many of these projects overlap with RUL projects and projects identified by the hydraulic model. Table 7.22 summarizes these projects, while Figure 7.16 shows their locations in the system.

Table 7.22 Maintenance-Identified Condition Projects

Project ID	Project Description	Approximate Pipe Length (ft)	City Prioritization
D-03(1)	Replace 4-inch and 6-inch cast iron water mains in the Windsor Hills area. Pipes were installed in 1942.	5,900	4
D-08(1)	Replace 4-inch and 6-inch cast iron water mains in north (downtown) Renton. Pipes were installed in the 1920s.	4,200	1
D-16	Replace old AC water main on NE 24th St from Jones Ave NE to Edmonds Ave in the Kennydale area.	1,700	6
D-17	Replace 8-inch AC water mains along NE 12th St with 12-inch ductile iron piping. In the new Highlands 445 Reservoir project, the City is replacing an 8-inch water main from the Reservoir site to Queen Ave NE. This project will continue pipe replacement east to Union Ave NE.	1,400	2
D-18	Replace old steel water mains off on Monroe Ave NE, south of the Highlands Reservoir and President Park.	3,000	8
D-19	Replace 6-inch cast iron pipe on Shattuck Ave S., north of S. 36th St.	500	3
D-20	Replace old 12-inch asbestos cement water mains in Garden Ave N from N 3rd St to The Landing (N 8th St).	2,500	7
D-21	Replace old 4-inch, 6-inch, and 8-inch steel water mains along Stevens Ave S from the south end of Stevens Ave to NW 4th St.	1,500	9
D-22	Replace steel-wrapped water mains in the Tiffany Park area.	11,200	5

Note:
(1) These maintenance condition-related projects are combined with capacity projects identified in Section 7.4.5.

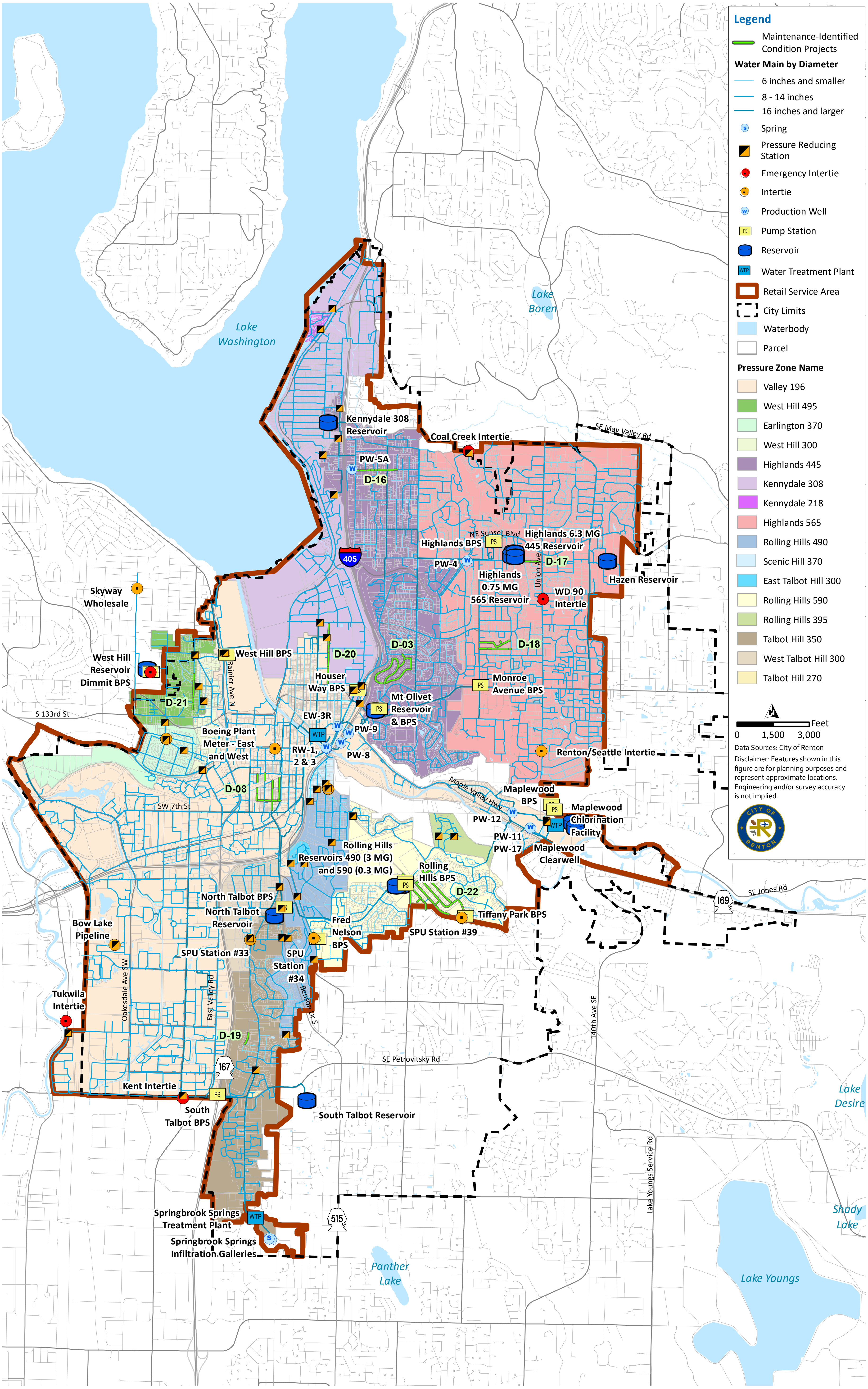


Figure 7.16 Maintenance-Identified Condition Projects

7.6.3 Remaining Useful Life Evaluation

As part of the pipeline replacement program, the City's existing pipes were assessed for their conditions through a RUL analysis.

The length of time that a pipe is anticipated to remain functional is called useful life. Useful life depends largely on the pipe material but can also depend on soil conditions, water constituents, and methods of installation. When a pipe is in service beyond its useful life, the increasing costs of maintenance associated with a failing pipe typically warrant replacement.

Table 7.23 presents the estimated useful life of various types of pipe materials found in the City's pipe data.

Table 7.23 Useful Life Assumptions by Pipe Material

Pipe Material	Useful Life Assumption (years)
Asbestos-Cement (AC)	50
Cast iron (CI)	80
Copper (COP)	50
Ductile iron (DI)	100
Galvanized iron (GI)	50
Galvanized steel (GS)	50
High-density polyethylene (HDPE)	50
Polyvinyl chloride (PVC)	50
Stainless steel (SSTL)	50
Steel (STL)	50

RUL is defined as the length of time left before a pipe will reach the end of its useful life. Pipe age and material type, derived from the City's geographic information system (GIS) data, were used to determine the RUL of the pipes. Approximately 0.03 percent of the pipes have unknown installation dates.

Table 7.24 presents the total length of piping according to the year installed and material type. The majority of the system is cast iron and ductile iron. Cast iron was primary installed between 1900 and 1979. Ductile iron installation started slowly in the 1960's and became the predominate pipe material installed by the 1970's.

The cells of Table 7.24 are color-coded to show the RUL of pipes in each category. For example, the lengths of pipe in the red cells have all reached the end of their useful life, meaning they have an RUL of zero. Using these assumptions, approximately 122,000 linear feet (LF) of pipe or 7.4 percent of the City's pipes have an RUL of 10 years or less. Furthermore, approximately 9.0 percent of the City's pipes are expected to reach the end of their useful life in the next 20 years.

Figure 7.17 shows the total length of pipe reaching the end of its assumed useful life for each year for the next 100 years, starting in 2019 and ending in 2119. All pipes that have already exceeded their useful life are shown in the year 2019.

If the City wished to start annually replacing all its pipes from 2019 to 2119, approximately 16,600 LF of piping must be replaced each year, shown as the dashed black line on the figure. If the City wishes to start annually replacing pipes that will reach their RUL within the 20-year planning horizon, approximately 7,000 LF of piping must be replaced each year. This is shown as the orange line on the figure.

The City is recommended to continue its annual pipe-replacement program and replace approximately up to 7,000 LF per year, targeting the pipes that have reached the end of their useful life and to offset the depreciation of this City asset. Figure 7.18 presents the locations of these pipes.

Table 7.24 Pipe Length by Decade Installed and Material Type

Material Type	Total Length (ft) by Decade Installed													
	Unknown	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010-2019	Total (ft)
Asbestos-Cement (AC)	53					316	12,946	2,700		1,590	17			17,621
Copper (COP)										45				45
Galvanized Iron (GI)		259									10	57	10	337
Galvanized Steel (GS)						1,567	139	1,399		85		23	20	3,233
High Density Polyethylene (HDPE)												145	594	740
Polyvinyl Chloride (PVC)										761		2,182		2,942
Stainless Steel (SSTL)											30	10		40
Steel (STL)						2,157	7,922	17,143	219	219	34	1,969		29,664
Cast Iron (CI)	142	8,717	29,762	1,783	328	34,967	22,500	212,329	92,580	7,752	178	46	117	411,201
Ductile Iron (DI)	317					15	478	16,631	167,804	338,705	303,115	256,612	92,810	1,176,488
Total Length (ft)	**512**	**8,976**	**29,762**	**1,783**	**328**	**39,022**	**43,986**	**250,203**	**260,603**	**349,156**	**303,383**	**261,045**	**93,552**	**1,642,311**

Legend

- **0 years Useful Life**
- **Between 0 and 10 years of RUL**
- **Between 10 and 20 years of RUL**
- **Over 20 years of RUL**
- **Unknown years of RUL**

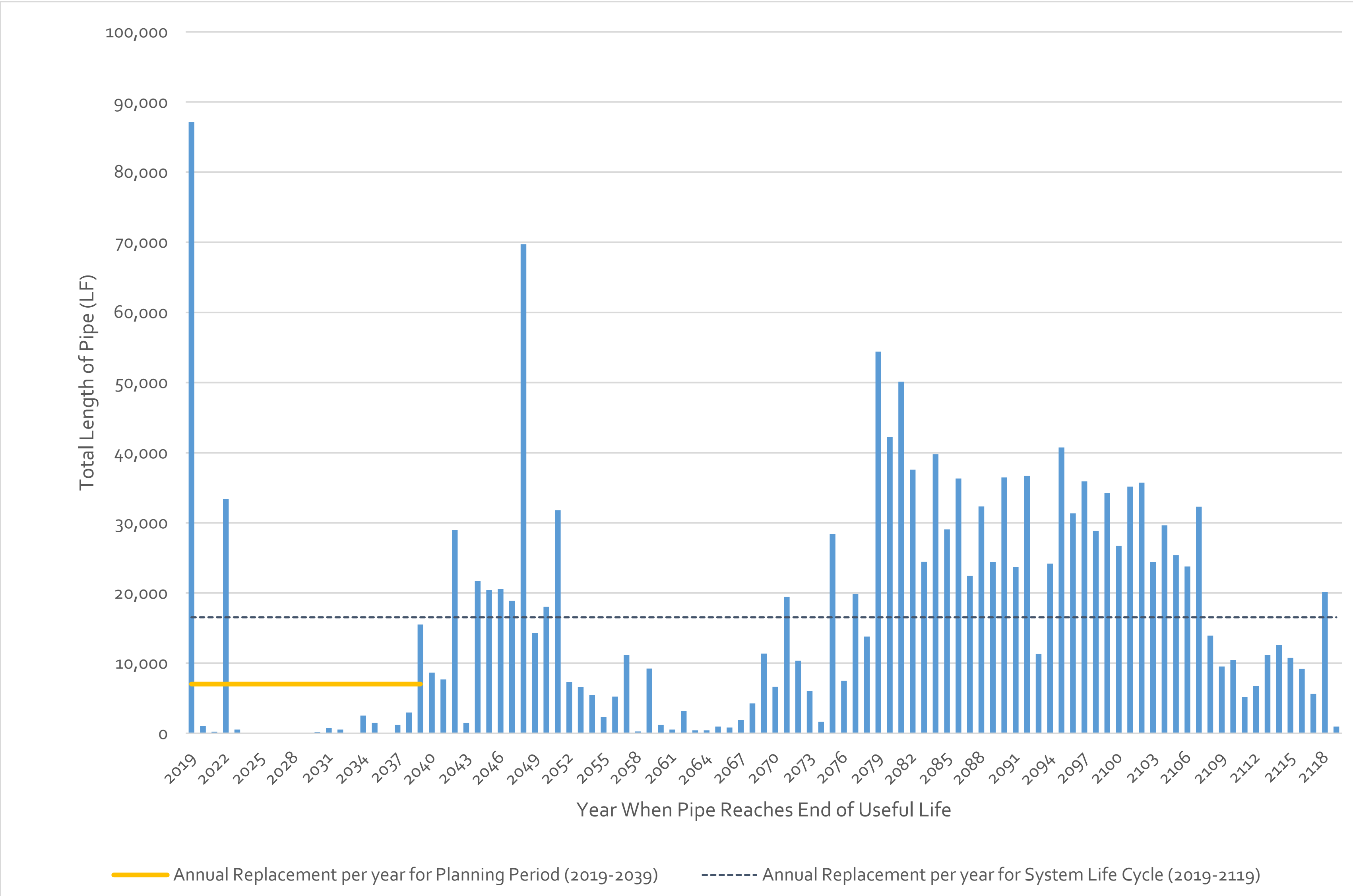


Figure 7.17 Pipes Reaching End of Useful Life

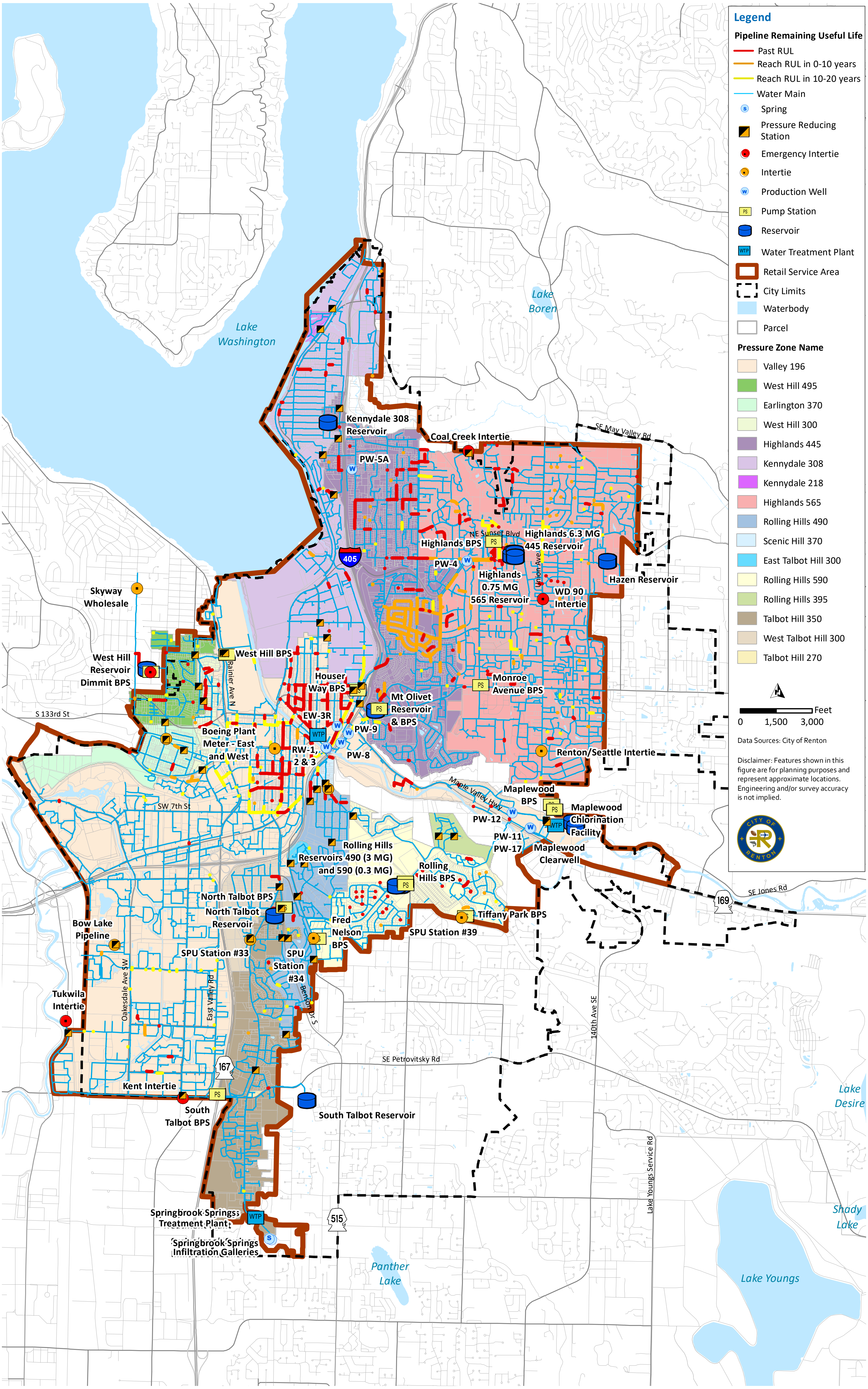


Figure 7.18 Pipeline Identified in Remaining Useful Life Analysis

7.7 Summary of Recommendations

The system analysis yielded a number of recommended improvements for the BPSs, reservoirs, pipelines, and pressure zones, which are summarized in Table 7.25, Figure 7.19, and Figure 7.20. Figure 7.21 shows all deficiencies mitigated with the recommended improvements.

Table 7.25 Summary of Recommended Improvement Projects

Project ID	Project Name	Improvement Type	Existing Diameter (in)	Proposed Diameter (in)	Location	Purpose	Description
D-01	NE 10th Place Pipe Upsize	Upsize pipe	6, 1	6, 8	NE 10th Place between Sunset Blvd NE and Edmonds Ave NE.	1. Fire flow deficiency (3,000 gpm fire flow requirement). 2. Maintenance condition (pipe size).	1. Upsize 6-inch pipe to 8-inch pipe. Pipe size and age contribute to fire flow deficiencies. 2. Upsize 1-inch pipe on dead end due to size.
D-02	Ferndale Place NE Pipe Upsize	Upsize pipe	4	8	Ferndale Pl NE between NE 7th St and Ferndale Ave NE.	Fire flow deficiency (3,000 gpm fire flow requirement).	Upsize 4-inch pipe to 8-inch pipe. Deficiency due to pipe size and age.
D-03	Windsor Heights Pipe Project	Upsize pipe	4,6	8	Fire flow deficiency location: Windsor Pl NE between Bronson Pl NE and Windsor Way NE. Maintenance Condition: Windsor Heights Area.	1. Fire flow deficiency (1,000 gpm fire flow requirement). 2. Maintenance condition (pipe age and size).	1. Upsize 4-inch pipe to 8-inch pipe. Deficiency due to pipe size and age. 2. Replace 4-inch and 6-inch cast iron water main in the Windsor Hills area.
D-04	Sunset Blvd N Pipe Upsize	Upsize pipe	6	8	Sunset Blvd N between N 3rd St and N 4th St.	Fire flow deficiency (3,000 gpm fire flow requirement).	Upsize 6-inch pipe to 8-inch pipe. Deficiency due to pipe size.
D-05	Maplewood Place SE Pipe Upsize	Upsize pipe	6	8	Maplewood Pl SE from SE 6th St to SE 7th Ave, SE 7th Ave.	Fire flow deficiency (3,000 gpm fire flow requirement).	Upsize 6-inch pipe to 8-inch pipe. Deficiency due to pipe size.
D-06	NW 4th St Pipe Upsize	Upsize pipe	6	8	NW 4th St between Taylor Ave NE and Hardie Ave NE.	Fire flow deficiency (3,000 gpm fire flow requirement).	Upsize 6-inch pipe to 8-inch pipe. Deficiency due to pipe size.
D-07	SW Sunset Blvd at Crestview Apartments Pipe Upsize	Upsize pipe / New PRV	6	12	SW Sunset Blvd at Crestview Apartments.	Fire flow deficiency (3,000 gpm fire flow requirement).	1. Install new PRV from EARL370 to WH300 on 8-inch pipe at intersection of SW Sunset Blvd and Stevens Ave SW. 2. Upsize 30 ft of 6-inch to 12-inch pipe on Langston Rd at intersection with SW Sunset Blvd. Deficiency is due to long, 8-inch dead-end pipe.
D-08	Downtown Renton Pipe Project	Upsize pipe / Replace pipe	4,6	8	Fire flow deficiency locations: - S 4th St between Burnett Ave S and Whitworth Ave S. - Whitworth Ave S from Houser Way S to S 6th St, S 6th St from Whitworth Ave S to Morris Ave S. Maintenance condition & RUL locations: - 4-inch & 6-inch Cast Iron main replacement in north (downtown) Renton. Installed in the 1920s."	1. Fire flow deficiency (1,000 gpm fire flow requirement). 2. Maintenance condition (pipe age and size). 3. RUL analysis (pipes are past remaining useful life).	1. Upsize 6-inch and 4-inch pipe. Pipe size and age contribute to fire flow deficiencies. 2. Replace pipes based on installation year and size. Pipes are past RUL.
D-09	Glenwood Ave NE Pipe Upsize	Upsize pipe	4	8	Glenwood Ave NE and NE 9th Pl.	Fire flow deficiency (1,000 gpm fire flow requirement).	Upsize 4-inch pipe to 8-inch pipe. Deficiency due to pipe size and age.
D-10	S 178th St Pipe Upsize	Upsize pipe	6	8	S 178th St from 98th Ave S south to end of street; Talbot Rd S between SE Carr Rd and S 177th St.	Fire flow deficiency (3,000 gpm fire flow requirement).	Upsize 6-inch pipe to 8-inch pipe. Pipe is dead end with pipes 12-inch then 6-inch then 8-inch. Upsize middle section to 8-inch.
D-11	N 4th St Pipe Upsize	Upsize pipe	6	8	N 4th St from Houser Way N west to end of pipe.	Fire flow deficiency (3,000 gpm fire flow requirement).	Upsize 6-inch pipe to 8-inch pipe. Deficiency due to pipe size.
D-12	Hydrant Lateral Connection at Benson Condominium	Change hydrant lateral connection	n/a	8	Hydrant S-00110 at Benson Condominium (Benson Rd S).	Fire flow deficiency (3,000 gpm fire flow requirement).	Move hydrant from 6-inch pipe to 8-inch pipe.
D-13	S 17th St Pipe Upsize	Upsize pipe	4	8	S 17th St between Talbot Rd S and Morris Ave S.	Fire flow deficiency (1,000 gpm fire flow requirement).	Upsize 4-inch pipe to 8-inch pipe. Deficiency due to pipe size and age.

Table 7.25 Summary of Recommended Improvement Projects (continued)

Project ID	Project Name	Improvement Type	Existing Diameter (in)	Proposed Diameter (in)	Location	Purpose	Description
D-14	Hydrant Lateral Connection on Sunset Blvd NE	Change hydrant lateral connection	n/a	8	Sunset Blvd NE at split to Houser Way Bypass.	Fire flow deficiency (3,000gpm fire flow requirement).	Move hydrant from 8-inch dead-end pipe to 14-inch main line pipe.
D-15	Maple Valley Hwy Pipe Upsize at Henry Moses Aquatic Center	Upsize pipe	8	12	Maple Valley Hwy at the Henry Moses Aquatic Center.	High velocity.	Upsize 8-inch pipe that is between 12-inch segments of pipe.
D-16	Maintenance Condition Project: Kennydale (NE 24th)	Replace pipe	8,12		NE 24th from Jones Ave NE to Edmonds Ave.	Maintenance condition.	Replace pipe due to condition.
D-17	Maintenance Condition Project: Highlands Reservoir to Queen Ave.	Replace pipe	8			Maintenance condition.	Replace pipe due to condition.
D-18	Maintenance Condition Project: Monroe Ave NE	Replace pipe	4, 6		Monroe Ave NE (south of Highlands Reservoir & President Park).	Maintenance condition.	Replace and/or upsize pipe due to condition.
D-19	Maintenance Condition Project: Shattuck Ave	Replace pipe	6		Shattuck Ave S. (north of S. 36th St).	Maintenance condition.	Replace and/or upsize pipe due to condition.
D-20	Maintenance Condition Project: Garden Ave N	Replace pipe	12	12	Garden Ave N from N 3rd St to The Landing (N 8th St).	Maintenance condition.	Replace pipe due to condition.
D-21	Maintenance Condition Project: West Hill	Replace pipe	4, 6, 8		Stevens Ave S from the south end of Stevens Ave to NW 4th St.	Maintenance condition.	Replace and/or upsize pipe due to condition.
D-22	Maintenance Condition Project: Tiffany Park Area	Replace pipe	4, 6, 8, 12		Tiffany Park Area.	Maintenance condition.	Replace and/or upsize pipe due to condition.
PZ-01	HLD 445/565 Pipe Reconfiguration	Re-zone	n/a	n/a	Development between Sunset Ln SE and NE Sunset Blvd.	Fire flow deficiency (3,000-gpm fire flow requirement).	Connect new developments from HLD 445 pipe to HLD 565 pipe, as area gets re-developed.
PZ-02	VLY196 Re-zone	Re-zone	n/a	n/a	Area around intersection of SE Carr Rd and Talbot Rd S.	Low pressure and fire flow deficiency (3,000-gpm fire flow requirement).	Re-zone area to address low pressure and fire flow deficiencies and in VLY196 on transmission main north of Springbrook Springs. Hydrant S-00235 at 401 S 43rd St & Talbot Rd will need to be re-zoned, decommissioned, or removed.
PS-01	Monroe Ave BPS Generator	Pump station	n/a	n/a	Monroe Ave BPS.	Pumping deficiency.	Install generator at Monroe Ave BPS to increase firm pumping capacity in Highlands 565 Operational Area.
ST-01	Rolling Hills 590 Storage	Storage	n/a	n/a	Rolling Hills 590 Storage Site.	Storage deficiency.	
ST-02	West Hill 495 Storage	Storage	n/a	n/a	West Hill 495 PZ.	Storage deficiency.	

Table 7.25 Summary of Recommended Improvement Projects (continued)

Project ID	Project Name	Improvement Type	Existing Diameter (in)	Proposed Diameter (in)	Location	Purpose	Description
P-01	Dead-End 3,000-gpm Fire Flow Program	Program	Varies	Varies	- Hydrant NW-00091 at 801 Rainier Ave N - SW CRN of Complex. - Hydrant S-00364 at 17910 Talbot Rd S. - Hydrant S-00174 at 1400 Talbot Rd S Renton Plaza NE CRN. - Hydrant S-00107 at 1301 Thomas Ln S. - Hydrant S-00123 at 1817 Grant Ave S - NW CRN of APT. - Hydrant S-00167 at 1 S Grady Way Renton Village-W SD of Red Lion Hotel. - Hydrant S-00053 at 400 S 2nd St Renton High School - E End. - Hydrant S-00218 at 400 S 2nd St Renton High School - N SD. (5,000-gpm fire flow requirement). - Hydrant N-00129 at 480 Houser Way N. - Hydrant SE-00020 at 2205 Maple Valley Hwy Riviera Apt. - Hydrant NE-00038 at 1442 Hillcrest Ln NE.	Fire flow deficiency (3,000 gpm fire flow requirement) on dead-end pipe.	Hydrants are on dead ends but main-line pipes can supply 3,000 gpm fire flow demand. Review these areas when new development takes place and potentially looped or upsized.
P-02	Dead-End 1,000-gpm Fire Flow Program	Program	Varies	Varies	- Hydrant S-00189 at 616 S 25th St & Smithers Ave S. - Hydrant NE-00801 at 1180 Monterey Ave NE. - Hydrant NE-01092 at 2025 NE 15th St. - Hydrant N-00172 at 2600 Garden Ct N. - Hydrant S-00182 at 2500 Talbot Dr S.	Fire flow deficiency (1,000 gpm fire flow requirement) on dead-end pipe.	Hydrants are unable to supply 1,000 gpm fire flow requirement in dead-end pipes. Move hydrants from dead-end pipes to main-line pipes.
P-03	Pipeline Repair and Replacement Program	Replace pipe	Varies	Varies	System-wide.	Pipes past remaining useful life (or will reach RUL in planning period).	Replace pipes that have reached or will reach their RUL in the planning period based on installation date and pipe material type.

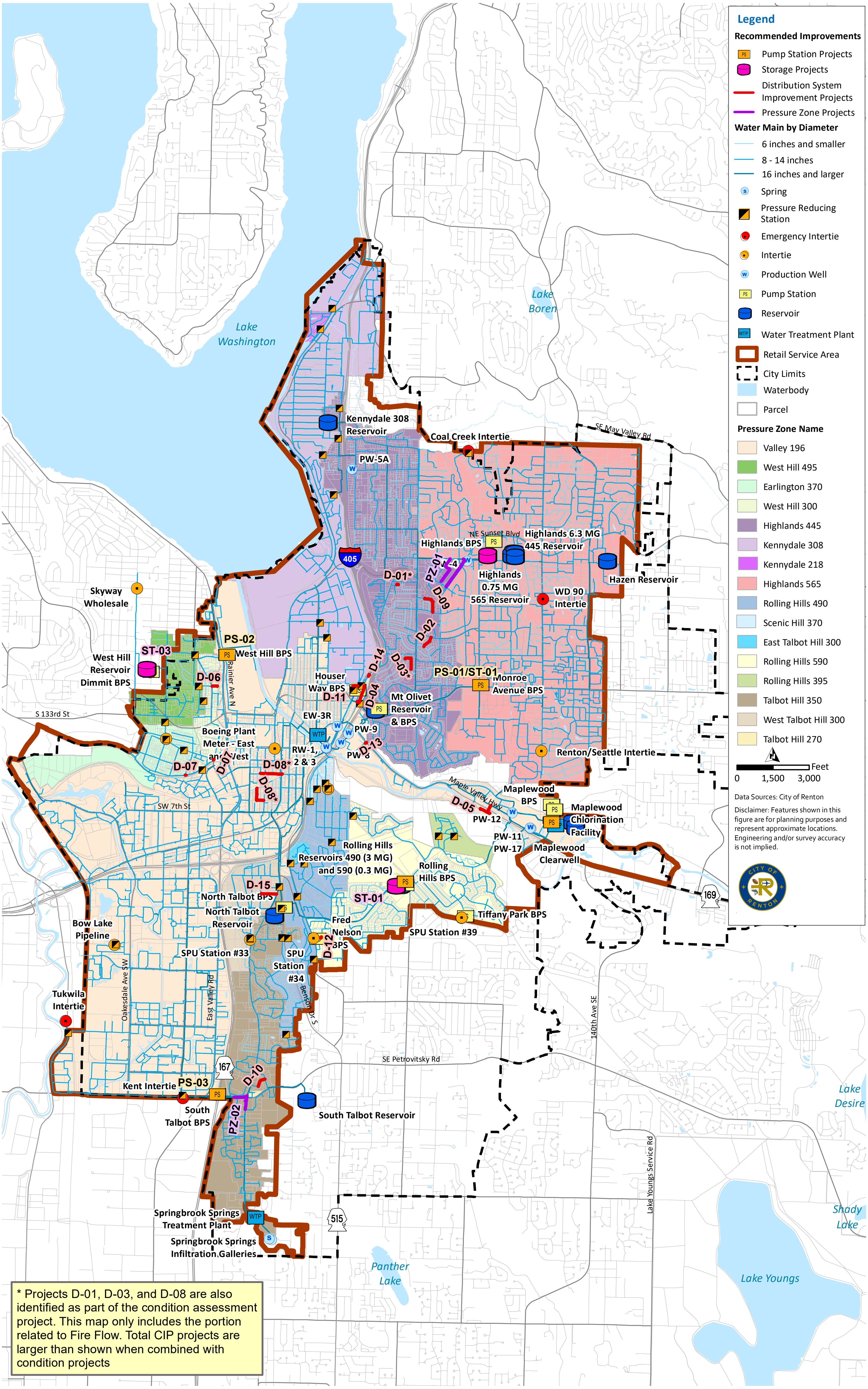


Figure 7.19 Recommended Improvement/Capacity Projects

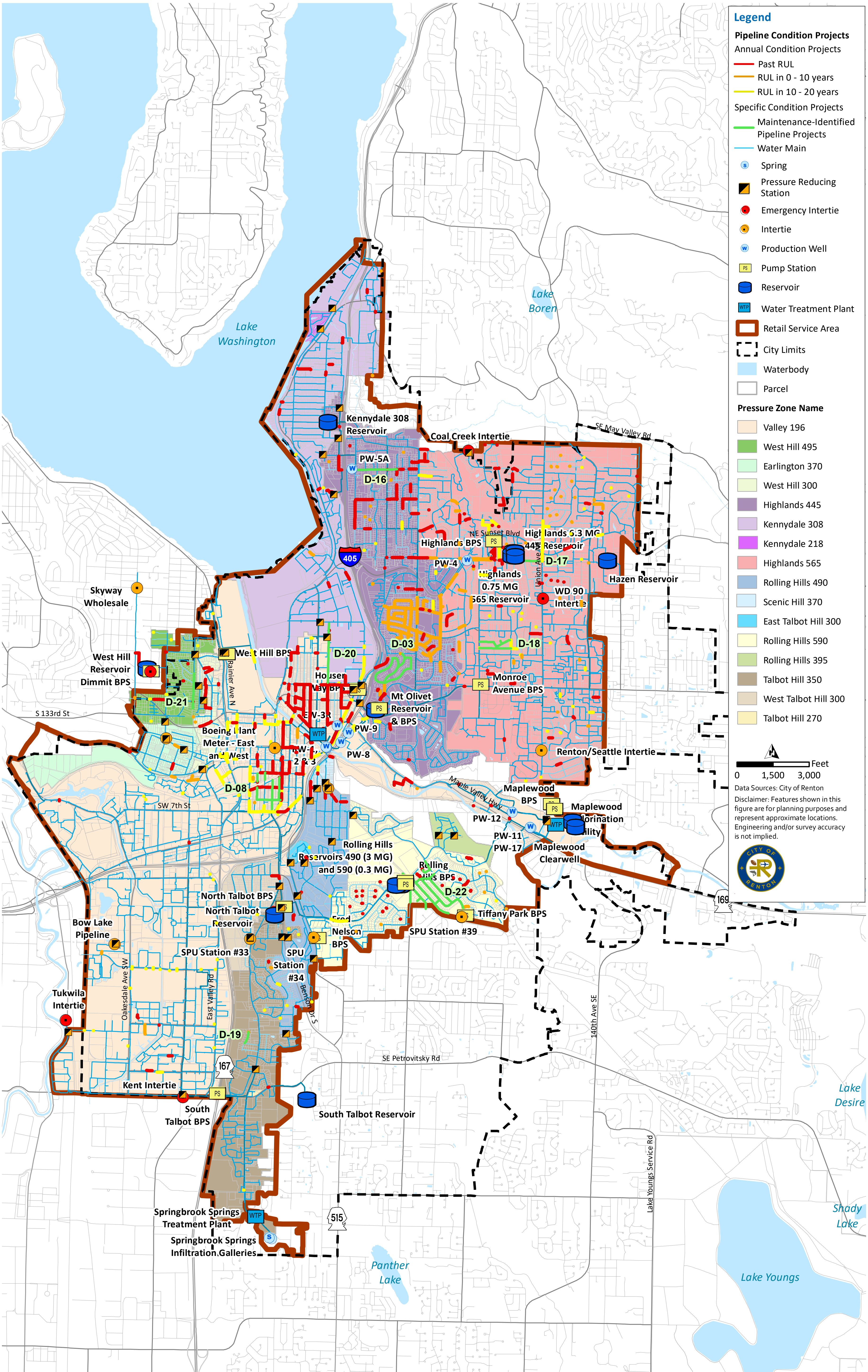
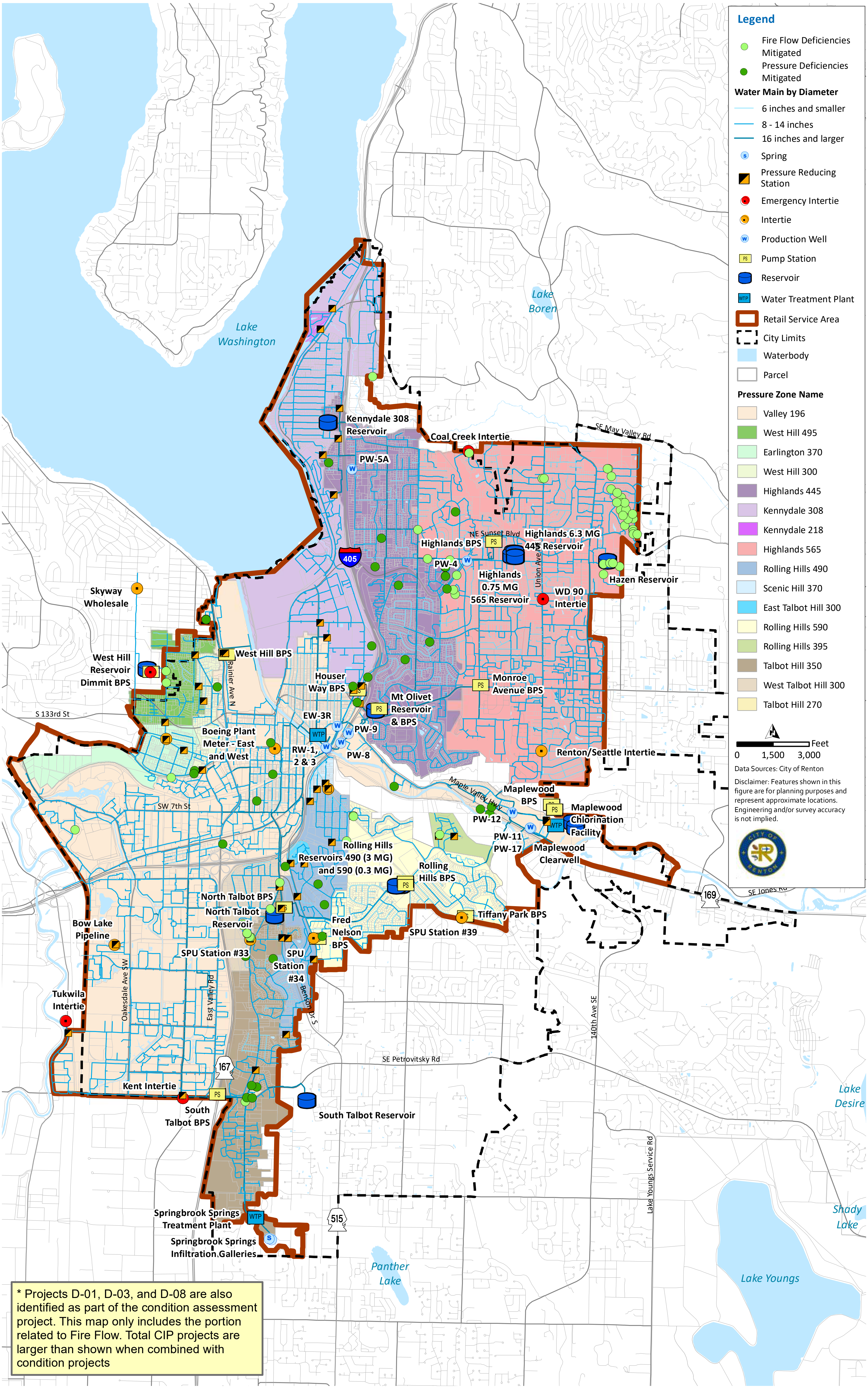


Figure 7.20 Recommended Pipeline Condition Projects



* Projects D-01, D-03, and D-08 are also identified as part of the condition assessment project. This map only includes the portion related to Fire Flow. Total CIP projects are larger than shown when combined with condition projects

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Figure 7.21 Mitigated Deficiencies with Recommended Improvements

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Chapter 8

OPERATIONS AND MAINTENANCE

8.1 Water System Management

This section describes the tasks and responsibilities of the operations and maintenance (O&M) staff that serve the City of Renton's (City) water system. Each member functions under the City's Maintenance Services Division.

Chapter 1 – Introduction (specifically, Figure 1.2, City of Renton Drinking Water Organization) explains how the water system is organized.

8.1.1 Normal Day-to-Day Operations

Normal, day-to-day operations of the Water Utility fall under the responsibility of the Water Maintenance Services Section directed by Water Maintenance Manager, George Stahl.

The Water Maintenance Services Unit (Services Unit) is led by Gregg Seegmiller and conducts the following tasks:

- Main flushing.
- Tank and reservoir cleaning.
- Exercising of valves and hydrants.
- Leak detection and repair.
- PRV maintenance and setting.
- Small meter maintenance, repair, and calibration.
- Hydrant maintenance and repair.
- Tie-in of water main extensions.

The Water Utility Maintenance Unit (Maintenance Unit) is led by Craig Pray and is responsible for the operation, maintenance, and repair of the pump stations, pressure reducing valves (PRVs), wells, treatment systems, treatment plants, and supervisory control and data acquisition (SCADA) system. This unit also samples water quality for operations and regulatory compliance.

8.1.2 Preventive Maintenance

Preventive maintenance is performed by both City staff and contracted private parties. For example, maintenance and calibration for large meters are contracted out, whereas painting of pump station components is usually performed by City staff. Large maintenance projects (e.g., elevated tank painting) is done through Public Works contracts with contractors selected under public bidding rules. These projects are usually managed by the Water Utility Engineering Section of the Utility Systems Division.

The City's preventative maintenance program is detailed later in this chapter in Section 8.3.5.

8.1.3 Field Engineering

Field engineering support is supplied by both City staff and contracted private parties such as engineering consultant firms.

8.1.4 Water Quality Monitoring

The Maintenance Unit conducts water quality monitoring for both operations and regulatory compliance.

Operational practices monitor chlorine, fluoride, turbidity, temperature, phosphate, iron, manganese, ammonia, hydrogen sulfide, pH, well water levels, and well production rates.

Compliance water quality monitoring is required by the Federal Safe Drinking Water Act of which most requirements are administered by the Washington State Department of Health (DOH) and are published in State of Washington Administrative Code (WAC)-246-290. This practice monitors volatile organic chemicals, synthetic organic chemicals, disinfection byproducts, inorganic chemicals, physical parameters, bacteriological, radionuclides, and lead and copper (via customer tap sampling).

The City systematically checks its network of groundwater monitoring wells to detect and prevent contaminants in the aquifers from reaching the production wells. Water table levels in the aquifers are also monitored.

Except for those of coliform monitoring sampling and monthly fluoride meter calibration check sampling, all test results of compliance monitoring are stored in the City's enterprise-wide database. This database also stores results of monitoring for aquifer contamination and water level data collected by a portable sounder. Water level and water temperature data collected by an automated sounder is stored on one of the City's network servers. More information on the City's records and reports can be found later in this chapter in Section 8.9.

8.1.5 Emergency Response

The City's Comprehensive Emergency Management Plan (CEMP) defines how the City will respond to emergencies. This plan is maintained by the City's Emergency Management Section.

As a sub-plan to the CEMP, the Water System Emergency Response Plan includes information on the system's security and methods of response to various terrorism threats. The Water Maintenance Manager prepares for and responds to emergencies involving the drinking water system, while the Maintenance Services Division maintains an emergency call-up list for employees on standby to respond to emergencies after hours on weekdays, on weekends, and on holidays.

The response to an emergency may vary from a single maintenance technician addressing a relatively minor problem to the City activating the Emergency Operations Center and calling on the state or federal government to lead the response to a large disaster or terrorism incident.

The Water System Emergency Response Plan is detailed later in this chapter in Section 8.6.

8.1.6 Cross Connection Control

Most potential cross connections are identified during the plan review and building permit review processes. Specifically, the Water Utility Engineering Section and the Development Engineering Section work together to identify potential cross connections when reviewing the plans for proposed development projects. Then, the Cross Connection Control (CCC) Specialist in the Water Utility Engineering Section works with the Development Engineering Section's building inspectors to ensure that identified cross connections are either eliminated or are controlled through installed backflow prevention assemblies.

The CCC Specialist maintains records on the City's enterprise-wide database, noting information about particular cross connections and the backflow prevention assemblies that are installed (e.g., installation and test history). The database also generates test notices to send to the owners of the backflow prevention assemblies. The City uses XC2 Software LLC's, XC2 software, to input information, query information, and generate reports, including those test notices from the database.

Members of the Water Maintenance Services Section, Water Utility Engineering Section, Development Engineering Section, and Building Section remain alert of cross connections as they go about their duties throughout the City and its built environment. If cross connections are discovered, they are reported to the City's CCC specialist.

Appendix L presents the City's Cross Connection Control Plan.

8.1.7 Capital Improvement Planning

The Water Utility's capital improvement plan (CIP) is implemented by its Engineering Supervisor, who works closely with the Water Maintenance Manager to identify and prioritize CIP projects. Most selected improvements are completed by public-bid contracts.

Chapter 9, Capital Improvement Plan, details this information further.

8.1.8 Budget Formulation

The Water Utility Engineering Supervisor formulates the budget for the Water Utility's CIP while the Water Maintenance Manager formulates the O&M budget. To formulate their budgets, both work closely with their division directors and the Public Works' Principal Financial and Administrative Analyst, who then works with the Finance Division's staff to formulate the complete Water Utility budget.

8.1.9 Response to Complaints

Complaints and questions are fielded by members of both the Water Utility Engineering Section and Water Maintenance Services Section. All water quality complaints are forwarded to the Maintenance Services Division's secretary at (425) 430-7400. The Water Maintenance Services Section log, respond to, track, and follow-up with said complaints.

Further information on the City's Customer Complaint Response Program can be found later in this chapter in Section 8.8.

8.1.10 Public and Press Contact

The City's Communications Director or their representative handles contact with the media. The Development Services Division mans a customer service counter on the sixth floor of City Hall. Members of the Water Utility Engineering Section often report to this counter to assist customers with questions about water quality and water service availability.

8.1.11 Billing

The Utility Billing Division of the Administrative Services Department handles customer service, billing, and revenue collections for the Water Utility, as well as for the Wastewater Utility and Surface Water Utility.

8.2 Operator Certification

The City's water system serves a population of greater than 50,000, thus is classified as a Class 4 distribution system. Considered a Class 3 purification plant by the Association of Boards of Certifications, the Maplewood Water Treatment Plant (WTP) completes the following processes:

- Treats water by removing iron and manganese using green sand filtration.
- Treats water using fluoride and sodium hydroxide.
- Converts hydrogen sulfide to sulfate through the addition of oxygen in conjunction with catalytic conversion of granular activated carbon.
- Removes ammonia by reacting it with chlorine to convert it to nitrogen gas.

Other treatment in the system includes in-line fluoridation, in-line chlorination, and the addition of sodium hydroxide and ortho-polyphosphates to inhibit the internal corrosion of water mains and private plumbing. These treatment systems are not considered purification plants.

The requirements of WAC 246-292 are as follows:

- The City's water system must be managed by a Water Distribution Manager (WDM) 4.
- The Maplewood WTP must be operated by a Water Treatment Plant Operator (WTPO) 3 or higher.
- Wells RW-1, RW-2, and RW-3 must be operated by a Basic Treatment Operator or higher.
- The CCC Program must be managed by a CCC Specialist.

The City meets or exceeds all of these requirements. Table 8.1 lists the certifications of the drinking water staff.

As the City's water system becomes increasingly complex, its staff must be trained to efficiently to keep up with advancements in technology and ever-expanding federal and state regulations. New employees require utility orientation and basic information while experienced employees need training in regulatory requirements and technological updates.

In-service training consists of special courses and seminars specifically designed for operation and maintenance groups. The training is offered through organizations like the American Water Works Association, Pacific Northwest Section; Evergreen Rural Water Association; Washington Environmental Training Center; equipment vendors; and local colleges, universities, and trade organizations. The City supports and promotes operator training.

Table 8.1 Staff Certification

Name	Certification
George Stahl	WDM4 (Mandatory certifications for the operation of the water system)
Craig Pray	WDM4, WTPO3 (Mandatory certifications for the operation of the water system)
Gregg Seegmiller	WDM3
Jason Burkey	WDM1
Sean Campbell	WDM3
Mark Combs	WDM2
John Dimond	WDM1
Charles (Greg) Durbin	WDM3, WTPO2
Joe Ferrer	WDS
Jayson Gallaway	WDM1
Todd Hamblin	WDM1
Danny Hribal	WDM3, WTPO3
Joel McCann	WDM1
Joshua O'Neill	WDM4, WTPO3
Patrick Pierson	WDM2
James Rodriguez	WDM1
Tyler Schwartzenberger	WDM1, WTPO1
Mick Holte	WDM4, CCS
Eric Ott	WDM4

Note:
Abbreviation: WDS - Water Distribution Specialist.

WTP operation requires an on-call staff 24 hours a day, 7 days a week. The City currently has five WTP staff members. To allow for more staffing flexibility, training or hiring an additional licensed WTP operator is recommended. This licensed staff member can also perform other duties for the utility.

In addition, additional maintenance staff may aid the City in conducting additional routine preventative maintenance activities that are currently being deferred due to lack of resources. Additional operators beyond the recommendations would allow the City to expand activities, such as acoustic leak detection of the distribution system and perform a consistent flushing program.

8.3 System Operation and Control

The following sections review the water system's routine operation practices conducted by staff, performance evaluation, operations under abnormal conditions, and preventative maintenance program that manages the condition and operations of all the Water Utility's major components and assets.

8.3.1 Identification of Major System Components

Chapter 2 - Existing System details the major components of the water system including wells, treatment plants, interties, pump stations, PRVs, reservoirs, and piping.

8.3.2 Routine System Operation

8.3.2.1 General System Operation

In general, the water supply is produced in the Valley 196 Pressure Zone (PZ) and is pumped to reservoirs on the surrounding hills. The majority of customers are located in the valley or on the hill pressure zones, which have reservoirs. Customers in the intermediate pressure zones are served through PRVs from higher pressure zones. Chapter 2 provides additional detail on system operations.

Supply is generated by City-owned wells. Wholesale supply provided by Seattle Public Utilities (SPU) addresses system operational challenges in the Bow Lake Area (PRV 24) and on West Hill. Additional SPU interties are used for emergencies.

8.3.2.2 Start-up and Shut-down Procedures

Each major system component has an O&M manual that describes start-up and shut-down procedures and safety procedures. Additionally, the City has written procedures for both electrical and hydraulic lock-out and tag-out of the water system facilities.

8.3.2.3 Meter Reading

In October 2011, the City installed an Automated Meter Infrastructure (AMI) System. The AMI allows City staff to remotely read water meters.

Meters are typically read remotely by the Utility Billing Division for purposes of billing. The Maintenance Services Division and Utility Engineering Divisions can also access meter readings for operational purposes or to support a capital project. In addition to reading usage, the City uses AMI meters to alerts customers about potential leaks.

The Maintenance Services Division operates and maintains the AMI meters (e.g., addresses communication errors, calibrates large meters, etc.). Meanwhile, the City's Information Technology Division operates and maintains the information technology resources needed to maintain the AMI system.

8.3.2.4 System Control

All sources and pump stations are metered, and the SCADA system monitors and records all their flows, as well as the flow through the metered connections to the SPU pipelines at the Fred Nelson Booster Pump Station (BPS), Tiffany Park BPS, and Bow Lake Pipeline.

In addition to the information recorded by the SCADA system, Water Maintenance Services staff read and record meter readings at all sources and pump stations daily if the facility is in operation and twice a week if the facility is on standby.

New telemetry using Ubiquiti technology is planned to be implemented for the Water Utility and other utilities in the next 5 years. The City currently contracts Emerson programmable logic controller (PLC) from California but plans to upgrade the PLCs to Allen Bradly and maintain consistent configuration of PLC ports across all stations. For operational reasons, the City prefers to own its fiber communications where practical and cost-effective.

8.3.3 System Performance Evaluation

System performance is evaluated by its ability to meet federal and state drinking water quality requirements, maintain customer satisfaction, control cost production and delivery of water, and meet system policy goals for service pressure and fire flow.

8.3.4 Operation during Abnormal Conditions

City operators are trained and experienced to operate the water system during abnormal conditions such as a power outage or equipment failure. The City has multiple approaches to maintain reliability during such abnormal conditions:

- Using redundant infrastructure and equipment to reduce effects to customers during abnormal conditions, e.g., the City has a redundant pump in each BPS and multiple PRVs for all PRV-fed pressure zones.
- Applying maintenance best practice (as resources allow) such as conducting preventative maintenance and keeping spare parts and pipe on hand.
- Keeping standby power available for key water facilities to continue providing service during power outages: as discussed in Chapters 2 and 9, the City plans to install on-site backup power generators at additional water system facilities.
- Maintaining emergency interties with four adjacent utilities to provide supply when needed.
- Maintaining emergency storage in its reservoirs, which can be distributed to the entire system by gravity through redundant PRVs.

8.3.5 Preventive Maintenance Program

The preventive maintenance program is documented and tracked by CityWorks, a computer-based system that schedules preventive maintenance, assign resources to where they will be most valuable, predicts equipment reliability problems and prevent them from happening, and manages assets to best meet the organization's goals.

The following section explains how various components of the City's water system are addressed by the preventative maintenance program.

8.3.5.1 Pipelines

Pipeline repair and replacement (R&R) is planned and performed by the City's Utility Services Division.

The current distribution mains are generally in good condition. Pipes reaching the end of their usable life are identified and repaired or replaced based on the City's available resources.

8.3.5.2 Reservoirs

Reservoirs act as storage and regulating devices for water flow, and maintaining them in prime physical condition is essential for any water distribution system. Operators control and monitor reservoirs through the SCADA system. Additionally, operators conduct visual checks regularly for evidence of vandalism, forced entry, or damage and control functionality.

The reservoirs are maintained on a periodic basis through weekly, quarterly, and annual activities. Periodic reservoir replacement is recommended to maintain a reliable water system.

8.3.5.3 Wells and Pump Stations

Reliable service from the City's wells and pumps stations is key to producing and transmitting water to customers. Operators control and monitor wells and pump stations through the SCADA system. As previously discussed, WTPs associated with the wells are staffed on-site by certified operators who conduct visual checks regularly for evidence of vandalism, forced entry, or damage and control functionality.

These facilities are maintained on a periodic basis including weekly, quarterly, and annual activities. Periodic replacement is recommended to maintain a reliable water system.

8.3.5.4 Pressure Reducing Valve Stations

PRV stations allow distribution systems to transfer water from higher pressure zones to lower pressure zones without exceeding the allowed pressures in the lower pressure zones. Water is transferred through a valve that reduces the pressure to a specified pressure setting.

Every month, Water Maintenance Services staff inspects the City's PRVs. These inspections are supplemented by a more thorough inspection conducted by a contractor that specializes in PRVs to determine which stations need to be rehabilitated or upgraded.

Maintenance on the PRVs is conducted by City staff. The Services Unit replaces the parflex tubing and fittings on all of the PRVs annually, and completely rebuilds typically 10 valves each year. According to the rebuild schedule, PRVs are typically rebuilt every 5 years.

8.3.5.5 Backup Power

To maintain system operations during an unforeseen power outage, backup power to critical communications elements and sites is desirable. Currently, the City runs and periodically maintains on-site standby generators to keep them in good working order.

8.3.5.6 Hydrants

Fire hydrants supply water for fire protection and other purposes.

The City's hydrants are tested annually to check if they can provide available fire flow in the event of an emergency. The inspection also improves water quality since, during this practice, stagnant water that is purged from the hydrant stubs. A follow-up inspection 2 weeks after testing is recommended to listen for potential leaks.

Maintenance of the hydrants includes replacement or rebuilding of older hydrants, rust removal, and painting or repainting hydrants. Hydrants replaced on 4-inch diameter mains are made with lower-capacity, 2-inch diameter ports that limit flow and do not have a hard connection. These ports prevent a pumper truck from drawing a vacuum and collapsing the pipes.

With its current funding, the City currently replaces 10 hydrants per year. An increase in funds would allow the City to replace more hydrants per year. Painting hydrants is mostly handled by City staff with the exception of the South Renton neighborhood. The City received grant funding in 2019 for a public arts campaign for community artists to paint murals on 20 City-owned fire hydrants.

8.3.5.7 Meters

The City uses data from AMI meters to monitor unusual changes in amounts of water, which indicate potential leaks. According to the manufacturer, the City's AMI system (Sensus), including system components and batteries in the radios, is anticipated to have a 20-year life. Thus, meter replacement is currently set on a 20-year program to coincide with the AMI system's end of life.

Large meters are calibrated according to the manufacturer recommendations.

8.3.5.8 Valves

The City inspects its valves twice a year, at least annually. As part of the inspection, blow offs and airvacs are inspected as well.

8.4 Sanitary Survey

From the last survey in 2012 the following were addressed:

Table 8.2 Sanitary Survey Summary – Completed and On-going Actions

Task	Completed?
Document routine inspections of reservoirs with photos	Completed for 2012 survey
Modify external overflow pipelines at each reservoir to incorporate an air gap and screen/flapper valve	On-going
Install inverted screen well vent on Well EW-3R, PW-11, and PW-17	Completed
Check integrity of Springbrook springs gasket seals on collection box hatches	Completed
Identify Springbrook springs collection box overflows and screen them to keep out potential contaminants.	Completed
Submit a Stage 2 Disinfection by Product (DBP) Monitoring Plan to DOH	Completed
Consider raising well PW-12 S15 above ground	Completed
Provide a watertight seal on the North Talbot Reservoir access hatch	Completed
Groundwater Rule Compliance Monitoring	Completed

A sanitary survey was conducted in 2017. From the 2017 survey, all recommended actions were completed; with one remaining on-going:

Table 8.3 Sanitary Survey Summary – Recommended Actions in 2017 Survey

Task	Completed?
Highlands 1.5 MG Concrete Reservoir. Clean out insects and debris. Seal crack in the concrete.	Completed
North Talbot Reservoir. Ensure there is a seal between inner rim of gutter and lid.	Completed
Please document routine inspection of reservoir with photos.	Completed
Modify external overflow pipelines at each reservoir to incorporate an air gap and screen/flapper valve	On-going
Continue to label tanks and plumbing in treatment plants and booster stations.	Completed
Review and update sources listed on the water facilities inventory.	Completed

8.5 Equipment, Supplies, and Chemical Listing

The City has vehicles and major equipment assigned to the Water Shop. Inventoried supplies (items stocked on shelves or stored in the yard) are purchased and tracked by the Maintenance Services Division. In addition to stock items, a list of vendors is maintained for parts and equipment items that are not stocked on the shelf or in the yard because they aren't purchased or they are large in size.

The Water Maintenance Manager maintains information regarding service representatives for major water system components and chemical suppliers. Additionally, the Water System Emergency Response Plan contains lists of contacts for suppliers and support services.

Both the Water Maintenance Services Section and the Water Utility Engineering Section maintain copies of O&M manuals for all major components of the water system. These manuals list manufacturer part numbers and descriptions as well as technical specifications for components and chemicals used.

8.6 Emergency Response Program

As mentioned earlier, the Water Utility maintains a Water System Emergency Response Plan, which is a sub-plan to the City's CEMP.

8.6.1 Water System Personnel Emergency Call-up List

The Water Maintenance Services Section publishes two emergency call-up lists: one for emergencies dealing with wells and pump stations and one for emergencies dealing with water mains, PRVs, and reservoirs. The SCADA system is connected to an auto-dialer that contacts call-up personnel when an alarm is triggered after office hours. The auto-dialer is programmed to move down a list of phone numbers until its call is acknowledged.

After-office-hours calls to 911 that are related to the water system are handled by the 911 dispatcher who then contacts a cell phone that is carried by on-call staff. If the on-call staff does not answer the cell phone, the dispatcher will attempt to contact the Water Maintenance Manager, the Water Maintenance Services Supervisor, or the Water Utility Maintenance Supervisor. Other phone numbers are available to the dispatcher including the Maintenance Services Director's cell phone number.

8.6.2 Notification Procedures – Water Quality Emergencies

See Appendix N, Drinking Water Quality Monitoring Program.

8.6.3 Vulnerability Analysis

As required by the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, the City's Water Utility completed a security vulnerability assessment in December 2003 and updated the city-wide CEMP in October 2017. The Water Utility budgets for such security improvements through its CIP. Typically, this money is transferred into specific project budgets when security upgrades are incorporated into the overall project scope. Chapter 5, Policies, Criteria, and Standards, further details for the Water Utility's reliability and vulnerability policies.

Periodically, the Water Utility assesses the vulnerability of its drinking water system to threats from earthquakes, floods, power outages, etc.

New facilities are designed and constructed to the latest building code standards. In addition, extra emphasis is placed on hazard engineering when the new facilities are critical to the operation of the water system. Meanwhile, retrofits of existing facilities typically incorporate security and safety upgrades and sometimes structural modifications to enhance survivability and operability of the facility after natural or manmade disasters.

The Water Utility designs and constructs redundancy in its water main network, supply sources, booster pumps and PRV stations, and other facilities to increase the system's overall reliability and reduce its vulnerability to disruptions.

America's Water Infrastructure Act of 2018 (AWIA) requires community water systems serving more than 3,300 people to develop or update risk assessments and emergency response plans. The risk and resilience assessment must be completed, and certification submitted to the United States Environmental Protection Agency by December 31, 2020 for systems serving between 50,000 and 99,999 people, and it must be repeated every 5 years.

8.6.4 Site Security

Site security is necessary to protect the City's assets at each facility site. Surveillance cameras are recommended at all of the facilities. The City plans to explore opportunities for grants from Homeland Security to aid in funding the cameras. In addition, the City plans to seek partnerships with the local Fire and Police departments to install higher quality cameras on several reservoirs, which would provide a wider view of the City for emergency personnel. In these cases, it is anticipated the Fire or Police departments would fund the cameras at the facilities.

8.7 Safety Procedures

The goal of the Water Maintenance Services Section is to comply with all Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act of 1973 (WISHA) regulations applicable to the operation of the section. All workplace hazards, related safety and first aid equipment, and procedures are identified and communicated to the Water Maintenance Services staff through safety briefings, facility-specific standard operating procedures, facility O&M Manuals, and safety data sheets.

8.8 Customer Complaint Response Program

Each year the Water Maintenance Services Section receives approximately 10,000 service requests, of which the majority are complaints in regard to water leaks and meter malfunctions. In 2018 there was a total of 7,150 requests and of that 177 requests were for meter inspections and 145 requests were to have large meters tested or repaired. Only a handful of water quality complaints are received each year and 99 percent of them are internal household plumbing issues. Each call is logged by customer service staff. When applicable, a staff member is assigned to the complaint.

The following information is documented about the complaint: its location, the individual assigned to investigate and fix the problem, observations and discoveries in the field, what was done to address the complaint, and how much time and materials were expended.

8.9 Record Keeping and Reporting

Maintenance and operating records are essential tools in utility management and operation that provide supporting data necessary for long-term planning.

The Water Utility keeps several types of records:

- Water quality sampling for operations and mandatory water quality sampling records (see Appendix N): mandatory water quality sampling test results are reported to the state and maintained by the City.
- Chemical dosing records.
- Water main disinfection records.
- Hydrant flushing records.
- Source production and pumping records.
- Reservoir level records.
- Aquifer level records.
- Personnel records.
- Customer contact records.
- Meter records.
- Inventory records.

The City's records are legible, permanent, accurate, and accessible, and hard copies are maintained in the Water Maintenance Manager's office.

The Water Utility Engineering Section maintains records of backflow assembly test results, tester certifications, test notifications, backflow assembly information, and cross connection information in a database in the City's enterprise database management system.

Meanwhile, the SCADA system (described in Chapter 2) records the flow rates and flow quantities of all wells, booster pumps, and spring; water levels in reservoirs and production wells; levels in chemical storage tanks; pH levels of raw and treated water; pump starts and fails; alarm conditions; and other data.

Current maps of the water system are available electronically in an ESRI ArcGIS platform. Maps are available to the Water Maintenance Services Section, the Fire Department, Development Services Division, and other departments. Geographic information system (GIS) data is periodically updated as required. On the other hand, paper forms of the maps including valve, hydrant, and fire flow map books at 1 inch = 400 inch scale and wall maps at various scales are available upon request. Maps are also available in PDF format.

All records are kept in accordance with Revised Code of Washington (RCW) and WAC requirements. The City's file maintenance plan outlining specific instructions for keeping and destroying files is maintained and managed by the City Clerk.

8.10 O&M Summary

The City's water system is well operated and maintained, meeting or exceeding its statutory requirements. The evaluation of O&M practices identified the following potential improvements:

- Train or hire an additional water treatment plant operator for operational flexibility.
- Additional resources, if available, could allow expansion of preventative maintenance and replacement activities.

Chapter 9

CAPITAL IMPROVEMENT PLAN

9.1 Introduction

This chapter combines the various projects recommended in the Water System Plan (Plan) for the City of Renton (City) water distribution system and presents them as a comprehensive Capital Improvement Plan (CIP). With this CIP, the City will have a guideline to plan and budget for the water system over the next 20 years, as well as the recommended timing and cost estimates for each identified project. Project phasing is described as either short term (0 to 10 years, which corresponds to 2020-2029) or long term (10 to 20 years, which corresponds to 2030-2039).

The City has a separate Capital Investment Plan that prioritizes all City projects and identifies funding plans for a 6-year period. The City updates the budget for the Capital Investment Plan every 2 years.

As part of the planning and development of the capital improvement plan, the water utility will continue to consider programs and projects to support the City's business plan, vision and mission for economic growth, social equity, and environmental sustainability goals. The water utility will continue to implement capital improvement projects in a transparent manner, informed by system and community needs and the financial, environmental, and social costs and benefits, to provide long-term community value.

Appendix R details each project with cost estimates and detailed implementation timing and prioritization.

9.1.1 Capital Project Categories

The Plan's CIP projects are categorized by the following infrastructure:

- Distribution pipeline(D).
- Pressure Zone (PZ).
- Storage Facilities (ST)
- Annual Repair and Replacement (R&R) Programs (P).
- Pump Station (PS).
- General and On-Going Capital Projects and Programs (G).
- Regulatory Compliance Programs (R).

The abbreviations presented above were used during project identification to delineate each project category.

The City's Water Main Replacement Annual Program (WM) consist of the replacement of aging and undersized water mains throughout the water distribution and transmission system. The prioritization and selection of pipes are based on several factors including degree of fire flow deficiencies identified from the hydraulic model, frequency of leaks and breaks, remaining useful life of the pipes, and coordination with other City capital projects. This program reduces the likelihood of system failures, unplanned service interruptions, and claims for damages against the City. The following project categories identified in this Plan will be ultimately included in the City's WM Program:

- Distribution Pipeline Projects (D), which consist of sited specific projects to help mitigate deficiencies identified in Chapter 7, and sited maintenance main projects.
- Annual R&R Programs (P), which included non-sited pipelines. The City will prioritize every year based on the City's priorities and opportunities such as major roadways improvements and redevelopment areas.

Pressure zone (PZ), storage (ST), and pump station (PS) projects are in their respective categories. Storage Projects include the construction of the new Highlands 445-reservoir, and Kennydale reservoir, the recommendation of a new reservoir in Rolling Hills 590 PZ and the Blackriver reservoir. Pump Station Projects include recommendations at West Hill, South Talbot, Monroe, Mt Olivet Pump Stations.

Meanwhile, general projects (G) include studies and seismic-related projects for the distribution system, and on-going capital projects and programs, such as security improvements, or pressure-reducing valve (PRV) rehabilitation. Finally, regulatory (R) projects represent general water quality compliance projects, water system plan updates, and water conservation program.

An overview of the City's recommended CIP is presented in Section 9.2.

9.1.2 Capital Project Types

To support the City's financial evaluation, CIP projects were allocated into three types:

1. Capacity: Projects that add system capacity to meet future demand growth. These projects are typically funded with connection fees and are recommended to meet the analysis criteria detailed in Chapter 7.
2. Improvement: Projects that increase the level-of-service (e.g., redundant pumping, backup power, pipe upsizing, fire flow, system reliability) of existing infrastructure. These projects are typically funded with rates and are needed whether demand increases or stays the same.
3. R&R: Projects that replace or maintain existing infrastructure without increasing capacity or level-of-service. These projects are typically funded with reserves and are meant to renew infrastructure that is in poor condition.

Individual projects may include elements of multiple capital project types, meaning that each project was defined as one or more of the three types and assigned a percentage of the total project cost to each type. The allocations between multiple types were made using professional judgment.

9.2 CIP Program Overview

This section summarizes the CIP program and illustrates the locations of recommended projects, both specific and programmatic. Tables 9.1 and 9.2 summarize the CIP projects by project category and priority, respectively. Figures 9.1 and 9.2 summarize the percent of each project identified by project category and project type, respectively. Specific project details are provided at the end of the chapter in Table 9.15.

When considering CIP costs by project category as shown in Table 9.1 and Figure 9.1, the majority of CIP costs (47.3 percent) are accrued from programmatic projects. Distribution pipeline projects and general projects comprise the other high-cost categories and account for 17.3 percent and 10.4 percent of the CIP, respectively.

When considering CIP costs by priority (more detail in Section 9.4) as shown in Table 9.2 and Figure 9.2, approximately 63 percent of the CIP costs are annual programs. The total water CIP cost over the next 20 years is approximately $124 million, which equates to approximately $6 million per year for the planning period. Of the total cost, approximately $28 million is budgeted for the short term, approximately $18 million is budgeted for the long term, and approximately $79 million is budgeted for the annual category.

Table 9.1 CIP Summary by Project Category

Project Category	Annual Cost	Total Cost	Percentage
Distribution (D)	$ 1,075,550	$ 21,511,000	17.3%
Pressure Zone (PZ)	$ 21,250	$ 425,000	0.3%
Annual R&R Programs (P)	$ 2,937,600	$ 58,752,000	47.3%
Pump Station (PS)	$ 225,250	$ 4,505,000	3.6%
Storage (ST)	$ 869,750	$ 17,395,000	14.0%
General (G)	$ 645,000	$ 12,900,000	10.4%
Regulatory (R)	$ 440,000	$ 8,800,000	7.1%
Total Cost	**$ 6,214,400**	**$ 124,288,000**	**100%**

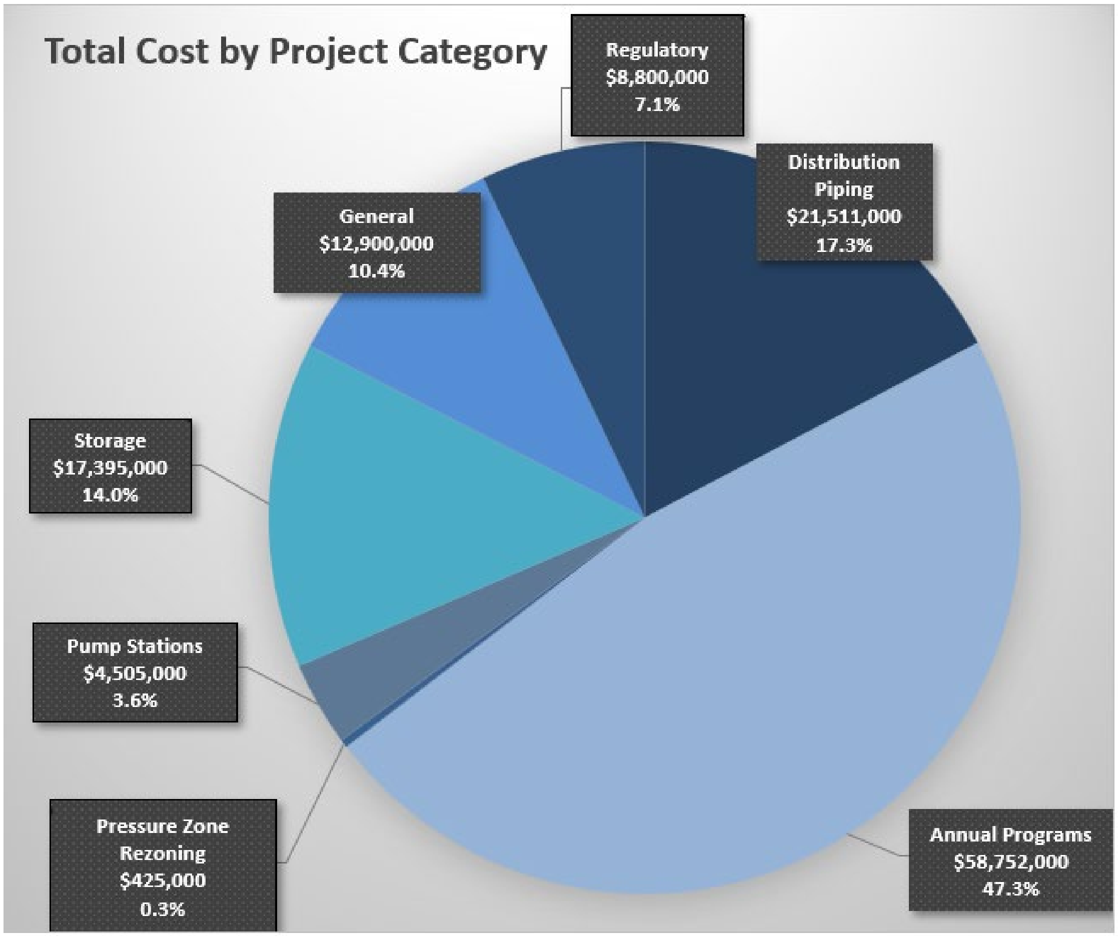

Figure 9.1 CIP Summary by Project Category

Table 9.2 CIP Summary by Project Priority

Project Priority	Total Cost	Percentage
0-10 years	$ 27,658,000	22.3%
10-20 years	$ 18,033,000	14.5%
Annual	$ 78,597,000	63.2%
Total Cost	**$ 124,288,000**	**100%**

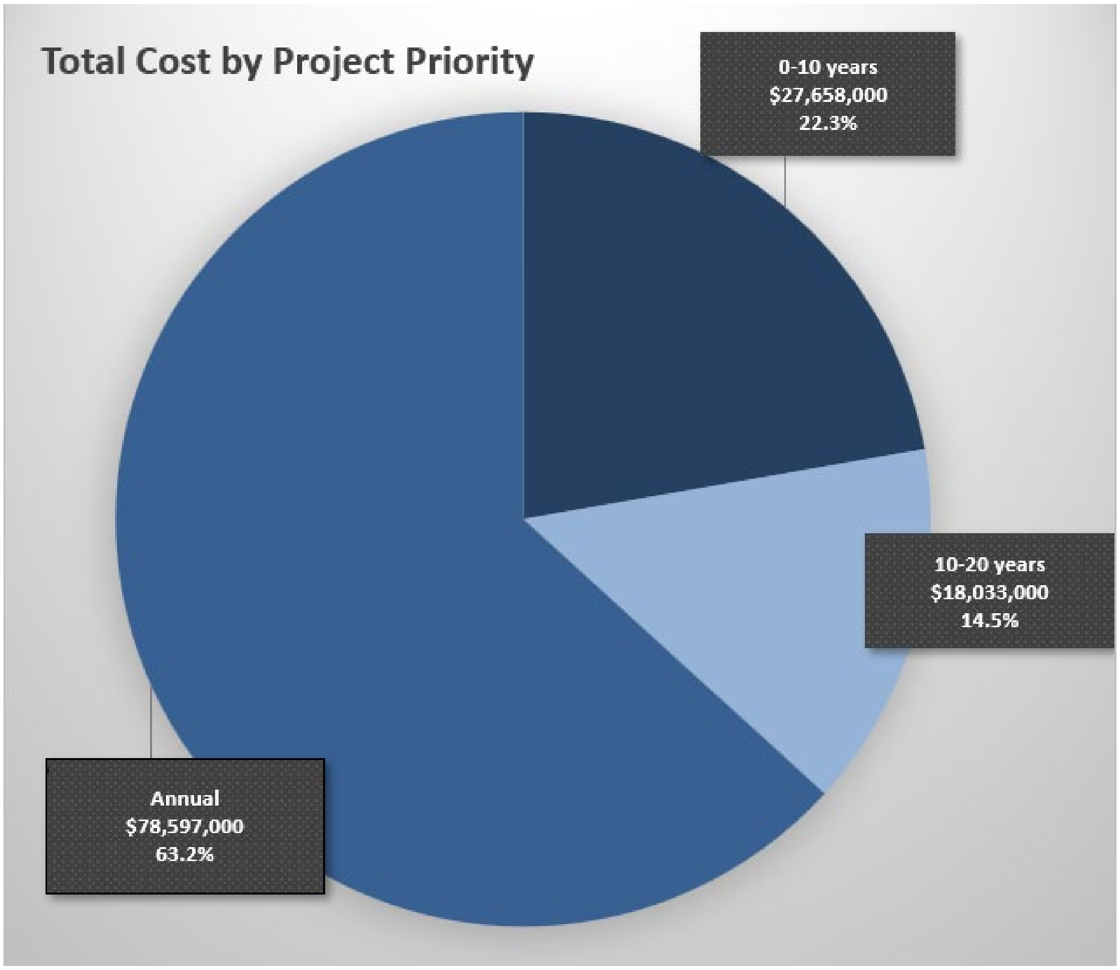

Figure 9.2 CIP Summary by Project Priority

9.3 Cost Estimating Assumptions

9.3.1 Cost Estimate Level

The CIP cost estimates in this chapter are Class 5 estimates (budget-level estimates). These costs were determined using both Carollo Engineers, Inc. (Carollo) understanding of project locations and current conditions and the City's costs of similar and recently constructed capital projects. Note, actual costs may vary from these estimates by -50 percent to +100 percent.

All costs are in 2019 dollars. The Engineering News Report's (ENR's) U.S. 20-City Construction Cost Index for June 2019 is 11,268. As previously stated, the estimates are subject to change as the project design matures and because costs for labor, materials, and equipment may vary in the future.

9.3.2 Baseline Unit Cost

Baseline construction costs were estimated using unit costs with the assumptions presented below.

9.3.2.1 Pipeline Unit Costs

Table 9.3 shows unit cost assumptions for pipelines provided by the City. These costs were developed from recent construction costs for various water pipeline projects and were rounded to the nearest tenth. To be conservative, these unit costs assume open-trench construction in improved areas.

The estimated construction costs cover pavement-cutting, excavation, hauling, shoring, pipe materials, hydrants, valves, service lines and installation, backfill material and installation, and pavement replacement. The unit costs are for typical field conditions for construction in stable soil at depths ranging between three to five feet.

Table 9.3 Pipeline Unit Costs

Pipe Size (Inches)	Pipeline Unit Cost(1) ($/LF)
8	$300
10	$350
12	$400
16	$500
18	$550
24	$700

Notes:
(1) The unit cost does not include the additional 25 percent for construction contingency, 30 percent for design and admin.
Abbreviation: LF – linear feet.

9.3.2.2 Pump Station Generator Costs

Costs for pump station generators were developed based on Carollo's and the City's past experience with similar projects. Unit cost for generators was assumed to be $200,000 per 100 horsepower (hp).

As presented in Table 9.4, pump station generator costs are based on pump horsepower.

Table 9.4 Pump Station Generator Unit Cost

Generator Size (hp)	Generator Unit Cost(1) ($/hp)
Any	$200,000

Note:
(1) The unit cost does not include the additional 25 percent for construction contingency, 30 percent for design and admin.

9.3.2.3 Storage Costs

Project costs for new storage were developed according to typical costs from past City projects. Conceptual costs for reservoirs vary by type (ground, standpipe, or elevated) and are estimated based on reservoir volume in gallons (gal), as presented in Table 9.5. Storage costs are sensitive to site-specific geotechnical and seismic considerations; therefore, the City is recommended to conduct a reservoir siting study at the start of every new storage project.

Table 9.5 Reservoir Unit Costs

Reservoir Type	Storage Unit Cost(1) ($/gal)
Ground	$3
Standpipe	$6
Elevated	$8

Note:
(1) The unit cost does not include the additional 25 percent for construction contingency, 30 percent for design and admin.

9.3.2.4 Pressure-Reducing Valve Costs

Other costs for the CIP include that of the PRV station. The conceptual cost presented in Table 9.6 was estimated based on Carollo's recent projects.

Table 9.6 Valve Costs

	Cost(1) (Lump Sum)
Pressure Reducing Valve Station	$200,000

Note:
(1) The unit cost does not include the additional 25 percent for construction contingency or 30 percent for design and admin.

9.3.3 Construction Contingency

Contingency costs must be reviewed on a case-by-case basis because they will vary considerably with each project. Consequently, the preliminary layout of a project will contain uncertainties such as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities; because all these items increase project costs, allowances should be made for them in preliminary estimates. To assist the City in making financial decisions for these future construction projects, a construction contingency cost of 25 percent is added to the baseline construction cost.

9.3.4 Design/Admin Costs

Design and administration costs include expenses associated with project engineering, professional services during the construction phase, and project administration. More specifically, engineering services associated with new facilities include the following tasks:

- Conducting preliminary investigations and reports.
- Preparing drawings and specifications during construction.
- Surveying and staking.
- Sampling of testing material.
- Providing start-up services.

Meanwhile, construction phase professional services cover items such as construction management, engineering services, materials testing, and inspection during construction. Finally, project administration costs cover items such as legal fees, financing expenses, administrative costs, and interest during construction.

In general, the City suggested that the projects in this CIP include a design and administration cost of 30 percent of the construction cost with contingency. Per City's direction, no specific planning contingency was added to the capital costs.

9.3.5 Total Capital Improvement Cost

The costs presented in this CIP are high-level planning costs that will help the City make financial decisions

The sample capital improvement project cost calculation shown below demonstrates how construction contingency as well as design and administrative costs were added to the baseline construction cost to determine the total project cost. The construction contingency plus design and administration costs make up 38.5 percent ($625,000/$1,625,000) of the total project cost estimate.

Example:

Baseline Construction Cost	**$1,000,000**
Construction Contingency (25%)	$250,000
Estimated Construction Cost	**$1,250,000**
Engineering Design Cost + Project Administration (30%)	$375,000
Total Capital Improvement Cost	**$1,625,000**

9.4 CIP Development and Implementation

The capital improvement implementation was separated into two phases:

- Short term: 0 to 10 years.
- Long term: 10 to 20 years.

The City developed prioritization criteria to prioritize all projects and recommendations from this Plan between Short-term and Long-term. Short-term projects have already started or are committed to starting within a reasonable timeframe and include high-priority projects, such as the following:

- High priority multi-feature projects.
- Projects improving system reliability.
- Maintenance-identified projects.

All other CIP projects, including single feature projects are long term.

Table 9.7 summarizes the high-level prioritization matrix for different project types and purposes.

Table 9.7 Overall Prioritization Criteria

Project Types[1]	0-10 years	10-20 years
Dead-end pipes in existing non-single-family areas (3,000 gpm):		X
Dead-end pipes in existing single-family areas (1,000 gpm):	X	
Maintenance projects	X	
Pipe upsize due to excessive velocity (over 8 fps)		X
R&R pipes only – past RUL		
R&R pipes only – reaching RUL 0-10 years	Annual replacement $	
R&R pipes only – reaching RUL 10-20 years		
Pipe upsize for fire flow only		X
Pipe upsize for fire flow, maintenance, and past RUL	X	

Project Types[1]	0-10 years	10-20 years
Pipe upsize for fire flow, and RUL reached in 0-10 years	X	
Pipe upsize for fire flow, and RUL reached in 10-20 years		X
Pressure Zone projects (PZ-02)	X	
Pump Station projects (PS-01, PS-02, PS-03)	X	

Note:
Abbreviations: gpm – gallons per minute; RUL – remaining useful life; fps – feet per second.

A detailed and customized scoring method using weighting factors was developed to help refine rankings and prioritize specific pipeline projects after the general method stated above. Appendix S details this scoring method. This detailed method resulted in the same project allocation between 0-10 years and 10-20 years as the simplified method presented in this section. This is an initial evaluation of the projects; however, it is recommended that the City develop a systematic method to prioritize projects, especially R&R projects

The following sections summarize recommended projects identified in previous chapters and incorporated in the summary in Section 9.5. Figures and detailed tables are located at the end of this chapter.

9.4.1 Recommended Distribution Pipeline Projects

Distribution pipeline projects (D) were developed using:

- The hydraulic model and were identified for areas not meeting velocity and pressure criteria, as detailed in Chapter 7.
- City staff input, specifically projects identified by the maintenance staff as areas of improvement.

Projects identified under this category will be part of the City's WM, which consists of the replacement of aging and undersized water mains throughout the water distribution and transmission system. The prioritization and selection of pipes are based on several factors including degree of fire flow deficiencies identified from the hydraulic model, frequency of leaks and breaks, remaining useful life of the pipes, and coordination with other City capital projects. This program reduces the likelihood of system failures, unplanned service interruptions, and claims for damages against the City. Pipelines identified under project P-03 (see section 9.4.3) will also be included in the City's WM Program for funding purpose.

9.4.1.1 D-1 through D-14: Fire Flow Recommended Pipeline Projects

To address fire flow deficiencies identified in Chapter 7, projects and recommendations presented in that chapter should be implemented. Namely, projects will upsize 4-inch and 6-inch pipes and change hydrant lateral connections. Once implemented, these projects will help mitigate the identified deficiencies. Section 9.5 details each fire flow pipeline project and references it according to its project identification. In the CIP, these are projects D-01 through D-14.

Given the results of the remaining useful life analysis presented in Chapter 7, some of these projects are also recommended to address the asset condition.

In summary, approximately 19,650 LF of piping is recommended to be upsized or built to mitigate fire flow deficiencies. These projects are estimated to total $10.06 million (including design and admin and construction contingency) and are recommended in both short-term and long-term phases, as shown in the Prioritization Criteria in Table 9.7.

9.4.1.2 D-15: Velocity Improvement Projects

One 8-inch line located at Maple Valley Highway and Interstate 405 (I-405) was found to exceed maximum velocity during peak hour demand (PHD) in the distribution system. This section of the pipe is surrounded by 12-inch piping and is recommended to also be upsized to 12 inches.

This velocity improvement project will upsize 70 feet of 8-inch line to 12 inches and is listed as the Maple Valley Hwy Pipe Upsize at Henry Moses Aquatic Center (D-15) in the CIP. D-13 is estimated at $46,000 and recommended in the long term. It is anticipated that this deficiency will be corrected as part of the water main improvements required for a proposed commercial development of the old Stoneway Concrete site along Maple Valley Highway.

9.4.1.3 D-16 through D-22: Maintenance-Identified Condition Projects

The City's maintenance department identified nine water main replacement projects and prioritized them according to City needs, maintenance history, pipe age, and pipe type. In the CIP, they are projects D-16 through D-22 in detailed Table 9.15. Many of these projects overlap with RUL projects and projects identified by the hydraulic model.

Per the City's policies on new pipe sizes, existing pipes with 4-inch or 6-inch diameters are recommended to be upsized to 8 inches. Through these maintenance-identified condition projects, a total of approximately 21,660 feet of piping is recommended to be replaced for a total of $11.4 million. They are all recommended to be implemented in the short term.

9.4.1.4 Distribution Pipeline Recommendations Summary

Table 9.8 summarizes the footage and the cost of different diameter piping that must be replaced in the short and long terms. This table includes all projects recommended in the above sections.

Table 9.8 Distribution Pipelines Projects Summary

Pipe Diameter	0-10 years		10-20 years	
	Length (LF)	Cost(2)	Length (LF)	Cost(2)
8-inch(1)	30,850	$15,041,000	3,350	$1,634,000
10-inch(1)	--	--	1,800	$1,024,000
12-inch(1)	5,210	$3,387,000	100	$391,000
Hydrant Lateral Connections	--	--	70	$34,000
Total	**36,060**	**$18,428,000**	**5,320**	**$3,083,000**

Notes:
(1) Both 4-inch and 6-inch existing diameters will be replaced with larger-diameter pipes.
(2) The cost includes 25 percent construction contingency and 30 percent engineer/legal/admin contingency.

9.4.2 Recommended Pressure Zone Projects

This CIP has two pressure zone projects, both of which are summarized in Table 9.9 with their respective priorities and costs.

Table 9.9 Pressure Zone Recommendations

Project Number	Project Name	Priority	Cost(1)
PZ-01	HLD 445/565 Pipe Reconfiguration	10-20 years	$325,000
PZ-02	VLY196 Re-zone	0-10 years	$100,000

Note:
(1) The cost includes 25 percent construction contingency and 30 percent engineer/legal/admin contingency.

9.4.2.1 PZ-01: HLD 445/565 Pipe Reconfiguration

Several low-pressure nodes (below 30 pounds per square inch [psi]) exist adjacent to the Highlands 565 transmission line. The City has been working to relocate connections currently located on the lower-pressure line to adjacent higher-pressure lines. In addition, as this area gets re-developed, new developments must connect to the neighboring Highland 565 PZ due to fire flow deficiencies on the Highland 445 adjacent pipe.

This pipe reconfiguration project is labeled HLD 445/565 Pipe Reconfiguration (PZ-01) in the CIP. PZ-01 is anticipated to be implemented in the long term and estimated at approximately $325,000.

9.4.2.2 PZ-02: VLY196 Re-Zone

The storage analysis detailed in Chapter 7 showed that, although this area has sufficient storage at 20 psi, the Valley 196 PZ is deficient in its ability to supply operational and equalizing volumes at 30 psi to the highest customers.

To address this issue, the City is connecting high-elevation residents within the Valley 196 PZ to higher-pressure infrastructure, thus providing them adequate operating and fire flow pressures.

This project is labeled VLY196 Re-zone (PZ-02) in the CIP and, in addition to the re-zoning, includes improvement of hydrant S-00235 at 401 S 43rd St and Talbot Rd. More specifically, the hydrant needs to be re-zoned, decommissioned, or removed.

PZ-02 is estimated at $100,000 and recommended to be implemented in the short term.

9.4.3 Recommended Annual Repair and Replacement Programs

Two types of programmatic projects (P) are recommended: annual R&R pipeline projects and dead-end programs.

9.4.3.1 P-01: Dead-End Pipes in Non-Single-Family Areas Program

The City has multiple 4-inch, 6-inch, or 8-inch diameter dead-end pipes in non-single family areas that are older and do not have the capacity to provide the City's fire flow requirements of 3,000 gpm. In some cases, customers are protected by multiple hydrants on different water mains. As long as the total fire flow from the multiple hydrants meets the fire flow requirement, no improvements are necessary. In other cases where only one water main serves customers, looping may be required or the dead-end main may need to be upsized to 12 inches to meet the fire flow requirements.

The City is recommended to individually evaluate each case of these dead-end pipes to determine how fire flow s can be provided to customers. These areas should be reviewed when new development takes place and potentially looped or upsized. No cost was developed for the annual Dead-End Pipes in Non-Single-Family Areas Program (P-01).

9.4.3.2 P-02: Dead-End Pipes in Single Family Areas Program

The City has multiple 4-inch and 6-inch dead-end pipes in single family areas that are also old and do not have the capacity to provide the City's fire flow requirements of 1,000 gpm. To address this situation, the City has been programmatically moving hydrants from the dead-end to the closest main with 1,000 gpm. The City is recommended to continue this approach and to also evaluate each case individually to determine how fire flows can best be provided customers.

The estimated cost for the Dead-End Pipes in Single Family Areas Program (P-02) is approximately $1.16 million and is recommended in the short term.

9.4.3.3 P-03: Pipeline Repair and Replacement Program

As outlined in Chapter 7, the RUL analysis examined the pipes' material and installation year, as well as their materials' useful life, to determine the year during which each pipe would reach the end of its useful life.

The City is recommended to continue its annual pipe-replacement program and replace approximately 6,000 LF of pipe per year, targeting pipes that have reached the end of their useful life and offsetting the depreciation of this City asset.

Table 9.10 summarizes the footage and the cost for each pipe diameter that's included in the CIP and also presents the total annual LF and cost. Additionally, it is recommended that the City invest in developing an Asset Management Program (AMP) to help prioritize which pipelines need to be replaced each year (see project G-11).

Table 9.10 Remaining Useful Life Repair and Replacement Summary

Pipe Diameter	R&R Annual Program Statistics	
	Total Length (LF)	Total Cost(1)
6-inch and less	65,630	$ 26,662,000
8-inch	17,950	$ 8,751,000
10-inch	4,620	$ 2,628,000
12-inch	20,270	$ 13,176,000
14-inch	770	$ 563,000
16-inch	4,410	$ 3,583,000
18-inch	2,360	$ 2,109,000
24-inch	110	$ 125,000
Total	**116,120**	**$ 57,597,000**
Annual Length/Cost	**5,806**	**$ 2,879,850**

Notes:
(1) The cost includes 25 percent construction contingency and 30 percent engineer/legal/admin contingency.
(2) Linear feet in this table are different than the ones presented in Chapter 7. Some of the recommended R&R pipelines were also included as part of the specific sited Distribution Pipeline projects. Linear feet from these projects were removed from the Remaining Useful Life R&R in this table.

P-03 is estimated to cost approximately $57.6 million or $2.9 million annually over the 20-year period. Note, the total linear feet of pipes in Table 9.10 differ from the analysis performed in Chapter 7. Some of the pipelines identified in the RUL evaluation were also included as part of the specific sited Distribution Pipeline projects (P-16 through P-22) and were therefore not included here.

No specific projects were identified as part of the Pipeline R&R Program (P-03). Instead, the City is recommended to decide which pipes to replace every year. It is recommended that the City continues to enhance its asset management program to help prioritize and time the R&R of its aging water infrastructure by weighing the costs of continued maintenance against the costs of R&R. This will help prioritize which pipelines identified under Project P-03 need to be replaced each year and will include additional data than remaining useful analysis only. These plans ultimately reduce operation and maintenance risks, thus resulting in overall lower costs burdened by ratepayers.

Currently, the City wishes to focus on the pipelines located in the downtown and Highlands areas and take advantage of opportunities such as implementing projects in conjunction with major roadway improvements as much as possible.

Water Main Improvements in conjunction with Major Roadway Improvements

This program consists of taking advantage of major roadway improvements planned by the City in areas where pipeline reaching their remaining useful life were identified. This would include the design and construction of new water mains as part of major roadway improvements, including Rainier Avenue Phase 4, Duvall Avenue and water main relocation to accommodate the I-405 corridor improvement project by WSDOT.

Water Main Improvements in Redevelopment Areas – Downtown and Highlands

Redevelopment activities can have a substantial impact on the ability of the existing distribution system to provide sufficient water to customers for fire protection service and for domestic uses. Significant activities are planned during the S 2nd and S 3rd 2-way conversion anticipated in 2019 - 2022. Typically, detailed hydraulic models are used in conjunction with area water demand forecasts and fire flow requirements to identify potential water main improvements in redevelopment areas.

Water main improvements needed for redevelopment projects are typically installed and paid for by the developers. The developers may recoup some of their costs from future benefitting properties by applying to City Council for a latecomer agreement. In some cases, with the approval of funding from the City Council, the City may install the improvements or participate in the cost of the improvements with the developers and the City recovers its costs from benefitting properties through a Special Assessment District. The pipe replacement program for redevelopment projects is designed to balance the City's investments in pipe replacement projects to reduce risks associated with aging pipe infrastructure with investments in major pipe replacement projects to support growth and development.

9.4.4 Recommended Pump Station Projects

Table 9.11 summarizes three pump station projects (PS), all of which are prioritized for the short term.

Table 9.11 Pump Station Recommendations

Project Number	Project Name	Priority	Cost(1)
PS-01	Monroe BPS	0-10 years	$ 488,000
PS-02	West Hill BPS	0-10 years	$ 1,842,000
PS-03	South Talbot BPS	0-10 years	$ 2,175,000

Notes:
(1) The cost includes 25 percent construction contingency and 30 percent engineer/legal/admin contingency.
Abbreviation: BPS – booster pump station.

9.4.4.1 PS-01: Monroe BPS Project

With the existing reliable sources and reservoirs, the Highlands 565 Operational Area does not have enough storage for all planning years until 2039. As described in Chapter 7, the Highlands 565 area will be deficient by 1.26 million gallons (MG) by 2029 and 1.65 MG by 2039.

However, excess storage located in the Highlands 445 Operational Area is sufficient to offset Highland 565 deficiencies.

For the Monroe BPS Project (PS-01), the City is recommended to install backup power generators at the Monroe Avenue BPS to allow storage to be provided from the Highlands 445 PZ to the Highlands 565 PZ, which will also improve pumping capacity in the long term.

The City is planning on adding a generator at Monroe BPS and is phased for the short term in the CIP. The total capital cost is estimated at approximately $488,000.

9.4.4.2 PS-02: West Hill BPS Project

The West Hill BPS Project (PS-02) will install a generator at the West Hill BPS, increasing pumping capacity and implementing electrical, structural, and mechanical improvements. PS-02 is currently under design and, therefore, phased for the short term in the CIP. The cost is estimated at $1.8 million based on a 2018 pre-design study.

9.4.4.3 PS-03: South Talbot BPS Project

The South Talbot BPS Project (PS-03) will replace fire and duty pumps in the South Talbot BPS and implement electrical, structural, and mechanical improvements. This project is currently under design and, therefore, phased for the short term. The cost is estimated at $2.2 million based on a 2018 pre-design study.

9.4.5 Recommended Storage Projects

This section summarizes the recommended storage projects (ST) that were identified through the storage analysis detailed in Chapter 7. Table 9.12 shows the two recommended projects.

Table 9.12 Storage Recommendations

Project Number	Project Name	Priority	Cost(1)
ST-01	Rolling Hill 590 Storage (1.5-MG)	0-20 years	$ 17,395,000
ST-02	West Hill 495 Storage	0-10 years	N/A Operational change only

Note:
(1) The cost includes 25 percent construction contingency and 30 percent Engineer/Legal/Admin contingency.

9.4.5.1 ST-01: Rolling Hill 590 Storage Project

As identified during the storage analysis, Rolling Hills 590 Operational Area does not have sufficient storage for all planning years until 2039. The analysis in Chapter 7 shows that the operational area will be deficient by 0.95 MG by 2039.

The Rolling Hill 590 Storage Project (ST-01) will mitigate this storage deficiency in two phases:

- Phase 1: Add backup power to the Maplewood BPS to increase pumping capacity from the Rolling Hills 490 PZ to the Rolling Hills 590 PZ, and add auto-start, auto-transfer, and backup power to the Rolling Hills BPS so that three pumps can be operated at the same time.
- Phase 2: Construct a new 1.5-MG standpipe for the Rolling Hills 590 Operational Area. The new standpipe will replace the existing 0.3-MG elevated tank.

Phase 1 is recommended to be implemented in the short term and is estimated to cost approximately $2.8 million. Phase 2 is recommended to be implemented in the long term and is estimated to cost approximately $14.6 million. After both phases are implemented, the Rolling Hills 590 Operational Area will have sufficient storage for the future and added redundancy with reliable pumping from the Maplewood BPS and Rolling Hills BPS.

Siting studies and property acquisition may be necessary for this project. Hydraulic analysis using the City's updated hydraulic model is recommended to confirm reservoir sizing and system hydraulics. The new facilities and related pipelines will be designed and constructed in accordance to the latest seismic codes and standards.

9.4.5.2 ST-02: West Hill 495 Storage

Even with the existing reliable sources and reservoirs, the West Hill 495 Operational Area does not have sufficient storage through 2039.

Excess storage located in the Valley Operational Area is sufficient to offset deficiencies in the West Hill 495. The Valley Operational Area has 1.04 MG of excess storage available by 2039, which can be reliably pumped to the West Hill 495 Operational Area via the new West Hill BPS. The City is currently planning on expanding capacity of the West Hill PS and adding a generator at the West Hill BPS as part of the West Hill BPS Improvement Project.

Additionally, the City currently operates the tank with a 16 ft operational band, which equates to a 0.22-MG operational storage volume. It is recommended that the City update operational strategy and reduce the operational band thus decreasing the operational volume and helping to mitigate deficiencies.

9.4.6 Recommended General and on-going Projects and Programs

Eleven general projects (G) were recommended for this CIP and are summarized in Table 9.13.

Table 9.13 Recommended General Projects Summary

Project Number	Project Name	Priority	20-year Total Cost(1)
G-01	Reservoir Repair, Painting, Cathodic Protection	Annual	$ 3,000,000
G-02	Emergency Response Water Projects	Annual	$ 2,000,000
G-03	Pump Station Condition Evaluation (mechanical, structural, electrical)	0-10 years	$ 300,000
G-04	Storage Condition Evaluation (structural, seismic)	0-10 years	$ 400,000
G-05	Security Improvements	Annual	$ 200,000
G-06	Telemetry System and SCADA Upgrades	Annual	$ 1,000,000
G-07	PRV Rehabilitation	Annual	$ 2,000,000
G-08	Improvements to pipelines on bridge	Annual	$ 4,000,000
Total			**$ 12,900,000**

Notes:
(1) The cost includes 25 percent construction contingency and 30 percent engineer/legal/admin contingency.
Abbreviation: SCADA - Supervisory Control and Data Acquisition.

9.4.6.1 G-01: Reservoir Repair, Painting, Cathodic Protection

The Reservoir Repair, Painting, Cathodic Protection project (G-01) consists of a scheduled recoating of the interior and exterior surfaces of the existing steel standpipe and elevated tanks to extend the useful life of the structures. The project will also install seismic and safety upgrades and a cathodic protection system.

The budget for this program is $150,000 per year for an estimated total of $3 million for the 20-year planning period.

9.4.6.2 G-02: Emergency Response Water Projects

Under G-02, the City wishes to budget $100,000 per year for an estimated planning total of $2 million for any emergency response water projects that may arise or are currently unknown.

9.4.6.3 G-03: Pump Station Condition Evaluation

The City is recommended to perform a condition evaluation of their existing pump stations in the short term. Any pump stations constructed before 1985 are anticipated to require replacement or repair within the planning period.

The Pump Station Condition Evaluation (G-03) is estimated to cost $300,000.

The outcome of this evaluation will result in pump station rehabilitation projects and recommend emergency power supply for the remaining pump station without emergency supply. This will result in the design and installation of upgrades and/or replacement of mechanical and electrical equipment, correcting deficiencies to pump buildings including the installation of backup power supply with auto-start transfer switches. The goal for these recommendations is to extend the useful life of the pump stations reduces the likelihood of pump failures and unplanned service interruptions for fire protection and for domestic uses.

9.4.6.4 G-04: Storage Condition Evaluation

The City is recommended to also perform a condition evaluation of its existing storage reservoirs since those that were constructed before 1975 may need to be replaced, repaired, or recoated within the planning period. G-01 is included as a capital project for potential costs and necessary repairs resulting from this storage evaluation.

The Storage Condition Evaluation (G-04) is a study recommended in the short term and $400,000 was allocated to this effort in the CIP.

9.4.6.5 G-05: Security Improvements

This project plans, designs, and installs security improvements to the existing water system facilities according to findings and recommendations derived from the security vulnerability assessment. The budget for the Security Improvements program (G-05) is $10,000 per year for a total of $200,000 during the planning period.

9.4.6.6 G-06: Telemetry System and SCADA Upgrades

This project systematically replaces the remote telemetry units (RTUs) in the City's various water facilities. Currently, some replacement parts for the existing RTUs are unavailable and, in any case, the City should be prepared with replacement units should the original system's manufacturers go out of business. This project also designs, reconfigures, programs, and conducts functional testing on the master telemetry unit (MTU) and the human-machine interface (HMI) in the City's operation and maintenance headquarters.

The Telemetry System and SCADA Upgrades project (G-06) will occur on a 5-year cycle and is estimated to cost $50,000 per year for a total cost of $1 million during the planning period.

9.4.6.7 G-07: PRV Rehabilitation

This program consists of the rehabilitation and replacement of 45 existing PRV's throughout the system. The improvements include the verification of the sizing and set points of the PRV's based on the hydraulic model analysis of the system, adequacy of pressure relief valves, metering, and integration with the City's SCADA system. The replacement criteria and schedule will be determined based on a PRV rehabilitation and replacement study that will be completed the City by June 2020.

The City is recommended to continue its PRV rehabilitation and maintenance program for its 45 PRVS, which are critical pieces of its distribution system. The PRV Rehabilitation project is budgeted $100,000 per year for an estimated total of $2 million for the planning period.

9.4.6.8 G-08: Improvements to Pipelines on Bridge

This program consists of the replacement of existing water mains located under existing bridges that are going to be retrofitted as part of the City's Transportation Division capital improvement plan.

The City owns and maintains the following water mains on bridges:

- One 12-inch water main on the Logan Ave N bridge.
- One 8-inch water main on the Williams Ave S bridge.
- Two 18-inch water mains on the Wells Ave S bridge.
- One 8-inch water main on the Bronson Way S bridge.
- One 16-inch water main on the Houser Way S bridge.
- One 16-inch water main on the SW 43rd St bridge.
- One 24-inch water main on the SW 43rd St bridge.

The Improvements to Pipelines on Bridge project (G-08) evaluates the condition and seismic resiliency of these locations, as well as makes seismic improvements and repairs as necessary. This project is budgeted $200,000 per year for an estimated total of $4 million for the planning period.

9.4.7 Recommended Regulatory Compliance Projects

Three regulatory Compliance projects (R) were recommended for this CIP and are summarized in Table 9.14.

Table 9.14 Recommended Regulatory Compliance Projects Summary

Project Number	Project Name	Priority	20-year Total Cost(1)
R-01	Water Quality Compliance Projects	Annual	$ 4,000,000
R-02	Water Conservation Program Implementation	Annual	$ 4,000,000
R-03	Water System Plan	0-10 years and 10-20 years	$ 800,000

9.4.7.1 R-01: Water Quality Compliance Projects

A budget of $200,000 per year for regulatory compliance projects (R-01) is recommended to be set aside for an estimated total of $4 million for the 20-year planning period.

9.4.7.2 R-02: Water Conservation Program Implementation

As recommended in Chapter 4, the Water Use Efficiency (WUE) rule, given the number of connections the City has, requires the City to evaluate or implement efforts for nine measures of its choice. These measures support the City's proposed goals for water use efficiency, in addition to the mandatory measures. The selected measures are as follows:

- Water bill consumption history.
- School outreach.
- Utility bill inserts.
- Natural yard care workshops.
- Advertising and public outreach.
- City demonstration garden.
- WashWise washing machine rebates.
- Hose gaskets.
- Web page.

A budget of $200,000 per year was allocated to the Water Conservation Program Implementation project (R-02) in the CIP for a total estimated cost of $4 million for the 20-year planning period.

9.4.7.3 R-03: Water System Plan

The Water System Plan project (R-03) includes the development of 10-year and 20-year updates to the City's Plan. Each plan is estimated to cost $400,000 for a total of $800,000 in the planning period.

9.4.8 Other Projects - Future Reservoirs to Increase Storage and Enhance Operational Flexibility

The City can meet its future storage requirements by adding new reservoirs and replacing its existing reservoirs. To improve operational flexibility and redundancy in the distribution system, the City plans to install larger reservoirs in the future by maximizing their footprints within the current City-owned properties. These larger reservoirs will provide added reliability when the City needs to take an existing reservoir out of service for maintenance.

These projects will need siting studies and property acquisition if necessary, hydraulic analysis and reservoir sizing, pre-design, final design and construction of storage facilities to increase storage in the water system operational areas to meet growth demand projection and to provide operational reliability and flexibility. The new facilities and related pipelines will be designed and constructed in accordance to the latest seismic codes and standards.

The following projects were identified for this effort. Proposed reservoir sizes will be confirmed during pre-design. These projects are planned for the long term (past our planning period of 20 years) and no detailed costs were developed at this time.

9.4.8.1 Blackriver Reservoir – Valley 196 PZ

This project acquires property and then plans, designs, constructs a new reservoir in the Valley 196 PZ to provide the City with additional storage along with operational flexibility, reliability, and redundancy of system capacity in case the City needs to take the existing North Talbot Reservoir out of service for maintenance. The new Blackriver Reservoir will supplement the storage that the North Talbot and Mt. Olivet Reservoirs provide to this operational area. The proposed reservoir size will be confirmed during the project's pre-design.

In 2011, the City completed a site assessment and geotechnical investigations of a potential site in the Blackriver Quarry. A pre-design report was completed for a proposed 6.6-MG reservoir and related transmission main.

9.4.8.2 Replacement of Existing Mt. Olivet Reservoir and Pump Station – Valley 196 PZ

This project plans, designs, and constructs the replacement of the existing 3-MG Mt. Olivet Reservoir and Pump Station, which were constructed in 1954. This reservoir provides storage to the Valley's operational area and, once replaced, will supplement the storage that the North Talbot and future Blackriver Reservoirs provide to this operational area. In the past, the City recoated the existing tank's interior and exterior and installed a cathodic protection system to extend its useful life.

The City plans to replace the existing reservoir with a new 7-MG tank. In addition, the booster pump station will be replaced with two 150-hp and two 125-hp pumps, with a total capacity of 9,000-gpm. The reservoir size and pump sizes will be confirmed during the project's pre-design.

9.5 CIP Program Detailed Summary

The summary table in Section 9.1 summarizes the CIP projects and labels them as D, P, PZ, PS, ST, G, or R. As mentioned before, each project is assigned a CIP Identification. Table 9.15 details all projects identified and defined in this chapter and identifies the planning period (short-term, long-term, or annual) determined for each project and project type.

Figure 9.3 illustrates the locations of the specific projects identified, while Figure 9.4 illustrates these projects phased between short and long terms. Distribution system improvements highlighted on Figure 9.3 includes both fire flow and velocity recommendations.

Figure 9.5 and Figure 9.6 illustrate the location of projects included in the programmatic CIP, which are not included in any of the specific projects. Figure 9.5 presents City's recommended program P-01, while Figure 9.6 presents City's recommended program P-03.

An individual project sheet was generated for each CIP project and includes project identifier, description, costs, project type, timeline, and comments to help with future implementation. To help the City identify individual projects, project sheets are separated by project category. Appendix T includes all the project sheets.

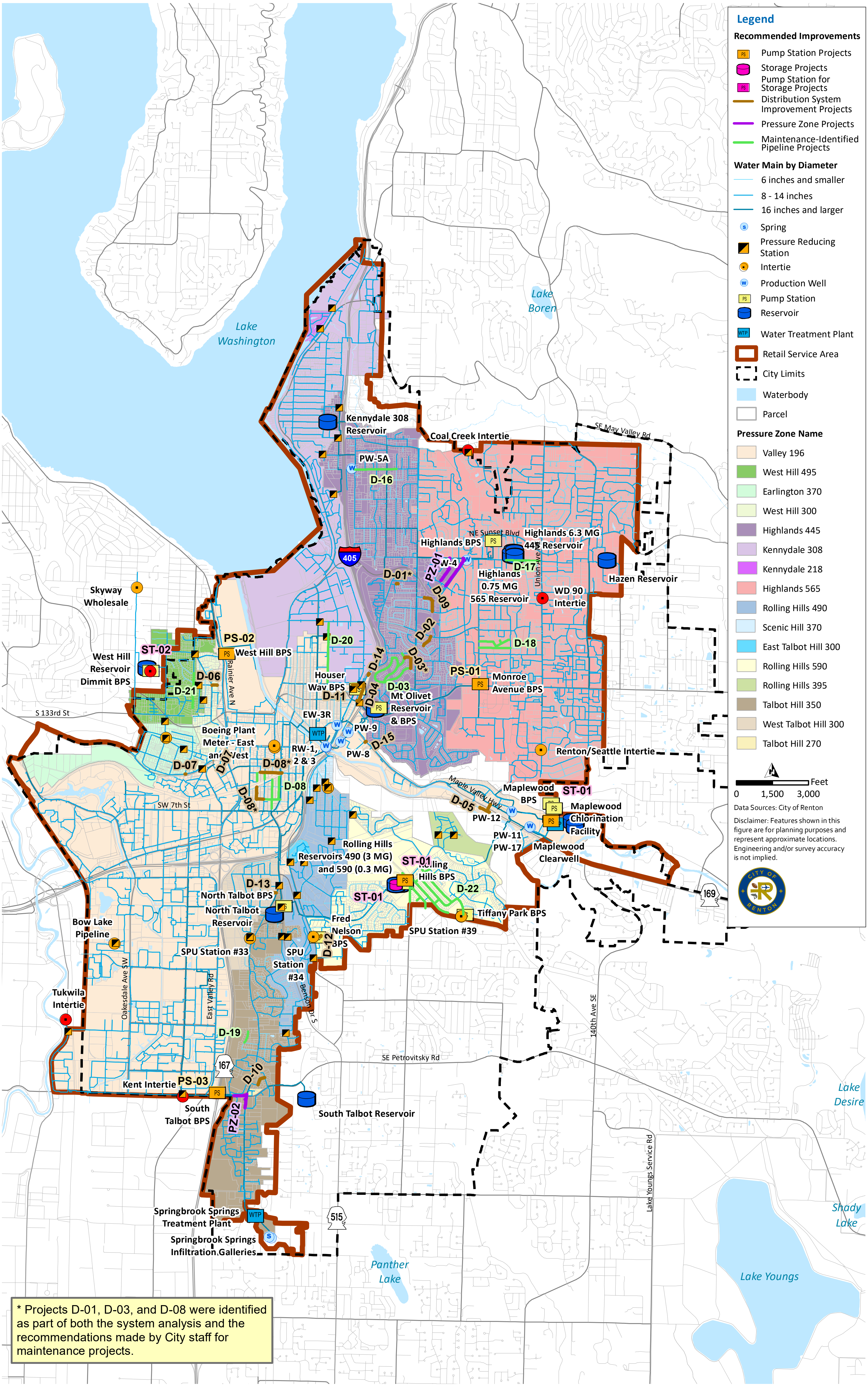

Figure 9.3 Recommended Specific CIP Projects

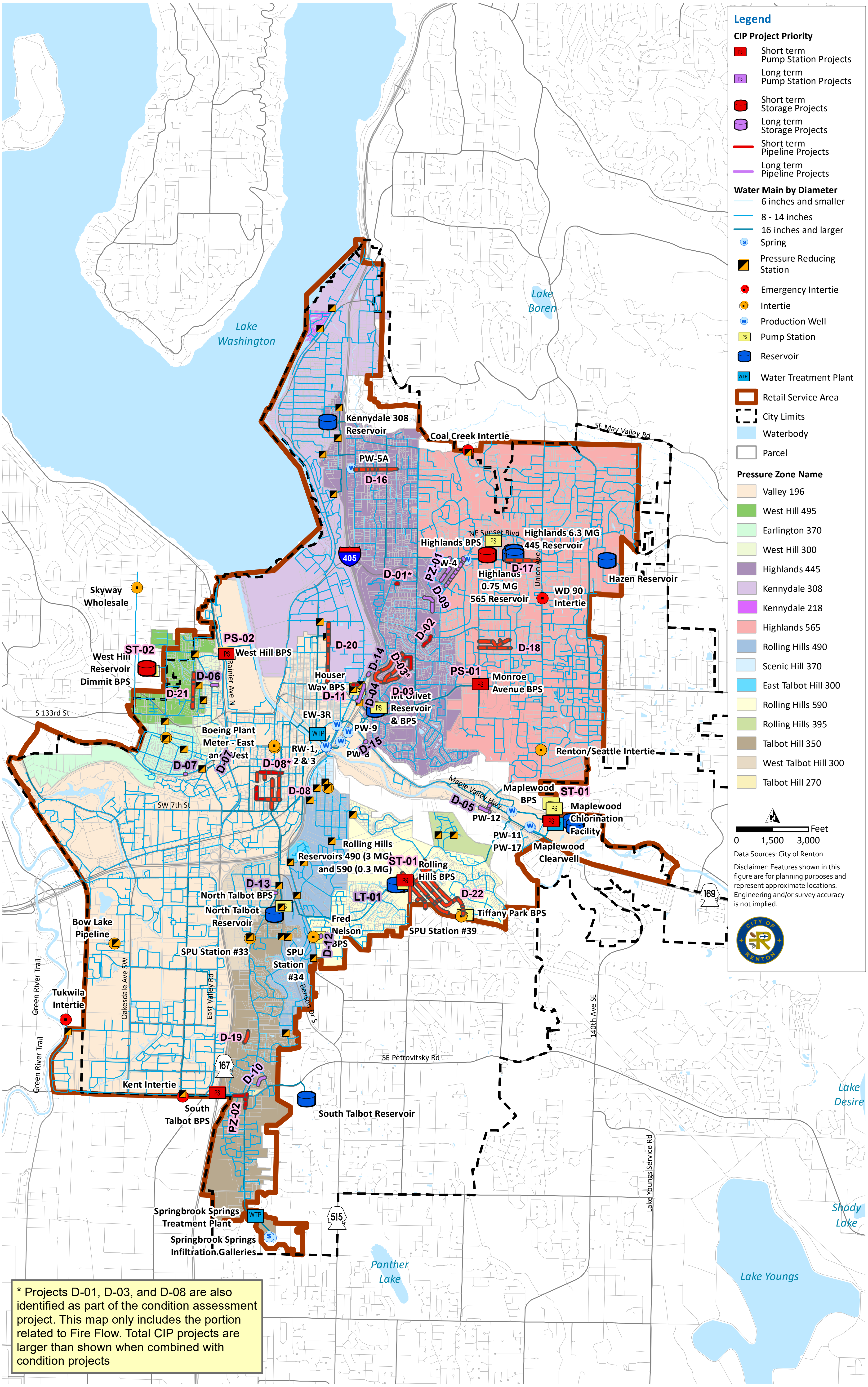

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Figure 9.4 CIP Specific Project Priority

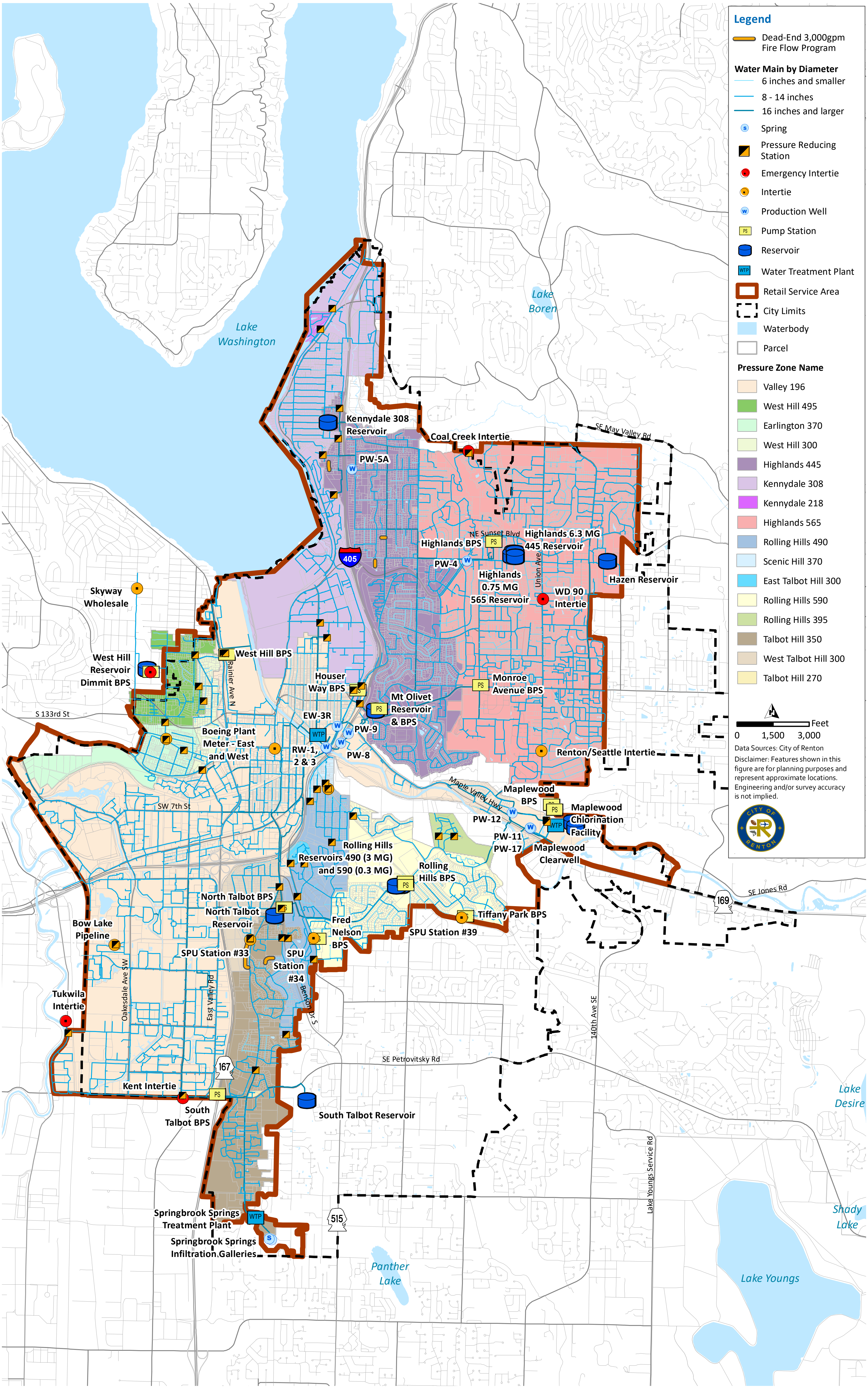

Figure 9.5 **P-01: Dead-end 3,000 gpm Fire Flow Program**

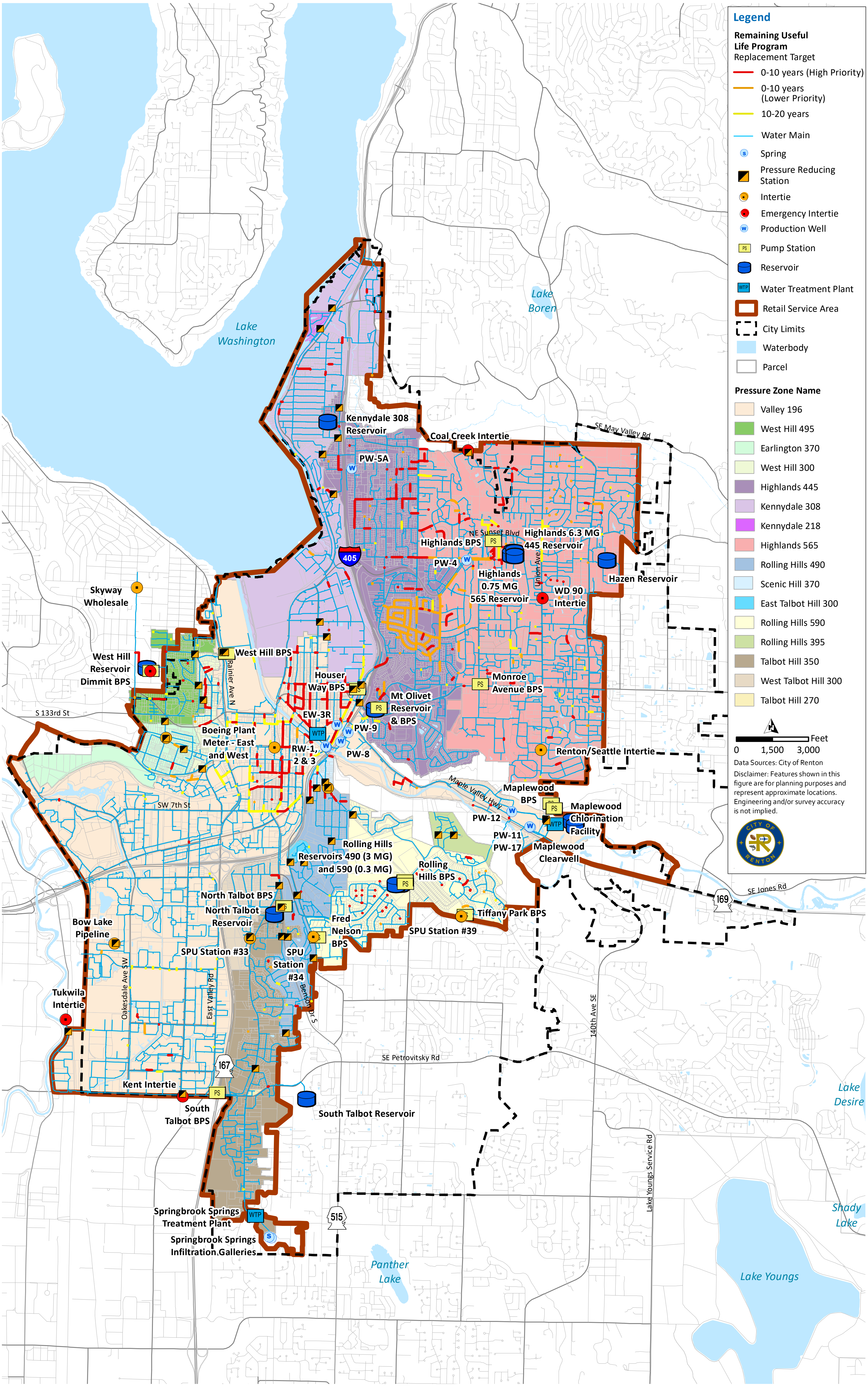

Figure 9.6 **P-03: Remaining Useful Life**

Table 9.15 CIP Recommended Projects

Summary	Total Cost
Distribution Piping	$ 21,511,000
Pressure Zone Rezoning	$ 425,000
Annual Programs	$ 58,752,000
Pump Stations	$ 4,505,000
Storage	$ 17,395,000
General	$ 12,900,000
Regulatory	$ 8,800,000
TOTAL	**$ 124,288,000**

CIP ID	2012 Plan ID	Project Name	Improvement Type	Pipe Length (LF)	Proposed Size	Units	Project Priority	Total Cost
Distribution Piping								
D-01	R-33	NE 10th Place Pipe Upsize	Upsize	1,030	8	Inches	0-10 years	$ 502,000
D-02	n/a	Ferndale Place NE Pipe Upsize	Upsize	500	8	Inches	0-10 years	$ 244,000
D-03	R-27	Windsor Hills Pipe Project	Upsize	6,850	8	Inches	0-10 years	$ 3,339,000
D-04	R-20	Sunset Blvd N Pipe Upsize	Upsize	1,800	10	Inches	10-20 years	$ 1,024,000
D-05	R-7	Maplewood Place SE Pipe Upsize	Upsize	1,200	8	Inches	10-20 years	$ 585,000
D-06	R-25	NW 4th St Pipe Upsize	Upsize	210	8	Inches	10-20 years	$ 102,000
D-07	R-24 R-26	SW Sunset Blvd at Crestview Apartments Pipe Upsize	Upsize / New PRV	30	12	Inches	10-20 years	$ 345,000
D-08	R-11 R-14 R-16	Downtown Renton Pipe Project	Upsize/Replace	5,900	8	Inches	0-10 years	$ 2,876,000
D-09	n/a	Glenwood Ave NE Pipe Upsize	Upsize	850	8	Inches	10-20 years	$ 414,000
D-10	R-4	S 178th St Pipe Upsize	Upsize	460	8	Inches	10-20 years	$ 224,000
D-11	R-35	N 4th St Pipe Upsize	Upsize	120	8	Inches	0-10 years	$ 59,000
D-12	R-1	Hydrant Lateral Connection at Benson Condominium	Change hydrant lateral connection	50	8	Inches	10-20 years	$ 24,000
D-13	n/a	S 17th St Pipe Upsize	Upsize	630	8	Inches	10-20 years	$ 309,000
D-14	n/a	Hydrant Lateral Connection on Sunset Blvd NE	Change hydrant lateral connection	20	8	Inches	10-20 years	$ 10,000
D-15	n/a	Maple Valley Hwy Pipe Upsize at Henry Moses Aquatic Center	Upsize	70	12	Inches	10-20 years	$ 46,000
D-16	n/a	Maintenance Condition Project: Kennydale (NE 24th)	Replace	1,670	8 & 12	Inches	0-10 years	$ 1,024,000
D-17	n/a	Maintenance Condition Project: Highlands Reservoir to Queen Ave NE	Replace	1,400	8	Inches	0-10 years	$ 683,000
D-18	n/a	Maintenance Condition Project: Monroe Ave NE	Replace	2,970	8	Inches	0-10 years	$ 1,448,000
D-19	n/a	Maintenance Condition Project: Shattuck Ave S	Replace	490	8	Inches	0-10 years	$ 239,000
D-20	n/a	Maintenance Condition Project: Garden Ave N	Replace	2,500	12	Inches	0-10 years	$ 1,625,000
D-21	n/a	Maintenance Condition Project: West Hill	Replace	1,440	8	Inches	0-10 years	$ 703,000
D-22	n/a	Maintenance Condition Project: Tiffany Park Area	Replace	11,190	8 & 12	Inches	0-10 years	$ 5,686,000
Pressure Zone Rezoning								
PZ-01	R-29	HLD 445/565 Pipe Reconfiguration		1,200	12	Inches	10-20 years	$ 325,000
PZ-02	n/a	VLY196 Re-zone		300	12	Inches	0-10 years	$ 100,000
Annual R&R Programs								
P-01	R-34 R-6 R-19 R-3 R-2	Dead-end 3,000 gpm fire flow program (see Figure 9.5)	n/a	n/a	n/a		10-20 years	$ -
P-02	n/a	Dead-end 1,000 gpm fire flow program	n/a	2,370	8	Inches	0-10 years	$ 1,155,000
P-03		Pipeline R&R Program (High Priority, see Figure 9.6)	Replace	116,120	n/a		Annual	$ 57,597,000
Pump Stations								
PS-01		Monroe Ave BPS Generator	Pump Station	n/a	125	hp	0-10 years	$ 488,000
PS-02		West Hill BPS	Pump Station	n/a	n/a		0-10 years	$ 1,842,000
PS-03		South Talbot BPS	Pump Station	n/a	n/a		0-10 years	$ 2,175,000

Table 9.15 CIP Recommended Projects (continued)

CIP ID	2012 Plan ID	Project Name	Improvement Type	Pipe Length (LF)	Proposed Size	Units	Project Priority	Total Cost
Storage								
ST-01		Rolling Hills 590 Storage	Storage	n/a	n/a		0-20 years	$ 17,395,000
ST-02		West Hill 495 Storage	Storage	n/a	n/a		0-10 years	$ -
General								
G-01		Reservoir Repair, Painting, Cathodic Protection	General		20	Years	Annual	$ 3,000,000
G-02		Emergency Response Water Projects	General		20	Years	Annual	$ 2,000,000
G-03		Pump Station Condition Evaluation (mechanical, structure, electrical)	General		1	Study	0-10 years	$ 300,000
G-04		Storage Condition Evaluation (structural, seismic)	General		1	Study	0-10 years	$ 400,000
G-05		Security Improvements	General		20	Years	Annual	$ 200,000
G-06		Telemetry System and SCADA Upgrades	General		20	Years	Annual	$ 1,000,000
G-07		PRV Rehabilitation	General		20	Years	Annual	$ 2,000,000
G-08		Improvements to pipelines on bridge	General		20	Years	Annual	$ 4,000,000
Regulatory								
R-01		Regulatory Compliance Projects	General		20	Years	Annual	$ 4,000,000
R-02		Water Conservation Program Implementation	General		20	Years	Annual	$ 4,000,000
R-03		Water System Plan	General		2	Plans		$ 800,000

Chapter 10

FINANCIAL PROGRAM

10.1 Introduction

This chapter summarizes the City of Renton's (City) financial status and provides a cursory evaluation of its ability to finance the necessary capital improvements identified in the capital improvement plan (CIP). The following sections present the financial status of the City's Water Utility, the funding required to finance the scheduled improvements, potential funding sources, and the impact that water system improvements will have on user rates.

10.2 Historical Financial Performance

The City accounts for its water revenues and other funding sources in two main separate funds: Fund 405 (Operating Fund) and Fund 425 (Construction Fund). The Finance Department maintains the financial records for the Water Utility, and both the Finance Department and the Public Works Department monitor and evaluate the Water Utility's fiscal performance.

10.2.1 Rates

The City serves meter sizes ranging from 3/4 to 12 inches under the following customer classes:

- Single family.
- Multi-family.
- Non-residential.
- Private irrigation.
- City irrigation.
- Hydrant meter.

The City offers reduced rates for water, wastewater, surface water, and garbage for low-income senior citizens (61 years of age and over), and low-income disabled citizens. Additional information can be found here:
https://rentonwa.gov/city_hall/administrative_services/finance/utility_billing/reduced_rates_and_tax_rebate#:~:text=CITY%20OF%20RENTON%20WASHINGTON&text=The%20City%20of%20Renton%20offers,who%20meet%20these%20same%20qualifications

10.2.1.1 Monthly Base Rates and Charges

Table 10.1 shows the City's monthly base service charges for the calendar year (CY) 2019 and CY 2020. The rates shall be adjusted on January 1 of each year.

Table 10.1 CY 2019 and CY 2020 Monthly Base Service Charges

Meter Size	Basic Charge		Charge for Irrigation		Fire Meter	
	2019	2020	2019	2020	2019	2020
3/4"	$17.60	$17.95	$10.58	$10.79	n/a	n/a
1"	$34.89	$35.59	$18.92	$19.30	$6.27	$6.40
1-1/2"	$67.33	$68.68	$32.29	$32.94	$7.01	$7.15
2"	$105.52	$107.63	$49.46	$50.45	$9.01	$9.19
3"	$216.81	$221.15	$104.57	$106.66	$23.79	$24.27
4"	$330.75	$337.37	$155.65	$158.76	$29.27	$29.86
6"	$645.28	$658.19	$294.81	$300.71	$42.06	$42.90
8"	$1,262.94	$1,288.20	$645.13	$658.03	$56.65	$57.78
10"	$1,882.63	$1,920.28	$829.55	$846.14	$73.08	$74.54
12"	$2,739.86	$2,794.66	$1,197.90	$1,221.86	$87.68	$89.43

Note:
(1) 2019 City of Renton Utility Rates Brochure and 2020 City of Renton Utility Rates Brochure.

10.2.1.2 Commodity Rates

In addition to monthly base services charges, customers pay a usage-based charge per water consumed in 100 cubic feet (CCF). Table 10.2 compares CY 2019 and CY 2020 commodity rates the City charges its water customers. Single family customers are charged based on a three-tier inclining block-rate structure. Multi-family, non-residential, private irrigation, City irrigation, and hydrant meter customers pay a unique uniform rate per CCF.

Table 10.2 CY 2019 and CY 2020 Commodity Rates

Class Type	CY 2019	CY 2020
Single Family		
Less than 500 cf per month	$2.54/ CCF	$2.59/ CCF
500 - 1,000 cf per month	$3.41/ CCF	$3.48/ CCF
Over 1,000 cf per month	$4.30/ CCF	$4.39/ CCF
Multi-Family	$3.29/ CCF	$3.36/ CCF
Non-Residential	$3.48/ CCF	$3.55/ CCF
Private Irrigation	$5.58/ CCF	$5.69/ CCF
City Irrigation	$3.92/ CCF	$4.00/ CCF
Hydrant Meter	$5.58/ CCF	$5.69/ CCF

Note:
Abbreviation: cf – cubic feet.
(1) 1 ccf = 748 gallons

10.2.2 Financial Operations

Based on the information provided, the Water Utility's revenues and expenditures in the period from CY 2016 to CY 2019 are summarized in Tables 10.3 and 10.4. Other Revenues in Table 10.3 include debt proceeds, reimbursements, transfer-in funds from other departments, and other miscellaneous revenues. A total debt of $8 million was issued in CY 2016 and CY 2017, resulting in higher revenues.

Over the last 3 years, the City's water fund balance, which represents the total unexpended resources carried forward to future years, increased from $28.5 million to $38.0 million. CY 2019's estimated ending balance of $7.2 million indicates that the City starts using the reserve to fund capital project expenditures in CY 2019.

Table 10.3 Summary of Historical Revenues

Revenues	CY 2016	CY 2017	CY 2018	CY 2019 (Estimated)
Service Charges	$16,885,230	$17,270,694	$17,478,657	$17,843,483
Other Revenues	5,332,306	4,228,275	932,288	597,709
Interdepartmental	13,961	-	-	-
Total:	**$22,231,497**	**$21,498,969**	**$18,410,945**	**$18,441,192**
Fund Reserve Ending Balances	$28,512,792	$33,897,303	$37,986,499	$7,206,612

Table 10.4 Summary of Historical Expenditures

Expenditures	CY 2016	CY 2017	CY 2018	CY 2019 (Estimated)
Fund 405: Water Utility Billing	$118,176	$156,221	$160,368	$185,707
Fund 405: Water Utility Admin	283,042	309,018	346,858	410,037
Fund 405: Engineering	9,452,384	8,386,699	5,186,161	5,770,669
Fund 405: Maintenance	5,623,549	5,932,879	5,960,807	6,227,377
Fund 405: Water Conservation	98,964	157,837	133,728	138,000
Total:	**$15,576,114**	**$14,942,654**	**$11,787,922**	**$12,731,791**
Debt-Service Payments	238,086	300,140	1,401,997	1,435,173
Total including Debt Service:	**$15,814,199**	**$15,242,794**	**$13,189,919**	**$14,166,963**

Figure 10.1 shows a graphical representation of the Water Utility's historical financial performance. Due to the debt proceeds, revenues were higher in CY 2016 and CY 2017 than those of later years. As illustrated in the figure, expenditures rose in CY 2019 because of increased capital spending, and not enough revenue is generated to fund upcoming capital project expenditures without a drawdown on reserves.

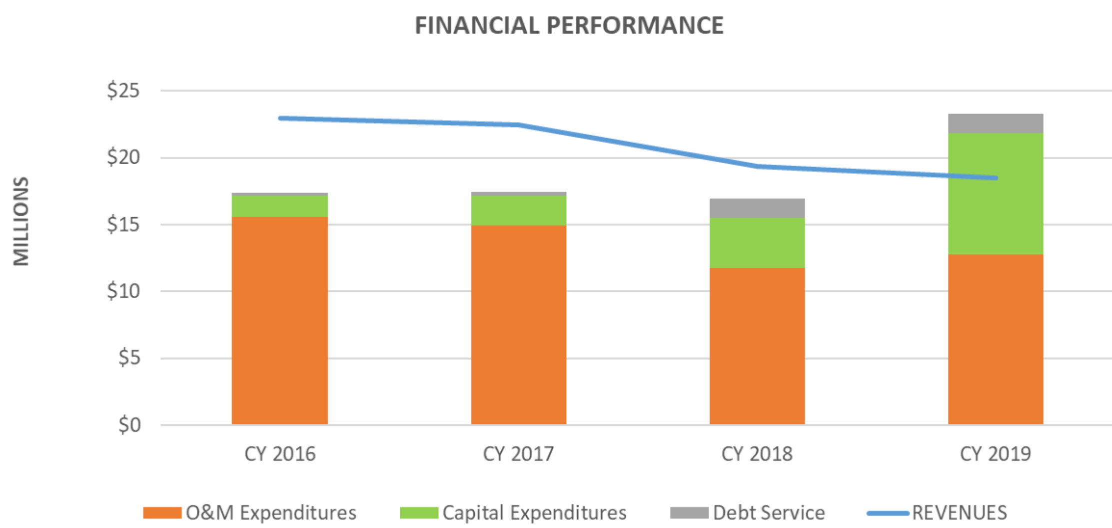

Figure 10.1 Historical Revenues vs Expenses

10.2.3 Outstanding Debt

In the past, the City's Water Utility funded a share of capital projects using debt and currently holds the following outstanding bonds:

- **2012 Water/Sewer Refunding Revenue Bonds (2004)**: Principal and interest payments averaging approximately $265,000 per year from CY 2020 to CY 2022 and $853,000 per year from CY 2023 to CY 2027.
- **2016 Water/Sewer Refunding Revenue Bonds (2008A)**: Principal and interest payments averaging approximately $502,000 per year, ending in 2027.
- **2017 Water/Sewer Refunding Revenue Bonds (2007 & 2007 [02])**: Principal and interest payments averaging approximately $693,000 per year, ending in 2022.

The Water Utility's debt-service coverage ratio (DSCR) is calculated by dividing the net income (revenues less expenses) by the annual debt-service payment. The City's current bond documents require a DSCR of 1.25, meaning the City is required to have sufficient funds to meet all ongoing O&M expenses, as well as 1.25 times the total annual debt service payment. In practice, the City has maintained a coverage factor well above the requirement due to its relatively small amount of debt.

10.3 Methodology

The financial sufficiency evaluation developed for this chapter aims to determine whether existing and adopted rates are sufficient to cover the capital program developed as a part of Master Plan and, if not, the level of rate increases that would be required to do so. The evaluation relies on a revenue requirements analysis, which is used to test revenue sufficiency against expected revenue needs.

10.3.1 Financial Sufficiency Tests

There are two tests used to define the annual revenues necessary to provide both sufficient (1) cash flow, and (2) debt coverage. These sufficiency tests are commonly used to determine the amount of annual revenue that must be generated from an agency's rates:

- ***Cash Flow Sufficiency Test*** defines the amount of annual revenue that a utility must generate in order to meet annual expenditure obligations. In the same lieu, the cash-flow test identifies projected cash requirements in each year. Cash requirements include operations and maintenance (O&M) expenses, debt-service payments, policy-driven additions to working capital, miscellaneous capital outlays, and rate-funded capital expenditures. These expenses are compared to the total annual projected revenues, and shortfalls are used to calculate the needed rate increases. In this analysis, the cash flow test is the driver of the rate increase.
- ***Debt-Coverage Test*** refers to the collection of revenues to meet all operating expenses, debt service payments, and debt service obligations, such as DSCR. The debt-coverage test measures an agency's ability to meet policy-driven revenue obligations. Currently, the City holds three outstanding debt obligations and does not have any plans to issue additional debt to fund capital projects in the near future. Typical DSCRs range from 1.10x to 1.35x depending on an agency's financial situation and the type of debt being issued. For this analysis, the debt coverage test was set to meet a 1.25x DSCR based on the City's outstanding bond's requirements, meaning that the City must collect sufficient revenue through user rates to meet all on-going O&M expenses, as well as 1.25 times the total debt-service requirements due each year. The debt coverage test was sufficient in this analysis.

10.3.2 Assumptions and Inputs

Financial projections in this analysis relied on the following assumptions and inputs:

- **Customer, demand, and revenue growth**: Based on the Chapter 3, the demand is expected to increase 1.5 percent per year in average from CY 2020 to CY 2029. However, the City requested that revenue growth in the financial model be equal to the expected growth in retail customers, which is conservatively assumed as 0.5 percent per year.
- **Non-rate revenues**: Given general inflation, interest and other revenue sources are anticipated to grow by 3 percent per year from CY 2020 to CY 2029.
- **O&M cost projection**: O&M costs are expected to increase annually by 3 percent from CY 2020 to CY 2029 according to historical trends and projected benefit cost increases in the Seattle Consumer Price Index (CPI-U).
- **CIP costs**: Capital improvement construction costs are escalated annually by 3 percent over the CIP's 10-year period to account for inflationary increases in construction costs.
- **Debt-coverage ratio**: The debt coverage test was set to meet a 1.25x coverage ratio per the City's outstanding debt obligations.
- **Reserve target**: Based on the City's input, the target reserve's ending balance is estimated at 90 days (24.7 percent) of annual O&M expenses. CY 2019's ending fund balance of $7.2 million was used in the analysis.
- **Financing assumptions**: The following assumptions were used for possible debt issuances:
  - Interest rate: 4 percent.

  - Loan period: 20 years.
  - Issuance costs: 1 percent.
- **Existing debt**: The City provided annual debt-service expenses for current outstanding revenue bond issues.

10.3.3 CIP Funding Strategy Scenarios

Three funding strategy scenarios were developed to evaluate the 10-year CIP's impact on the Water Utility's financial status. Each scenario assumes a different amount of debt to fund the CIP projects. All scenarios include the expected debt issuance with the financing assumptions mentioned above:

- **Scenario 1, PAYGO (No Additional Debt)**: This scenario assumes that all 10-year CIP projects are funded by Pay-As-You-Go (PAYGO), using revenues from user rates and available reserves. The City has indicated that this is the preferred scenario as it hopes to no longer rely on debt as a means of controlling long-term expenses.
- **Scenario 2, Maximized Additional Debt**: This scenario maximizes the use of debt to mitigate rate increases in the short term. The first additional debt issuance would be needed in CY 2022 with debt proceeds needed every 3 years of the analysis.
- **Scenario 3, Moderate Additional Debt**: This scenario assumes that rate increases are front loaded in the first 5 years of the analysis, then additional debt issuances are used to smooth out peaks in CIP spending. The first additional debt issuance would be required in CY 2021 and another in CY 2025.

The City has indicated that Scenarios 1 or 3 are the preferred scenarios as they would decrease reliance on debt. All three scenarios are detailed in Section 10.5.

10.4 Financial Projections

Financial projections from CY 2020 through CY 2029 were developed using the assumptions and inputs described above, as well as other inputs provided by the City or developed for the project. All three scenarios used the same assumptions for O&M costs, capital expenditures, and most offsetting revenues (all except interest earnings).

The financial forecast gives the City a snapshot of its current financial status. As numerous assumptions were made for analysis, projected results can vary from the actual data depending on factors such as actual customer use, demand projection, and growth. Therefore, this high-level projection should be updated and evaluated during future City budget development to confirm the assumptions and adjust as needed.

10.4.1 O&M Cost Projections

Common to all scenarios, projected O&M costs are expenditures that the City incurs for day-to-day operations such as employee salaries and benefits, fuel, chemicals, and power.

The City's CY 2020 operating budget served as the basis for forecasting the future operating expenses for each utility. The budget was compared to actual financial information from the previous year to identify any anomalies or one-time expenditures that are not useful to the present projections. Table 10.5 presents the projected O&M costs for the 10-year analysis period.

10.4.2 CIP Expenditures

Table 10.6 presents the expenditures of short-term CIP projects identified in Chapter 9. All listed projects are "replacement and rehabilitation" related to existing infrastructure. This analysis organized projects based on priority and broke them down further into the following seven project types:

- Distribution piping.
- Pressure zone.
- Annual repair and replacement programs.
- Pump stations.
- Storage.
- General.
- Regulatory.

Each project total is spread out throughout the anticipated project years. Costs are escalated at 3 percent per year from CY 2020. Funding these CIPs is a primary driver for future rate increases and/or debt issuances.

10.4.3 Fund Balance and Reserves

The City currently holds reserves that have been generated through user rates and other revenue sources. Based on the data provided by the City, money is held and tracked in the following separate funds:

- ***Fund 405 (Operating Fund).*** This fund was created in 2006 to identify water utility revenues and expenses. Revenue sources for this fund are generally from water sales and collections but also include plan review and inspection fees, water meter installation fees, utility billing fees, rent and leases, and inter-fund reimbursements from other City's departments for services provided. Expenses include O&M, debt service payments for Public Works Trust Fund (PWTF) loans, revenue bonds, taxes, and transfers to the Construction Fund.
- ***Fund 425 (Construction Fund)*** is held for the design, construction, and project management of capital improvement projects. Revenues from this fund include transfers from the Operating Fund, special assessment fees, system development charges, water connection charges, City issued bonds, proceeds from revenue bonds, proceeds from PWTF loans, and from Community, trade, and economic development grants.

The starting fund balance included in the analysis is based on each fund's ending balance in CY 2019: $6 million in the Operating Fund and $1.2 million in the Construction Fund for a total of $7.2 million.

Projected reserve balances for each funding strategy scenario vary year-to-year based on fluctuations in capital spending. The total target is typically made up of several components, which may include an operating reserve, capital reserves, rate stabilization reserves, debt service reserves. The City's reserve target is 60 to 90 days.

Table 10.5 O&M Cost Projections

	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026	CY 2027	CY 2028	CY 2029
Fund 405: Water Utility Billing	$192,444	$197,815	$203,337	$209,015	$214,853	$220,854	$227,025	$233,370	$239,893	$246,600
Fund 405: Water Utility Admin	466,687	478,896	491,427	504,288	517,488	531,035	544,940	559,211	573,858	588,891
Fund 405: Water Engineering	5,862,038	6,014,140	6,170,211	6,330,356	6,494,680	6,663,295	6,836,313	7,013,849	7,196,022	7,382,954
Fund 405: Water Maintenance	6,467,097	6,641,988	6,821,647	7,006,206	7,195,800	7,390,567	7,590,649	7,796,193	8,007,348	8,224,270
Fund 405: Water Conservation	163,515	167,603	171,793	176,088	180,490	185,002	189,627	194,368	199,227	204,208
TOTAL O&M EXPENDITURES	**$13,151,781**	**$13,500,443**	**$13,858,416**	**$14,225,953**	**$14,603,311**	**$14,990,754**	**$15,388,554**	**$15,796,989**	**$16,216,348**	**$16,646,923**

Table 10.6 Short-Term CIP Expenditures (Escalated)

Capital Projects	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026	CY 2027	CY 2028	CY 2029
Distribution Piping	$1,700,000	$1,973,223	$2,291,279	$2,093,392	$2,946,863	$2,118,863	$2,182,429	$2,667,699	$1,582,935	$1,362,618
Pressure Zone Rezoning	100,000	-	-	-	-	-	-	-	-	-
Annual Programs	2,995,350	3,085,211	3,177,767	3,273,100	3,371,293	3,472,432	3,576,605	3,683,903	3,794,420	3,908,252
Pump Stations	-	632,420	651,393	670,934	815,994	840,474	865,688	-	-	636,729
Storage	-	-	-	-	-	-	-	1,135,584	1,169,651	1,204,741
General	610,000	628,300	647,149	666,563	686,560	1,054,939	1,205,993	750,223	772,730	795,912
Regulatory	400,000	412,000	424,360	437,091	450,204	463,710	477,621	491,950	506,708	1,043,819
TOTAL CIP Expenditures (2020 Dollars)	**$5,805,350**	**$6,731,153**	**$7,191,947**	**$7,141,080**	**$8,270,914**	**$7,950,418**	**$8,308,335**	**$8,729,358**	**$7,826,443**	**$8,952,071**

10.5 Findings and Results

This section summarizes the results of the financial sufficiency evaluation according to the three funding strategy scenarios introduced in Section 10.3.3.

10.5.1 Projection Results without Rate Increases

Figure 10.2 summarizes the Water Utility's overall financial forecast, assuming that no further rate increases (beyond the CY 2020) are implemented. O&M expenditures and revenues increase with the escalator factors discussed earlier. With no additional debt issuances, the current debt-service payments will end in CY 2027.

If the CIP is implemented as scheduled without any debt issuances or rate increases, reserve levels would begin to drop in CY 2020 and be fully depleted by CY 2023, meaning the City will not be able to fund future capital investments.

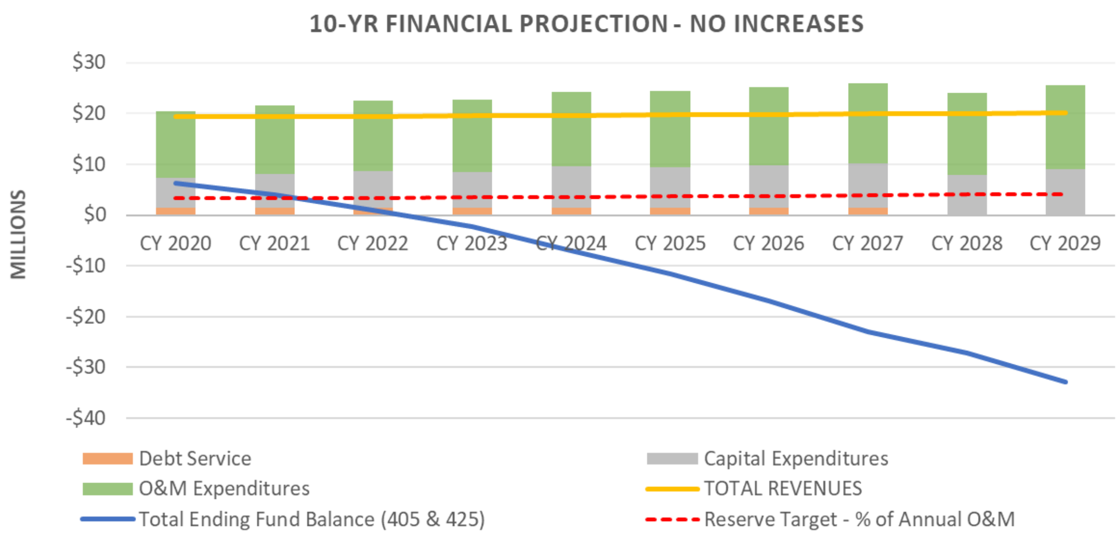

Figure 10.2 Ten-Year Financial Forecast Without Rate Increases or Additional Debt Issuances

The following sections present the three funding scenarios, their results, and the necessary rate increases required to implement them.

10.5.2 Scenario 1- PAYGO (No Additional Debt)

Scenario 1 assumes that all 10-year CIP projects are PAYGO-funded, and no additional debt would be issued. Figure 10.3 shows the cash funding required to pay a total of $76.9 million over the 10-year analysis period.

Figure 10.4 presents the annual rate increases required to fully implement the CIP. The compounded rate increase over the 10-year projection period would be approximately 32.8 percent.

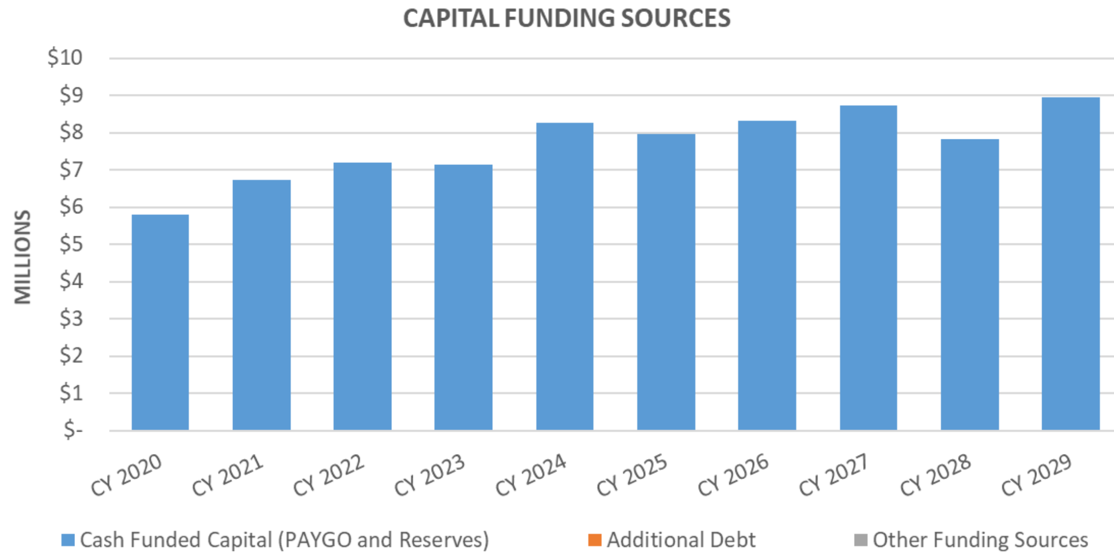

Figure 10.3 Scenario 1 (PAYGO) Capital Funding Sources

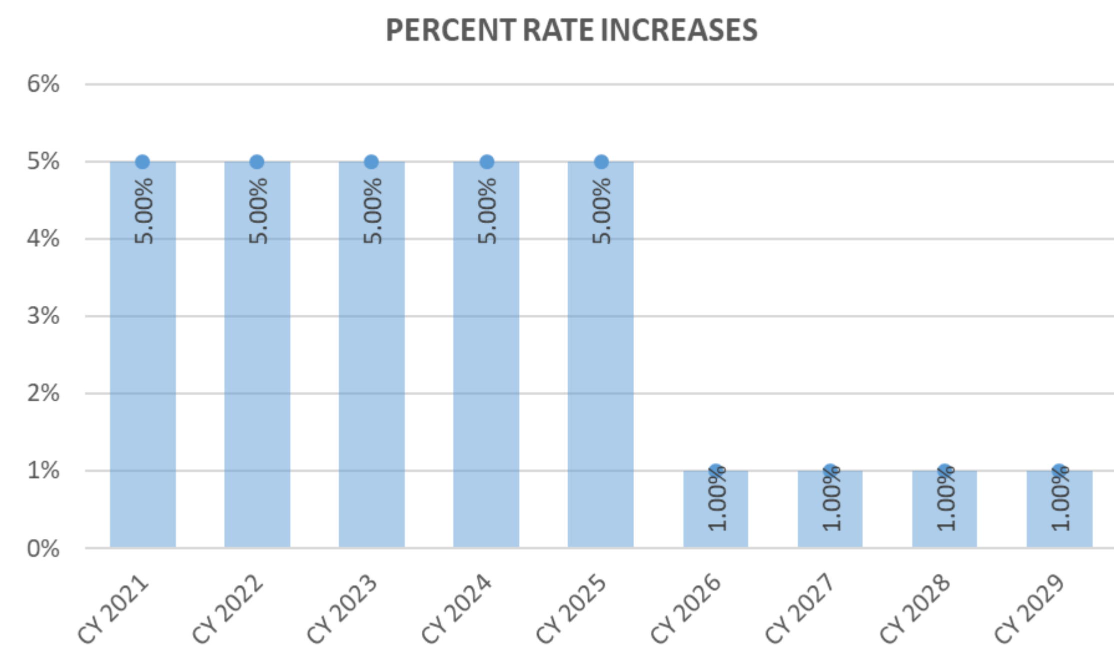

Figure 10.4 Scenario 1 (PAYGO) Rate Increases

Under Scenario 1, user rates would increase in the initial years to build the financial capacity necessary to fund CIP expenditures in peak years. Once that funding capacity begins to grow with the compounding effects of the rate increases, less severe increases could be implemented. Rate increases could also potentially be smoothed if the City elects to further decrease reserves in years with high levels of capital spending.

Figure 10.5 summarizes 10-year financial projection under Scenario 1. With the rate increases noted in Figure 10.4, the City would have sufficient cash available every year to fund capital projects.

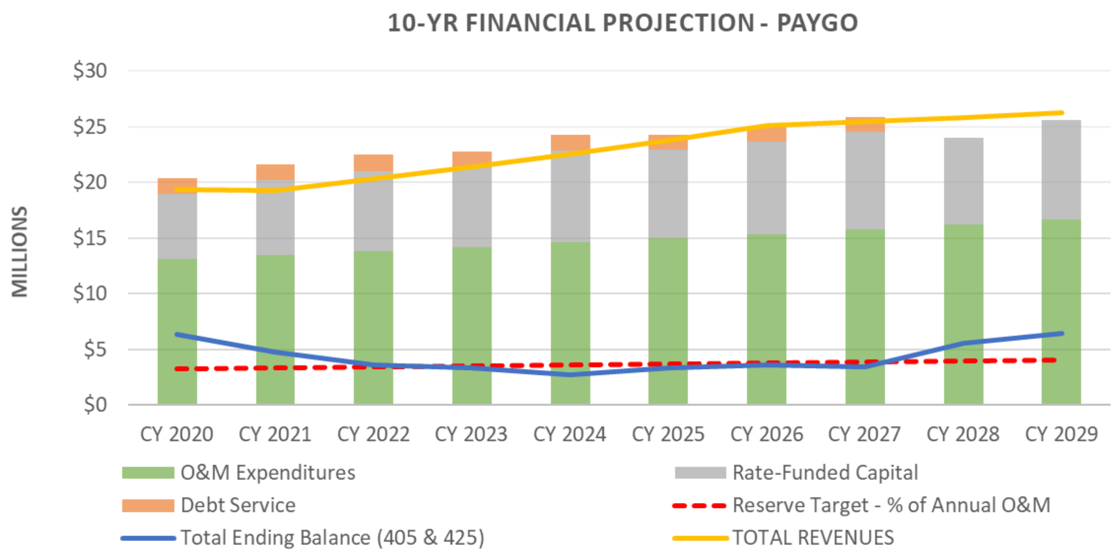

Figure 10.5 Scenario 1 (PAYGO) Financial Projection

If the City ultimately decides to adopt a cash-funding model such as Scenario 1, prudent financial planning will be imperative to ensure that sufficient revenues or reserves are available every year and to avoid delaying projects. Table 10.7 summarizes the revenue requirement, cash flow, and fund balances for the next 10 years if Scenario 1 is implemented.

Table 10.7 Scenario 1 (PAYGO) Revenue Requirement, Cash Flow, and Fund Balances

	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026	CY 2027	CY 2028	CY 2029
Rate Increase	**0.00%**	**5.00%**	**5.00%**	**5.00%**	**5.00%**	**5.00%**	**1.00%**	**1.00%**	**1.00%**	**1.00%**
Revenues										
Rate Revenues (w/o Rate Increase)	$18,593,943	$18,686,912	$18,780,347	$18,874,249	$18,968,620	$19,063,463	$19,158,780	$19,254,574	$19,350,847	$19,447,601
Revenues From Rate Increase	0	934,346	1,924,986	2,975,053	4,087,856	5,266,883	5,537,738	5,813,626	6,094,630	6,380,830
Other Revenues	747,709	606,420	615,349	624,501	633,882	643,498	653,353	663,456	673,810	684,424
Total Revenues	**$19,341,652**	**$20,227,678**	**$21,320,681**	**$22,473,803**	**$23,690,358**	**$24,973,844**	**$25,349,871**	**$25,731,656**	**$26,119,287**	**$26,512,855**
Expenditures										
Ongoing O&M Expenses (Fund 405)	$13,151,781	$13,500,443	$13,858,416	$14,225,953	$14,603,311	$14,990,754	$15,388,554	$15,796,989	$16,216,348	$16,646,923
Rate-Funded Capital	4,582,497	3,811,047	5,788,836	6,982,473	8,270,914	7,950,418	8,308,335	8,729,358	7,826,443	7,450,276
Debt Service	1,428,121	1,427,106	1,426,554	1,393,919	1,393,115	1,391,509	1,394,051	1,393,173	0	0
Total Expenditures	$19,162,400	$18,738,595	$21,073,806	$22,602,346	$24,267,340	$24,332,680	$25,090,940	$25,919,520	$24,042,791	$24,097,198
Operating Cash Flows	**$179,252**	**$1,489,083**	**$246,875**	**($128,543)**	**($576,982)**	**$641,163**	**$258,932**	**($187,864)**	**$2,076,496**	**$2,415,657**
Beginning Fund Balance (405 & 425)	**$7,206,612**	**$6,163,011**	**$4,731,988**	**$3,575,751**	**$3,288,601**	**$2,711,619**	**$3,352,782**	**$3,611,714**	**$3,423,850**	**$5,500,346**
Operating Cash Flows	$179,252	$1,489,083	$246,875	($128,543)	($576,982)	$641,163	$258,932	($187,864)	$2,076,496	$2,415,657
Interest Earnings	175,000	53,478	43,580	33,231	27,457	24,001	24,258	27,858	28,142	35,697
Use of Reserves for Capital Projects	(1,222,853)	(2,920,106)	(1,403,111)	(158,607)	-	-	-	-	-	(1,501,795)
Ending Fund Balance (405 & 425)	**$6,338,011**	**$4,785,466**	**$3,619,331**	**$3,321,832**	**$2,739,076**	**$3,376,783**	**$3,635,971**	**$3,451,708**	**$5,528,489**	**$6,449,905**

Given the rate increases discussed for Scenario 1, Figure 10.6 estimates the monthly bills for 3/4-inch meter single family residential customers with monthly use of 7 CCF for each year of the analysis: bills would increase from $48.65 in CY 2020 to $64.61 by CY 2029. After CY 2029, no further rate increases would likely be required to keep up with increases in O&M costs and continued capital investments.

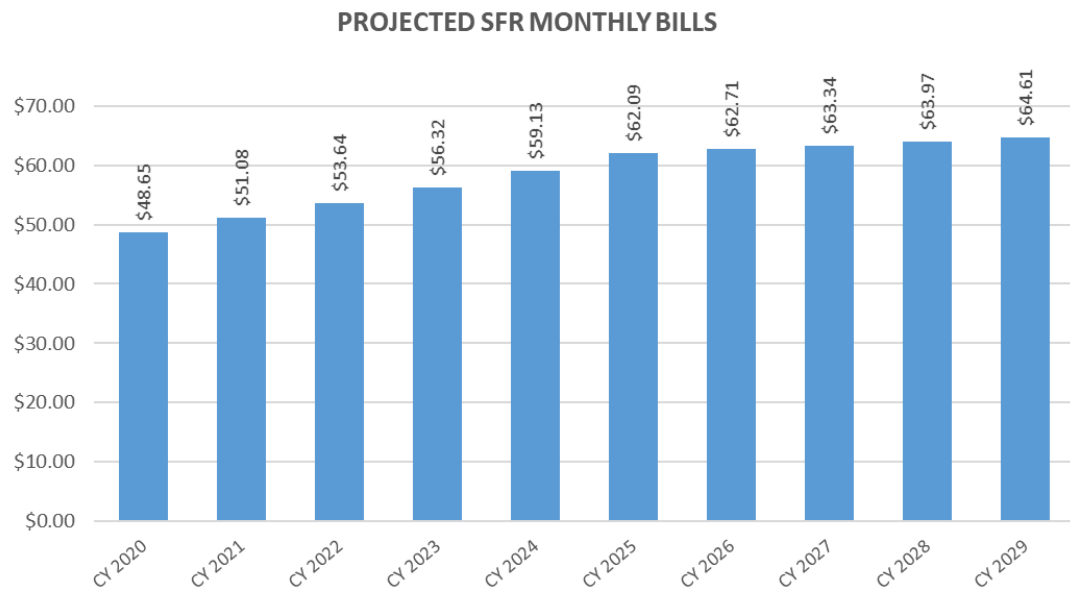

Figure 10.6 Scenario 1 (PAYGO) Estimated Single Family Residential (SFR) Monthly Bills

10.5.3 Scenario 2 – Maximum Additional Debt

Scenario 2 assumes the maximized use of additional debt to fund CIP projects. The first additional debt issuance would need to take place in CY 2022, and debt proceeds for capital funding would be required in every 3 years thereafter. This heavy use of debt would allow the City to spread costs out over time to mitigate rate increases in the short term.

Table 10.8 shows the projected required debt issuances, issuance costs associated with each issuance, and the estimated debt service payment. The Annual Debt Service in the table indicates average annual debt service payment during the analysis years (CY 2020 –2029). The actual debt service payment would vary each year.

Table 10.8 Scenario 2 (MAX DEBT) Projected Debt Issuances

Year	Proceeds Required (millions)	Issuance Amount (millions)	Annual Debt Service (millions)
CY 2022	$6.50	$0.596	$0.454
CY 2025	$10.50	$0.963	$0.791
CY 2028	$6.50	$0.596	$0.522
Total	**$23.50**	**$0.256**	

Notes:
(1) Totals may not sum due to rounding.
(2) Issuance amount includes 1 percent issuance costs and a debt-service reserve requirement equal to 1 year of debt-service payments.

Figure 10.7 shows the expected capital funding sources for each year of the analysis under Scenario 2. Approximately, $53.4 million in cash funding and $23.5 million in new bond proceeds would be required to fund the $76.9 million CIP, as summarized in Table 10.9.

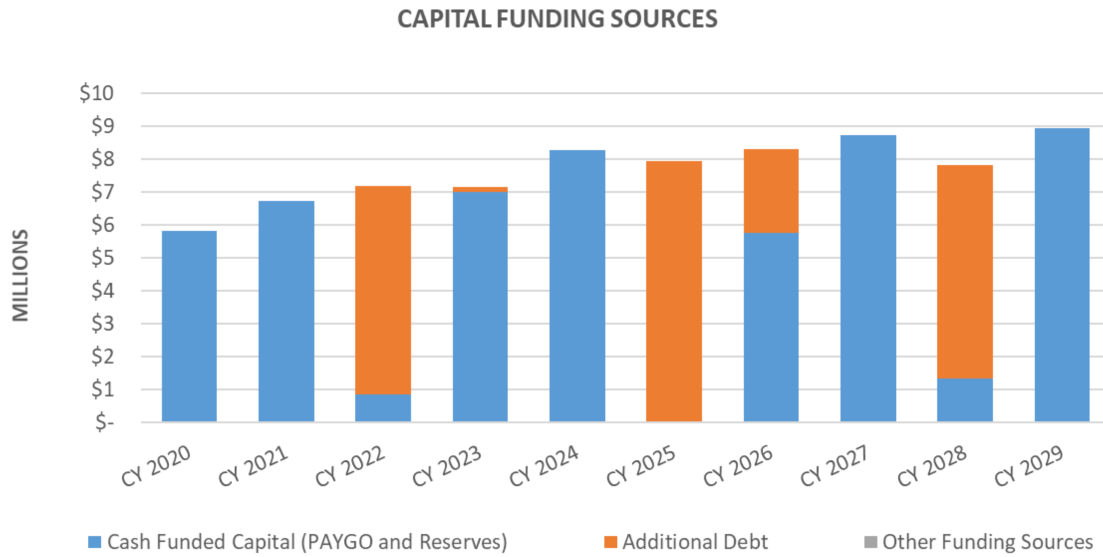

Figure 10.7 Scenario 2 (MAX DEBT) Capital Funding Sources

Table 10.9 Scenario 2 (MAX DEBT) Capital Funding Summary

	10-Year Sum (Millions)
Cash Funded Capital (PAYGO and Reserves)	$53.4
Additional Debt	$23.5
Total CIP Funding	**$76.9**

Note:
(1) Totals may not sum due to rounding.

Under Scenario 2, rate increases could be held constant at 2 percent per year from CY 2021 to CY 2024, as shown in Figure 10.8. After CY 2024, higher increases at 3.2 percent per year would be required in order to meet debt coverage requirements. The compounded rate increase over the 10-year projection period would be approximately 26.7 percent.

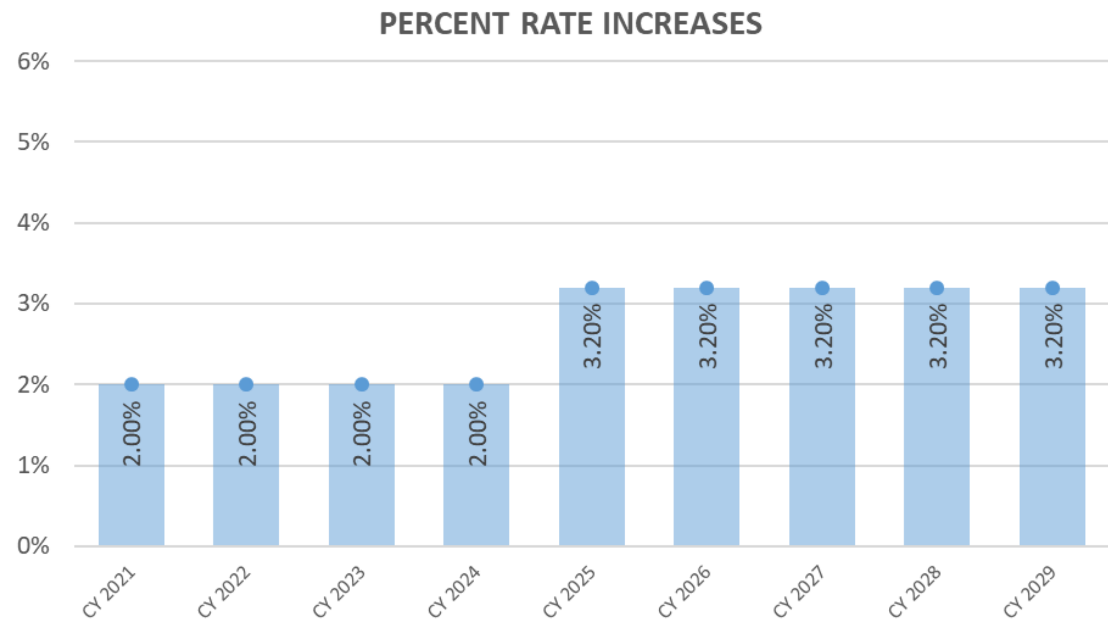

Figure 10.8 Scenario 2 (MAX DEBT) Rate Increases

Figure 10.9 summarizes 10-year financial projection under Scenario 2. With the increases noted above, the City would have sufficient cash available every year to fund capital projects.

The projected working capital balance would exhibit less year-to-year fluctuation as compared to Scenario 1 since the use of debt helps smooth the impact of peaks in CIP expenditures.

At the end of the projection period, the City would have approximately $21.9 million in outstanding debt principal. Table 10.10 summarizes the revenue requirement, cash flow, and fund balances for the next 10 years if Scenario 2 is implemented

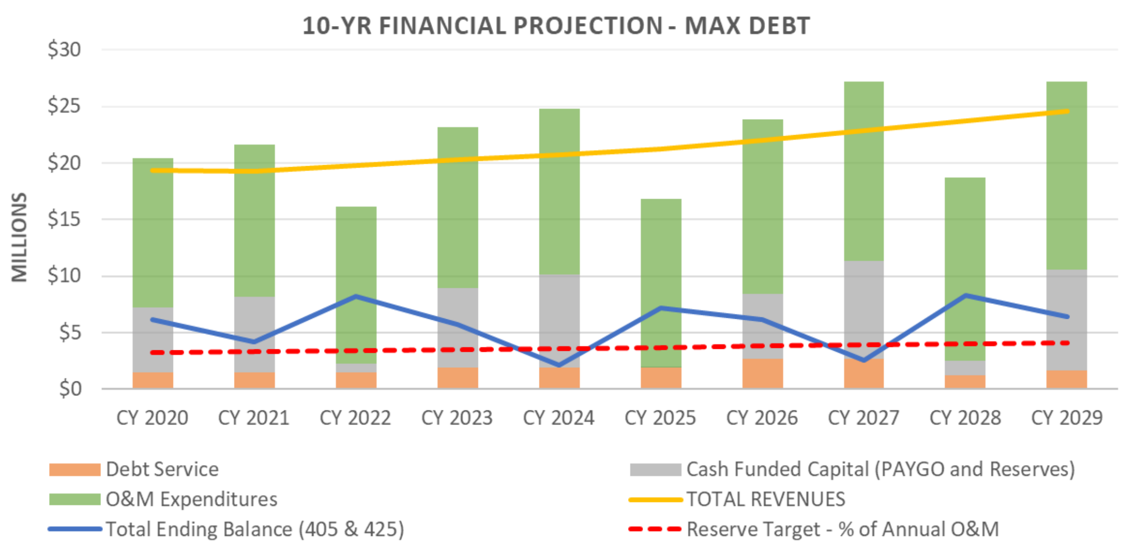

Figure 10.9 Scenario 2 (MAX DEBT) Financial Projection

Table 10.10 Scenario 2 (MAX DEBT) Revenue Requirement, Cash Flow, and Fund Balances

	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026	CY 2027	CY 2028	CY 2029
Rate Increase	**0.00%**	**2.00%**	**2.00%**	**2.00%**	**2.00%**	**3.20%**	**3.20%**	**3.20%**	**3.20%**	**3.20%**
Revenues										
Rate Revenues (w/o Rate Increase)	$18,593,943	$18,686,912	$18,780,347	$18,874,249	$18,968,620	$19,063,463	$19,158,780	$19,254,574	$19,350,847	$19,447,601
Revenues from Rate Increase	0	373,738	758,726	1,155,255	1,563,624	2,231,759	2,927,773	3,652,715	4,407,677	5,193,789
Other Revenues	747,709	606,420	615,349	624,501	633,882	643,498	653,353	663,456	673,810	684,424
Total Revenues	**$19,341,652**	**$19,667,071**	**$20,154,422**	**$20,654,005**	**$21,166,126**	**$21,938,720**	**$22,739,906**	**$23,570,745**	**$24,432,334**	**$25,325,815**
Expenditures										
Ongoing O&M Expenses (Fund 405)	$13,151,781	$13,500,443	$13,858,416	$14,225,953	$14,603,311	$14,990,754	$15,388,554	$15,796,989	$16,216,348	$16,646,923
Rate-Funded Capital	4,582,497	3,811,047	0	2,206,637	6,051,383	0	2,230,163	6,378,299	1,315,456	4,661,462
Debt Service	1,428,121	1,427,106	1,426,554	1,916,061	1,893,984	1,870,254	2,693,245	2,634,074	1,180,277	1,639,368
Total Expenditures	**$19,162,400**	**$18,738,595**	**$15,284,971**	**$18,348,651**	**$22,548,678**	**$16,861,007**	**$20,311,962**	**$24,809,363**	**$18,712,081**	**$22,947,753**
Operating Cash Flows	**$179,252**	**$928,475**	**$4,869,451**	**$2,305,354**	**$1,382,551**	**$5,077,712**	**$2,427,944**	**$1,238,618**	**$5,720,253**	**$2,378,062**
Beginning Fund Balance (405 & 425)	**$7,206,612**	**$6,163,011**	**$4,171,380**	**$8,198,327**	**$5,722,497**	**$2,125,218**	**$7,202,930**	**$6,124,294**	**$2,555,820**	**$8,276,073**
Operating Cash Flows	$179,252	$928,475	$4,869,451	$2,305,354	$1,382,551	$5,077,712	$2,427,944	$1,238,618	$5,720,253	$2,378,062
Interest Earnings	175,000	53,478	41,338	49,479	55,683	31,391	37,313	53,309	34,720	43,328
Use for Reserves for Capital Projects	(1,222,853)	(2,920,106)	(842,504)	(4,783,886)	(2,219,531)	(4,201)	(3,524,389)	(2,351,059)	(10,987)	(4,290,609)
Ending Fund Balances (405 & 425)	**$6,163,011**	**$4,171,380**	**$8,198,327**	**$5,722,497**	**$2,125,218**	**$7,202,930**	**$6,124,294**	**$2,555,820**	**$8,276,073**	**$6,376,613**

Given the rate increases discussed for Scenario 2, Figure 10.10 estimates the monthly bills of 3/4-inch meter single family residential customers with monthly use of 7CCF for each year of the analysis: bills will increase from $48.65 in CY 2020 to $61.64 by CY 2029. Beyond CY 2029, higher rate increases would likely be required to keep up with annual debt services.

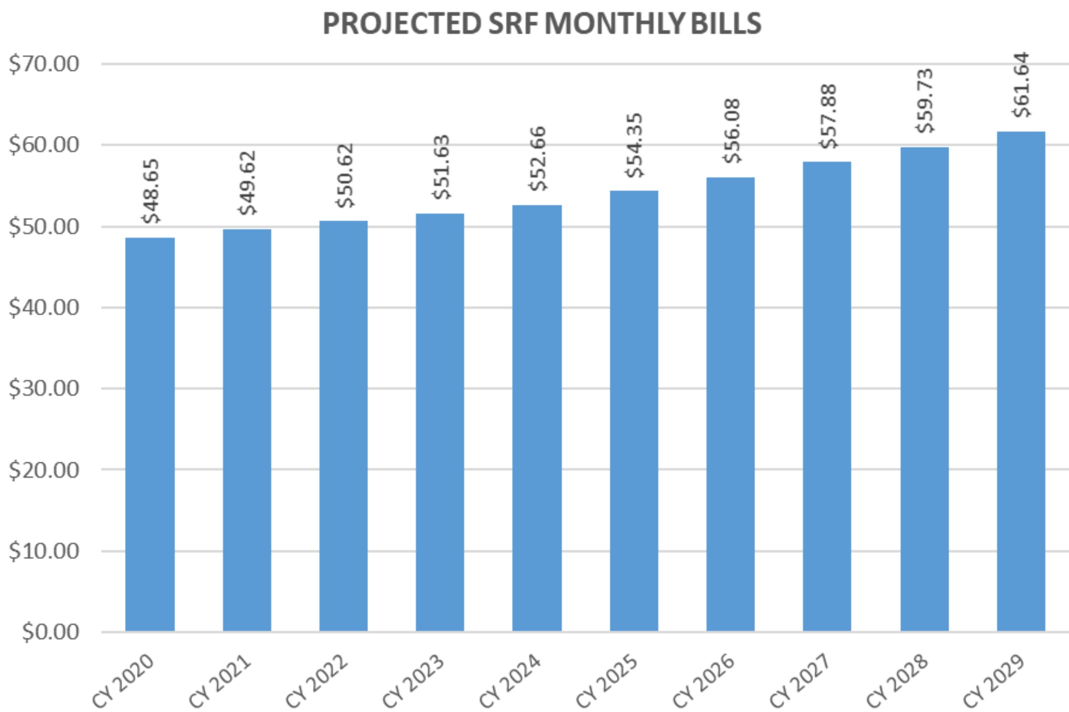

Figure 10.10 Scenario 2 (MAX DEBT) Estimated SFR Monthly Bills

10.5.4 Scenario 3 – Moderate Additional Debt

Scenario 3 assumes moderate use of debt to fund the CIP projects. The first additional debt issuance would take place in CY 2021, and additional debt proceeds would be required in CY 2025 to smooth their impact on the Water Utility's finances.

Table 10.11 shows the projected debt issuances that would be required, issuance costs associated with each issuance, and estimated debt service payment. The Annual Debt Service in the table indicates average annual debt service payment during the analysis years (CY 2020 –2029). The actual debt service payment would vary each year.

Table 10.11 Scenario 3 (MODERATE DEBT) Projected Debt Issuances

Year	Proceeds Required (millions)	Issuance Amount (millions)	Annual Debt Service (millions)
CY 2021	$4.00	$0.367	$0.321
CY 2025	$4.00	$0.367	$0.321
Total	**$8.00**	**$0.734**	

Notes:
(1) Totals may not sum due to rounding.
(2) Issuance amount includes 1 percent issuance costs and a debt-service reserve requirement equal to 1 year of debt-service payments.

Figure 10.11 shows the expected capital funding by source for each year of the analysis under Scenario 3. Approximately $68.9 million in cash funding and $8 million in new bond proceeds would be required to fund the $76.9 million CIP, as shown in Table 10.12.

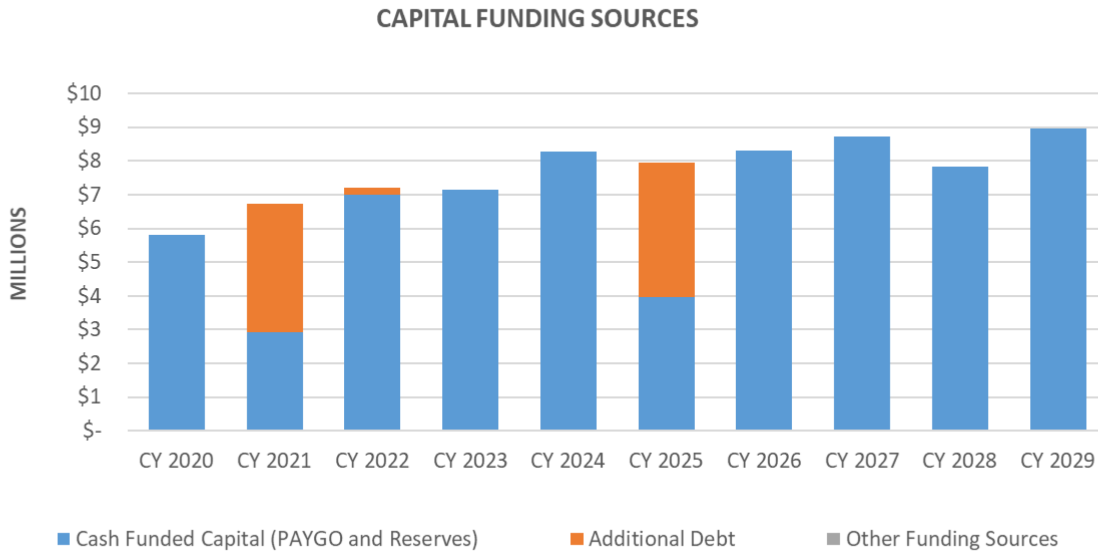

Figure 10.11 Scenario 3 (MODERATE DEBT) Capital Funding Sources

Table 10.12 Scenario 3 (MODERATE DEBT) Capital Funding Summary

	10-Year Sum (Millions)
Cash Funded Capital (PAYGO and Reserves)	$68.9
Additional Debt	$8.0
Total CIP Funding	**$76.9**

Note:
(1) Totals may not sum due to rounding.

Under Scenario 3, increases in user-service charges would be held constant at 3.5 percent per year from CY 2021 to CY 2024, as summarized in Figure 10.12. After CY 2024, higher increases at 3.8 percent per year would be required to meet debt-coverage requirements. The compounded rate increase over the 10-year projection period will be approximately 38.3 percent.

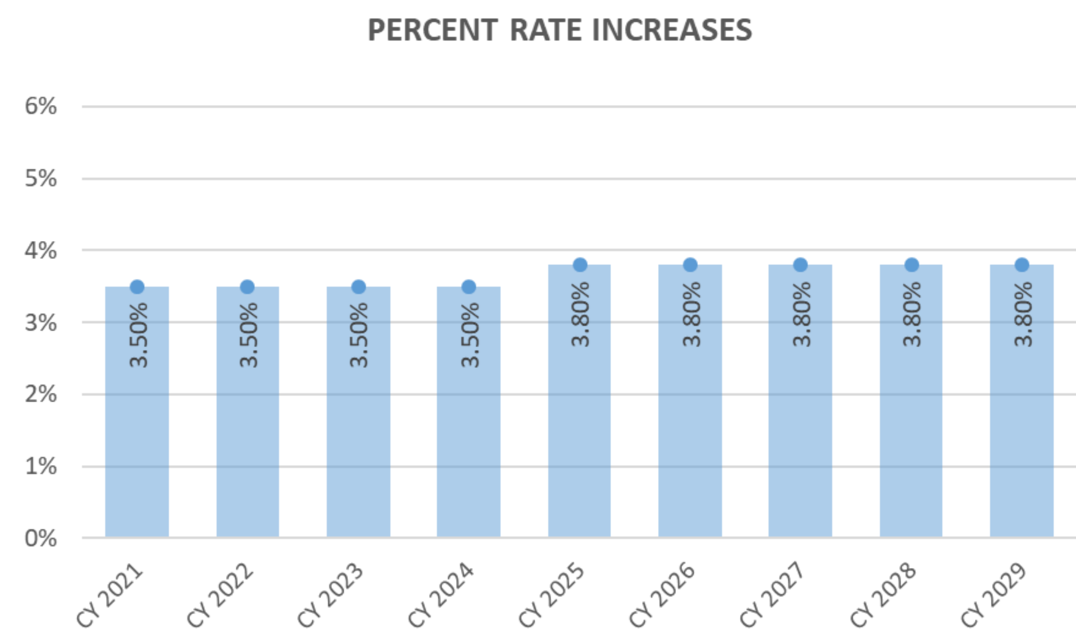

Figure 10.12 Scenario 3 (MODERATE DEBT) Rate Increases

Figure 10.13 summarizes 10-year financial projection under Scenario 3. With the rate increases in Figure 10.12, the City's Water Utility would have sufficient cash available every year to fund capital projects. The projected working capital balance will have less year-to-year fluctuation as compared to Scenarios 1 and 2 since the use of debt helps smooth the impact of peaks in CIP expenditures.

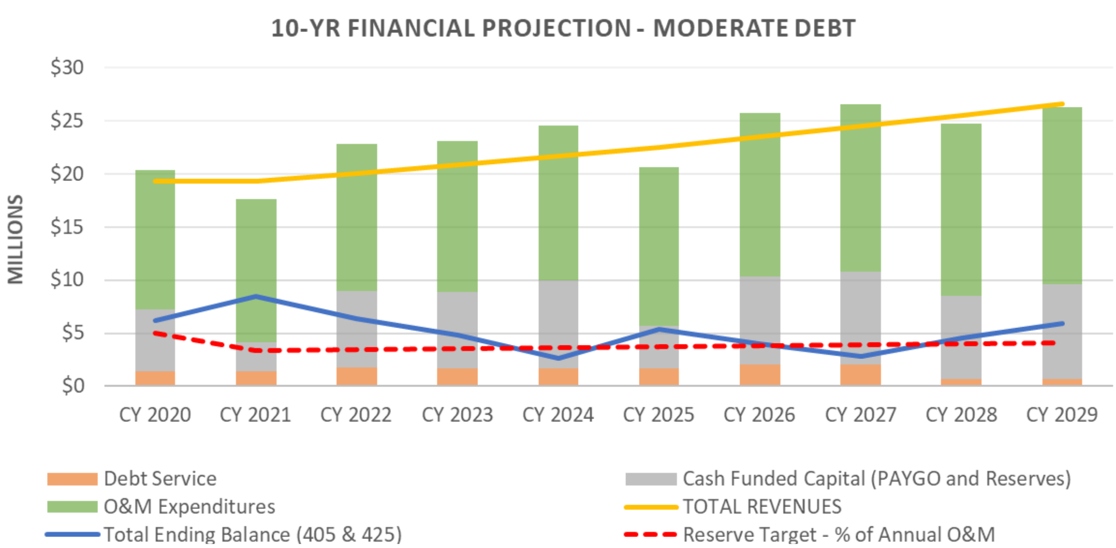

Figure 10.13 Scenario 3 (MODERATE DEBT) Financial Projection

At the end of the projection period the City would hold $6.8 million in outstanding debt principal. Table 10.13 summarizes the revenue requirement, cash flow, and fund balances for the next 10 years if Scenario 3 is implemented.

Table 10.13 Scenario 3 (MODERATE DEBT) Revenue Requirement, Cash Flow, and Fund Balances

	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026	CY 2027	CY 2028	CY 2029
Rate Increase	**0.00%**	**3.50%**	**3.50%**	**3.50%**	**3.50%**	**3.80%**	**3.80%**	**3.80%**	**3.80%**	**3.80%**
Revenues										
Rate Revenues (w/o Rate Increase)	$18,593,943	$18,686,912	$18,780,347	$18,874,249	$18,968,620	$19,063,463	$19,158,780	$19,254,574	$19,350,847	$19,447,601
Revenues From Rate Increase	0	654,042	1,337,630	2,051,968	2,798,308	3,643,578	4,528,978	5,456,258	6,427,246	7,443,848
Other Revenues	747,709	606,420	615,349	624,501	633,882	643,498	653,353	663,456	673,810	684,424
Total Revenues	**$19,341,652**	**$19,947,374**	**$20,733,326**	**$21,550,718**	**$22,400,810**	**$23,350,539**	**$24,341,112**	**$25,374,288**	**$26,451,904**	**$27,575,873**
Expenditures										
Ongoing O&M Expenses (Fund 405)	$13,151,781	$13,500,443	$13,858,416	$14,225,953	$14,603,311	$14,990,754	$15,388,554	$15,796,989	$16,216,348	$16,646,923
Rate-Funded Capital	4,582,497	0	2,067,091	4,166,060	6,915,487	3,947,832	6,626,335	8,532,738	7,821,273	8,370,613
Debt Service	1,428,121	1,427,106	1,747,872	1,715,237	1,714,433	1,712,827	2,036,686	2,035,808	642,635	642,635
Total Expenditures	**$19,162,400**	**$14,927,548**	**$17,673,379**	**$20,107,251**	**$23,233,231**	**$20,651,413**	**$24,051,574**	**$26,365,535**	**$24,680,256**	**$25,660,171**
Operating Cash Flows	**$179,252**	**$5,019,826**	**$3,059,947**	**$1,443,467**	**-$832,422**	**$2,699,126**	**$289,537**	**-$991,247**	**$1,771,648**	**$1,915,702**
Beginning Fund Balance (405 & 425)	**$7,206,612**	**$6,163,011**	**$8,262,731**	**$6,388,823**	**$4,860,611**	**$2,675,348**	**$5,374,473**	**$3,985,888**	**$2,803,191**	**$4,574,838**
Operating Cash Flows	$179,252	$5,019,826	$3,059,947	$1,443,467	-$832,422	$2,699,126	$289,537	-$991,247	$1,771,648	$1,915,702
Interest Earnings	175,000	53,478	57,703	58,606	44,998	30,144	32,199	37,441	27,156	29,512
Use of Reserves for Capital Projects	(1,222,853)	(2,920,106)	(4,935,903)	(2,975,020)	(1,355,427)	(2,585)	(1,682,001)	(196,620)	(5,170)	(581,457)
Ending Fund Balance (405 & 425)	**$6,163,011**	**$8,262,731**	**$6,388,823**	**$4,860,611**	**$2,675,348**	**$5,374,473**	**$3,985,888**	**$2,803,191**	**$4,574,838**	**$5,914,253**

Given the rate increases discussed for Scenario 3, Figure 10.14 estimates the monthly bills of 3/4-inch meter single family residential customers with monthly use of 7-CCF for each year of the analysis: bills will increase from $48.65 in CY 2020 to $67.27 by CY 2029, the lowest overall increase seen among the scenarios tested.

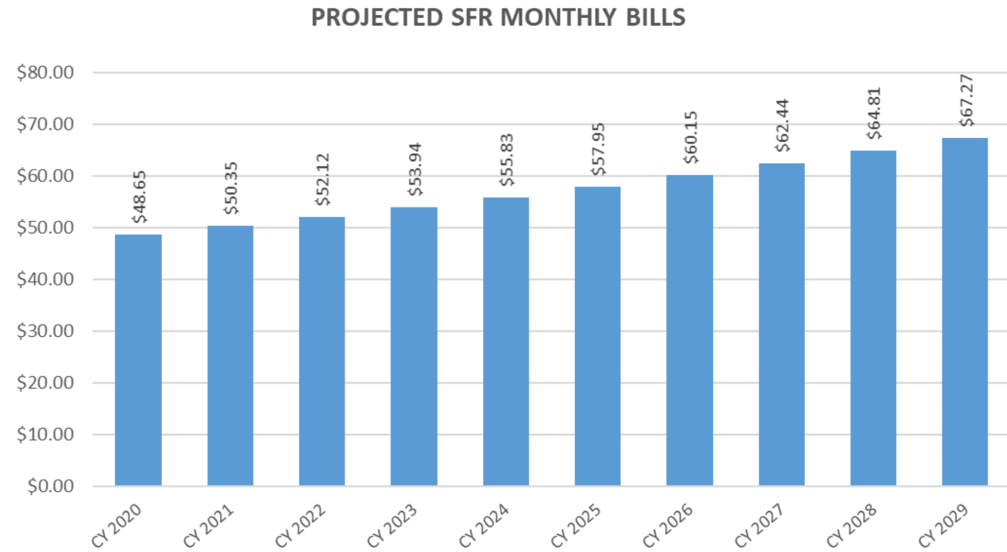

Figure 10.14 Scenario 3 (MODERATE DEBT) Estimated SFR Monthly Bills

10.6 Conclusion

Figure 10.15 compares each scenario's total capital funding sources from CY 2020 to CY 2029. As shown, Scenario 2 would require substantial use of debt to hold rate increases to 2 percent per year through CY 2025 and still implement the full 10-year CIP.

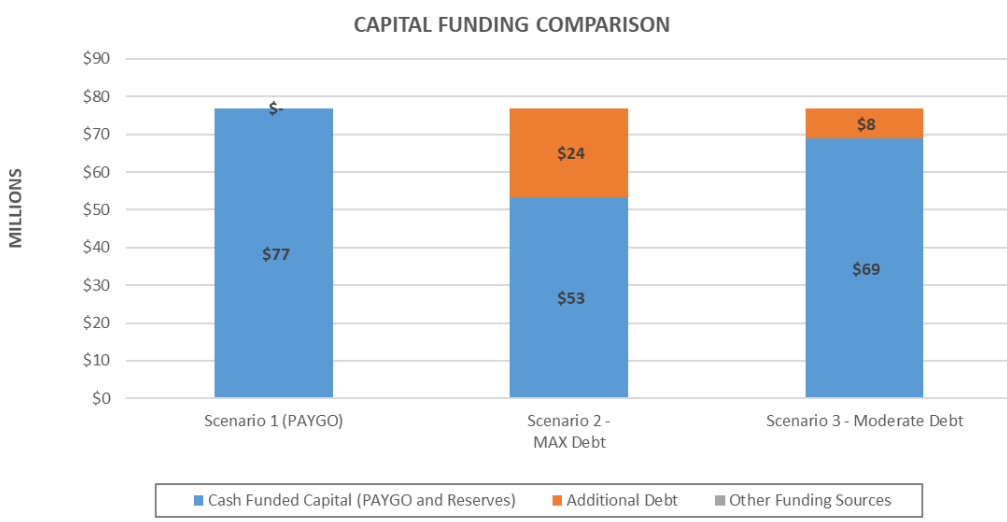

Figure 10.15 Capital Funding Comparison

Figure 10.16 compares the outstanding debt principal and projected interest payments that the water funds would hold after CY 2029 for each scenario. Under Scenario 2, the City would still need to pay off approximately $21.9 million in debt principal with almost $11 million in interest payments. This will lead to higher long-term costs and rate increases beyond CY 2029 as compared to what's demanded by the other scenarios. Furthermore, the City may not be able to issue debt at the frequency required for Scenario 2.

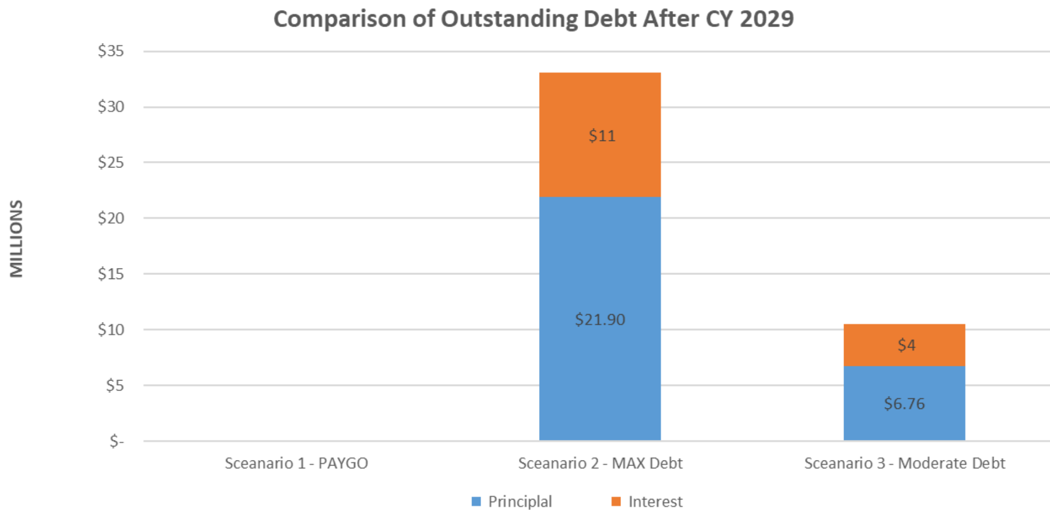

Figure 10.16 Comparison of Outstanding Debt After CY 2029

Figure 10.17 compares estimated single family residential bills from CY 2020 to CY 2029 under each scenario. As shown, the long-term rate outlook for each scenario has the same general magnitude with estimated single family charges ranging from about $61 to $68 per month by CY 2029. Increasing the amount of debt issued allows rate increases to be smoothed over time for a more gradual ramp-up to the ultimate rates.

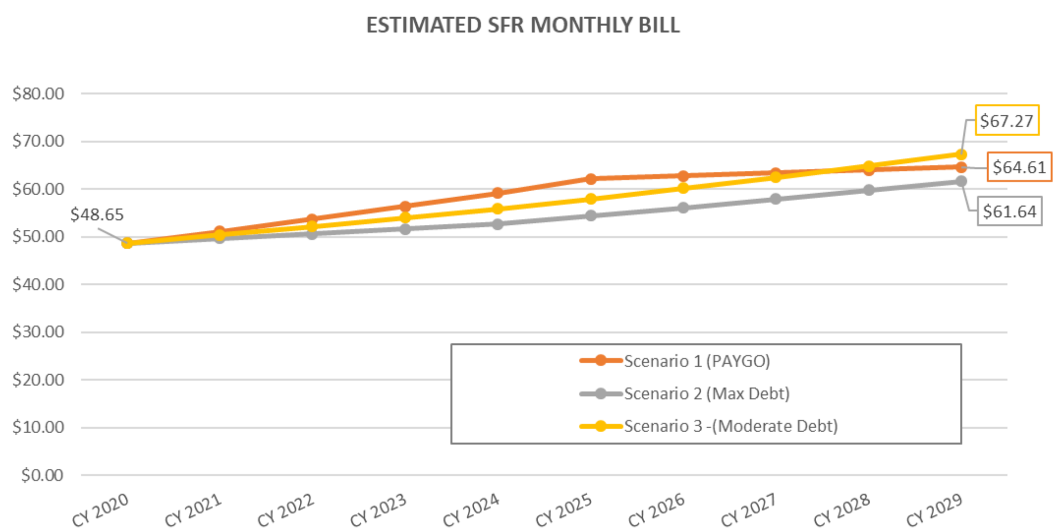

Figure 10.17 Estimated SFR Bill Comparison

The projections presented in this chapter are intended to guide the financial planning of the City's Water Utility, not to serve as the basis for any implemented rate increases. The City will need to confirm the capital projects that could be included within future budget development. This will give the City the opportunity to develop a funding strategy using their rate model and proposed recommended rate modifications.