WOODINVILLE WATER DISTRICT

COMPREHENSIVE
Water System Plan

FINAL

March 2019

carollo®

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Woodinville Water District

COMPREHENSIVE WATER SYSTEM PLAN

FINAL | FEBRUARY 2019

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Abbreviations

AC	Asbestos Cement
ADD	Average Day Demand
AED	Automated External Defibrillator
AF/yr	acre-feet per year
AMI	Advanced Metering Infrastructure
AWWA	American Water Works Association
BAT	Backflow Assembly Tester
Board	Board of Commissioners
BPS	Booster Pump Station
Carollo	Carollo Engineers, Inc.
CCCP	Cross Connection Control Plan
CCF	Hundred Cubic Feet
CCR	District's Consumer Confidence Report
CCS	Cross Connection Control Specialist
CEU	Continuing Education Units
cfs	cubic feet per second
CIP	Capital Improvement Plan
CIS/FIS	Customer Information System/Financial Information System
COW	City of Woodinville
CPR	Cardiopulmonary Resuscitation
D	Distribution Projects
DBP	Disinfection By-products
DBPR	Disinfection By-products Rule
DE	Developer Extension
DF	District Financed Projects
District	Woodinville Water District
DNS	Determination of Non-Significance
DOH	Washington State Department of Health
DSCR	Debt Service Coverage Ratio
DSL	Distribution System Leakage
DWSRF	Drinking Water State Revolving Fund
Ecology	Washington State Department of Ecology
EKC CWSP	East King County Coordinated Water System Plan
EPA	U.S. Environmental Protection Agency
ERU	Equivalent Residential Unit
ESA	Endangered Species Act

ET	Evapotranspiration
fps	feet per second
FSS	Fire Suppression Storage
ft	feet
gal	gallons
gal/ERU	gallons per Equivalent Residential Unit
GIS	Geographic Information System
GMA	Growth Management Act
G.O.	General Obligation
gpd	gallons per day
gpd/SFR	gallons per day per Single-Family Residential
gpm	gallons per minute
HDPE	High-Density Polyethylene
HGL	Hydraulic Grade Lines
HR	Human Resources
IACC	Infrastructure Assistance Coordinating Council
IFC	International Fire Code
ISDE	Initial Distribution System Evaluation
IT	Information Technology
KC	King County
LF	Linear Feet
LUV	Land Use Vision
M3	AWWA Manual M3: Safety Practices for Water Utilities
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDD	Maximum Day Demand
MFR	Multi-Family Residential
MG	Million Gallons
mgd	million gallons per day
MRSC	Municipal Research and Services Center
MWL	Municipal Water Law
NOAA	National Oceanic and Atmospheric Administration
NUD	Northshore Utility District
O&M	Operations and Maintenance
OSHA	Occupational and Safety Health Administration
PAA	Potential Annexation Area
PCHB	Pollution Control Hearings Board
PE	Registered Professional Engineer, State of Washington

PHD	peak hour demand
Plan	Comprehensive Water System Plan
ppb	parts per billion
ppm	parts per million
PRV	Pressure Reducing Valve
PS	Pump Station
psi	pounds per square inch
PSRC	Puget Sound Regional Council
PVC	Polyvinyl Chloride
PWTF	Public Works Trust Fund
PZ	Pressure Zone Projects
Qa	Annual Quantity
QA/QC	Quality Assurance/Quality Control
Qi	Instantaneous Quantity
R&R	Repair and Replacement
RAA	Running Annual Average
RCW	Revised Code of Washington
ROE	Report of Examination
RPBA	Reduced-Pressure Backflow assembly
RTU	Remote Terminal Unit
RWSA	Retail Water Service Area
S	Supply Projects
SCADA	Supervisory Control and Data Acquisition
SDC	Standard Development Charge
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
SFR	Single-Family Residential
SOP	Standard Operating Procedure
SPU	Seattle Public Utilities
SRRWA	Snohomish River Regional Water Authority
SSMP	Satellite System Management Program
ST	Storage Projects
SWP	Saving Water Partnership
TESSL	Tolt Eastside Supply Line
TOC	Total Organic Carbon
TPL1	Told Pipeline Number 1
Tribes	Tulalip Tribes

TT	Tolt Tap
UAW	Unaccounted-for Water
UGA	Urban Growth Area
ULID	Utility Local Improvement District
UPC	Uniform Plumbing Code
WAC	Washington Administrative Code
WASWD	Washington State Association of Sewer and Water Districts
WDM	Water Distribution Manager
WDS	Water Distribution Specialist
WETRC	Washington Environmental Training Resources Center
WISHA	Washington Industrial Safety and Health Act
WSDOT	Washington State Department of Transportation
WUE	Water Use Efficiency

EXECUTIVE SUMMARY

ES.1 Introduction

This Comprehensive Water System Plan (Plan) for the Woodinville Water District (District) has been prepared through a collaborative effort by District Staff, Carollo Engineers, Inc., and RH2 Engineering to update the District's 2008 Comprehensive Water System Plan. The purpose and objective of this Plan is to document the District's means for developing its water system to meet its potable water and fire flow demands for existing and future systems. The Plan is in accordance with Washington Administrative Code (WAC) 246-290 and Washington State Department of Health (DOH) requirements.

The District owns and operates potable supplies and wastewater collection and conveyance located in portions of King and Snohomish Counties in Washington State, servicing a population of approximately 49,000 residents and 20,000 employees. The District retail water service area (RWSA) encompasses approximately 30 square miles, including the entire City of Woodinville and portions of the cities of Bothell, Kirkland, and Redmond, and shares borders with five (5) water purveyors: the Cross Valley Water District, Alderwood Water District, Northshore Utility District, the City of Bothell Water System, and the City of Redmond Water System, as shown in Figures ES.1 and ES.2.

This Plan encompasses a 20-year planning horizon and the District has requested 10-year Plan approval from DOH. Historical District data through year 2015 were used for the analyses throughout the Plan. The short-term, 10-year planning period is 2018-2027. The long-term planning period is 2028-2037.

ES.2 Planning Data and Water Demands

Description of the District's RWSA physical features, existing and future land use, historical water purchase and consumption trends, as well as water demand forecasts for the six-year (2023), ten-year (2027), and twenty-year (2037) planning periods are presented in Section 2. Three (3) demand projection scenarios were developed to estimate the possible range of future demands for the District. The future demand projections are used as input conditions for the water system analyses that in turn contribute to the development of the District's capital improvement plan (CIP).

Each jurisdiction in the District's RWSA provided existing land use designations and future land use and zoning data. No significant land use changes are expected to occur over the planning periods, as illustrated in Figures ES.3 and ES.4.

The District purchases all its water from Seattle Public Utilities (SPU) through ten (10) active Tolt Taps (TT). The amount of water purchased is fairly evenly spread out among the various taps, as shown for 2015 water purchase by tap in Figure ES.5. Since 2015 Tolt Tap 195 has been added to the system.

The District's consumption varies throughout the year, seasonally, as shown in Figure ES.6. July and August are the driest months and the months of greatest water use.

Based on billing records from 2006 to 2015, the District's average day demand (ADD) has been around 4 million gallons per day (mgd) and has not increased over the last decade despite a continual one (1) percent annual increase in the number of customer accounts. Maximum day demand (MDD) has trended slightly downward, as shown in Figure ES.7.

This District has five (5) customer categories: single-family residential (SFR), multi-family residential (MFR), commercial and industrial, government and education, and irrigation. The SFR customer class comprises 92 percent of customer accounts and has the highest water consumption. Urban SFR households were found to use 27 percent less water than rural SFR households with average consumption of 162 gallons per day (gpd) and 221 gpd, respectively. Maps of the District's urban and rural pressure zones in the RWSA are displayed in Figure ES.8.

Consumption of the District's eight (8) largest water consumers was evaluated separately. Their locations are shown on Figure ES.9. Combined, their consumption comprises four (4) percent of the District's ADD.

Puget Sound Regional Council (PSRC) data for demographic growth indicate residential growth within the District's RWSA over the 20-year planning period may range from 0.6 to 0.9 percent annually and non-residential growth may range from 1.0 to 1.3 percent annually. Two (2) growth scenarios (PSRC and Reduced) were used to project future water accounts for each customer type (Figure ES.10).

Historical consumption data, key demand projection parameters, and demographic projection scenarios were used to develop low, medium, and high demand forecasts, which are shown in Figure ES.11. The Medium Demand Projection Scenario used the Reduced Growth Scenario, shown in Figure ES.10, and predicts the 2015 ADD of approximately 4.0 mgd to increase to 4.4 mgd by 2037. MDD is predicted to increase from 8.6 to 9.5 mgd, a 0.4 percent annual increase in water demand over the 20-year planning period.

ES.3 Existing Water System

Due to the hilly nature of the District's RWSA, with elevations ranging from 20 feet to 625 feet, the District has a complex water system consisting of 20 individual pressure zones, eight (8) storage facilities, five (5) booster pump stations (BPS), and 46 pressure reducing valves (PRV). The District's pressure zones and water system facilities are shown on Figure ES.12. Due to the complexity of the system, the hydraulic profile is split into West, Central, and East service and are shown in Figures ES.13 through ES.15.

District supplies consist of either (8) Tolt taps along SPU's Tolt Pipeline Number 1 (TPL1) and two (2) Tolt taps along the Tolt Eastside Supply Line (TESSL). One (1) additional tap along the TPL1 can be used for emergency backup (TT-123). Additionally, nine (9) emergency interties and one (1) emergency well remain on standby in case the SPU supply is ever interrupted or inadequate. The District also has a water right on the Snohomish River that will be developed in the future to be used for domestic supply.

A long-term pipeline replacement strategy was developed using the District's geographic information system (GIS) data of existing pipe material, length, installation year, and original useful life assumptions. The analysis indicates that between now and 2055 the District should prepare to replace approximately 4,400 linear feet (LF) of water main annually and will need to replace water main at an increased rate starting around 2075. A water main replacement schedule chart and map is presented in Figures ES.16 and ES.17.

ES.4 Policy and Criteria

This Section summarizes the policies and criteria that govern the operation and expansion of the District's water system. District policies are presented in four (4) categories: Service Area Policies, Performance Criteria, Design Criteria, and Rules and Regulations.

The District's service area policies describe its duty to serve, emergency services, annexations, system extensions, and satellite system management program. The purpose of these policies is to ensure that the District's customer base understands their rights as they apply to the use or obtainment of water services within the District.

Performance criteria establish a minimum standard for the performance of the District's existing water system. Establishing criteria is important for determining deficiencies in the existing system and identifying operational changes or capital improvements that may be required to meet the District's performance criteria.

The District's supply and pumping criteria are:

- Sources must be capable of replenishing depleted fire suppression storage within 72 hours while concurrently supplying MDD.
- System must be capable of delivering MDD within 18 hours of pumping.
- Pumping stations supplying open zones must have multiple booster pumps with a sufficient capacity to meet MDD with largest pump out of service.
- Pump stations supplying closed zones shall contain multiple booster pumps of sufficient capacity to meet peak hour demand (PHD) with fire flow conditions with the largest pump out of service. Pump stations (PS) supplying closed zones that have reliable backup power are not required to have a redundant fire pump.

The District's storage criteria are consistent with the DOH Water System Design Manual. Figure ES.18 shows the components of storage the District is required to have available and the minimum hydraulic grade line (20 pounds per square inch (psi) or 30 psi) for each storage component. Dead storage is the volume in a tank that cannot be used to serve the highest customer in the water system with a pressure of at least 20 psi.

Design Criteria set a minimum standard for the design of new facilities within the water system and include: state agency regulations, reference datum, facility reliability and security considerations, water pressure, pipeline velocities, pipe sizing and material, valves, fire hydrants, residential fire sprinkler system, standard plans and specifications, cross connection control, water storage, pump stations, and general facility placement. All new facilities must also meet the District's performance criteria.

Federal, state, county, and city rules and regulations of that govern the District's operation of its water system are also described in Section 4.

ES.5 Water System Analysis

The District's water distribution system was evaluated for its ability to meet the District's performance criteria under 2023, 2027, and 2037 future demand conditions using the medium demand projection scenario. The distribution system was evaluated for its supply and pumping capacity and reliability, the capacity of its storage facilities, and for adequate pressures and fire flow capacity using the District's updated hydraulic model. Fire flow requirements are shown in Figure ES.19.

The analysis of the District's water system identified several system deficiencies and recommends the following improvements to eliminate these deficiencies. These recommendations form the basis of the District's CIP outlined in Section 8:

1. The pumping analysis identified that, in situations where the Tolt Pipeline has insufficient pressure to supply the 650 Central Zone directly, the Hollywood PS does not have sufficient capacity to supply PHD plus fire flow with the largest pump out of service. To provide sufficient redundancy it is recommended that additional pumping from either the Tolt Pipeline or the 570 Central Zone to Zone 650 Central be installed with a 1,000 gpm capacity.
2. The storage analysis identified that the 670 East Service Area has a storage deficit of 0.2 million gallons (MG). This deficit is because of only 40 percent of the total 1.1 MG volume of Aspenwood Reservoir is available at 20 psi to the highest costumer. To provide sufficient storage it is recommended that dead storage be made available by construction of a pump station to pump storage out of the Aspenwood Reservoir.
3. The distribution system analysis used an updated hydraulic model of the District's existing system along with fire flow requirements throughout the system to identify areas experiencing high pressure, areas experiencing low pressure, and areas that do not provide adequate fire flow. Results are shown in Figures ES.20 through ES.22. The analysis also identified dead-end pipes in non-single family areas that do not have the capacity to provide the District's fire flow requirements. These are identified in Figure ES.23.

Forty-six pipeline projects, including upsize and new pipe installation, are recommended to ensure required fire flows and pressures are available to all water mains in the service area. These are mapped and numbered in Figure ES.24.

ES.6 Water Use Efficiency and Reuse

The District implemented a water conservation program in 1992 and continues to recognize the importance of water efficiency efforts by maintaining a comprehensive, proactive program in water conservation. Details in this Plan include the District's past water use efficiency (WUE) performance, WUE goals, and WUE measures.

The District is in compliance with DOH with annual submission of its WUE report and supports the development of regional, as well as local, water conservation programs. The District publicizes regional program opportunities and participates in local events to increase awareness of water saving measures their customers can implement themselves.

The District endorses and participates in conservation programs through the Saving Water Partnership (SWP) with SPU, and as such, has adopted the current SWP water conservation goal for the years 2013 - 2018. The current regional goal is to reduce per capita water use from current levels so that the total average annual retail water use of the members of the SWP is less than 105 mgd from 2013 – 2018 despite forecasted population growth. The District plans to participate in the next Saving Water Partnership Regional Water use Efficiency Goal and Program, which will cover 2019 through 2028.

The District also has its own WUE targets, which are first to Reduce Equivalent Residential Unit (ERU) values (starting at 209 gpd/ERU) by one (1) percent annually for 2016 through 2027 and 0.5 percent annually from 2028 through 2037, and second to maintain a distribution system leakage rate of below five (5) percent.

ES.7 Operations and Maintenance Program

The District is authorized under the Revised Code of Washington (RCW) Title 57 to operate and maintain a public water utility and sanitary sewer system. The District operates under a commissioner system wherein five (5) commissioners are elected by the residents of the District. By resolution, the board of commissioners (Board) makes and establishes policies that govern the operation of the District. The District's organization chart is illustrated in Figure ES.25.

Section 7 outlines the District's operation and maintenance (O&M). Specific operation of individual system components are detailed in the O&M manuals for each specific component of the system. Water quality monitoring programs are maintained in accordance with a variety of regulations and in coordination with the District's wholesale water provider, SPU. Similarly, the District maintains a separate emergency response plan that details the mitigation and emergency response activities and is kept confidential.

ES.8 Improvement Program

The recommended supply, storage, pipeline, and other ongoing projects are compiled into a comprehensive CIP for the water utility to provide a guideline for planning and budgeting. Section 8 presents the cost estimate and schedule for each project and describes the assumptions used to develop cost estimates and to prioritize projects.

The total Water CIP cost over the next 20 years is just over $103.7 million, which equates to $5.2 million annually, as presented in Table ES.1. Project phasing is described as either short-term (2018-2027), or long-term (2028-2037). Of the total cost, $49.2 million is budgeted for the short-term phase and $54.5 million is budgeted for the long-term phase.

The water CIP is split into six (6) categories: distribution system, pressure zone, supply, storage, pump station, and district funded. As outlined in Table ES.2, throughout the 20-year planning period, $69.1 million (66.6 percent) is budgeted for Distribution system upgrades, $1.9 million (1.9 percent) is budgeted for pressure zone projects, $0.7 million (less than one (1) percent) is budgeted for supply projects, $19.6 million (18.9 percent) is budgeted for storage projects, $6.5 million (6.3 percent) is budgeted for pump station projects, and $5.9 million (5.7 percent) is budgeted for District funded projects.

Table ES.1 Summary by Project Type

Project Type	Total CIP Cost Estimate	CIP Phasing	
		Short-term (2018 – 2027)	Long-term (2028 – 2036)
Total Cost	**$ 103,723,000**	**$ 49,191,000**	**$ 54,533,000**
Capacity	$ 3,631,000	$ 2,452,000	$ 1,179,000
Repair & Replacement	$ 61,752,000	$ 18,936,000	$ 42,817,000
Improvements	$ 38,340,000	$ 27,803,000	$ 10,537,000
Annual Cost	**$ 5,186,000**	**$ 4,919,000**	**$ 5,453,000**

Table ES.2 CIP Summary by Project Category

Project Category	Total CIP	Percentage
Distribution System	$ 69,103,000	66.6%
Pressure Zone	$ 1,946,000	1.9%
Supply	$ 725,000	0.7%
Storage	$ 19,581,000	18.9%
Pump Station	$ 6,495,000	6.3%
District Funded	$ 5,873,000	5.7%
Total	**$ 103,723,000**	**100%**

The capital improvement projects are shown on Figure ES.26. They were prioritized based on a pipeline risk evaluation, the number and type of customers impacted by each project, and from District input. Each project also has a project sheet in Appendix K describing it in detail.

ES.9 Financial Program

The last section of the Plan presents a financial program that allows the water utility to remain financially viable during the planning period. The financial analysis considers the historical financial condition, current and future financial obligations, O&M needs, and the ability to support the financial impact related to the completion of the capital projects identified in the CIP.

The analysis shows that the District's reserves will be adequate to fund the anticipated CIP projects with moderate rate increases (3.0 percent increase per year from 2019 to 2020 and then continuing at 2.5 percent through 2037). This would decrease the ending fund balance to approximately $4 million by 2023, which is above the District's financial requirement of 60 days of operating expenses. The ending fund balance would begin to increase as current debt services end, as illustrated in the financial forecast (Figure ES.27). The District has the option to issue debt, apply for qualifying grants, or conduct a rate study to determine if a rate increase would help cover the costs of the projected capital improvements.

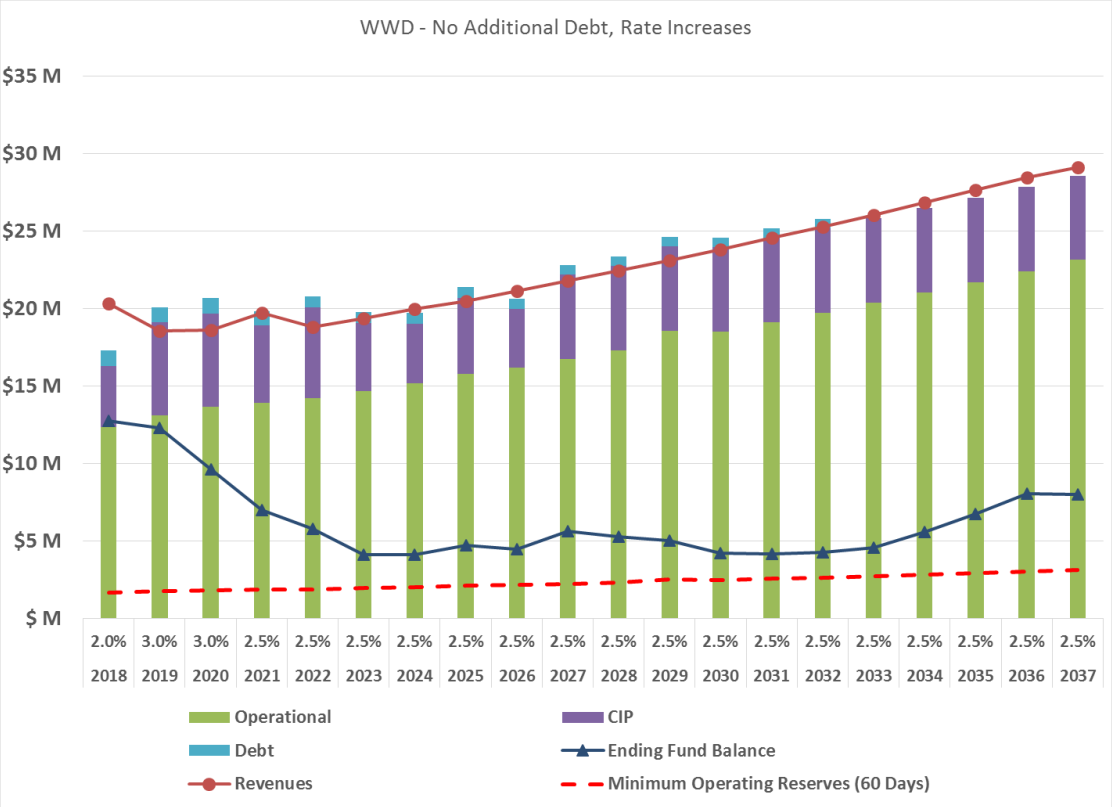

Figure ES.27 Financial Forecast

Section 1

INTRODUCTION

1.1 Introduction

This Comprehensive Water System Plan (Plan) updates the Woodinville Water District's (District) 2008 Comprehensive Water System Plan. It was developed collaboratively by District staff, Carollo Engineers, Inc. (Carollo), and RH2 Engineering.

This Plan encompasses a 20-year planning horizon and the District has requested 10-year Plan approval from DOH. Historical District data through year 2015 were used for the analyses throughout the Plan. The short-term, 10-year planning period is 2018-2027. The long-term planning period is 2028-2037.

In accordance with Washington Administrative Code (WAC) 246-290 and Washington State Department of Health (DOH) requirements, this Plan:

- Defines the District's retail water service area (RWSA).
- Projects future demands within the RWSA.
- Describes the existing water system.
- Establishes minimum performance criteria for the system.
- Identifies system deficiencies.
- Presents a capital improvements plan.
- Offers a financing and implementation plan.

1.2 Authorization

In 2016, the District's Board of Commissioners (Board) authorized Carollo to prepare this document in accordance with District policies and procedures and all applicable federal, Washington State, King County, and local city rules and regulations.

1.3 Overview of the District

The District is an incorporated municipality authorized under Revised Code of Washington (RCW) Title 57-Sewer and Water Districts. It is a special purpose district that supplies potable water, as well as wastewater collection and conveyance for its service area.

A five-member Board, elected for six-year terms, manages the District. The Board establishes District policies through resolutions and motions, adopts a bi-annual budget for the District, establishes rates and charges, approves appropriations and contracts for services, and issues debt to fund capital expenditures.

Overseeing day-to-day District operations is a board-appointed General Manager who reports directly to the Board. The General Manager directs the District's operations and activities in accordance with District policies and administers the capital improvement plan.

1.3.1 Location

The District is located primarily in north King County, Washington, as shown in Figure 1.1. According to Puget Sound Regional Council Estimates, the District served a population of approximately 49,000 residents and 20,000 employees in 2016.

The District's RWSA encompasses approximately 30 square miles, serving the entire City of Woodinville and portions of the cities of Bothell, Kirkland, and Redmond. The District also serves many residents of unincorporated King County and a handful of residents of unincorporated Snohomish County. Figure 1.2 shows the District's RWSA boundary and the jurisdictions within it.

The District shares borders with five (5) entities: the Cross Valley Water District, Alderwood Water & Wastewater District, the City of Bothell, Northshore Utility District, and the City of Redmond. One (1) Group A, and approximately 55 Group B, water systems reside within its RWSA as of June 2016. Figure 1.3 shows the District's adjacent utilities, its RWSA, and corporate boundary.

1.3.2 History of the District

The District was established as King County Water District No. 104 in 1959. A year later, a comprehensive plan for water development was completed. The District began serving water to its first customers in 1963 and began providing sewer service in 1969. In 1985, the District officially became the Woodinville Water District.

1.3.3 Goals of the District

The District's mission is to provide safe and reliable service at the lowest responsible rates. To carry out this mission, the District:

1. Provides drinking water to all customers at flows and pressures as required by law.
2. Recognizes that the District's function is not to plan land uses within its boundary, but rather to respond to land uses the proper authority has planned for the community.
3. Educates customers on ways to use water efficiently.

1.4 Purpose and Objectives of this Plan

This Plan documents the District's means for developing its water system to meet its potable water and fire flow demands for existing and future customers. The Plan also considers the plans and policies of the Seattle Regional Water System, which the District purchases water from, and the goals of the Saving Water Partnership, which the District is a member of.

The Plan estimates the District's future water demands and evaluates the system for the 6-year (2023), 10-year (2027), and 20-year (2037) planning horizons. A 20-year capital improvement plan has been developed based on the results of the system evaluation.

1.5 Interlocal Coordination and Agreements

The District coordinates its planning and operations with several agencies, particularly those within or adjacent to its RWSA. These agencies are discussed below.

The District purchases all of its water from Seattle Public Utilities (SPU). In 2004, the District signed a contract with SPU to purchase water through the year 2061. Along with various other terms and conditions, the contract addresses issues related to water quality and quantity and establishes the hydraulic grade line (HGL) for delivering water to each metered connection from the Tolt Pipeline. Appendix D provides a copy of the agreement.

The District is a member of the Snohomish River Regional Water Authority (SRRWA), which develops water resources shared by the District, the Northshore Utility District, and the City of Everett. In 1996, the SRRWA acquired a surface water right from the Weyerhaeuser Company to withdraw from the Ebey Slough. The Weyerhaeuser water right is for a withdrawal of 36 million gallons per day (mgd) and 26,547.5 acre-feet per year (AF/yr). The SRRWA agreement assigns 11 mgd of the available 36 mgd to the District.

In 2014, the Washington State Department of Ecology (Ecology) issued a Superseding Certificate of Water Right. This certificate defined the withdrawal's purpose as municipal and established the SRRWA's service areas as the place of use. The District has not yet used this water right because the water quality requires treatment for domestic use.

Service area boundaries for the District were originally designated in the East King County Coordinated Water System Plan (EKC CWSP), which was first published in 1989 and most recently updated in 1996. Since then, the District has established interlocal agreements with its adjacent utilities, including the cities of Bothell and Redmond, the Cross Valley Water District, and the Northshore Utility District to modify the service boundary when necessary.

The District also serves a small number of parcels within Snohomish County. Resolution 2388 defines the District's policy regarding extension into Snohomish County. Table 1.1 lists these agreements, which are also included in Appendix E.

Table 1.1 Interlocal Agreements

Contracted Parties	Approval Date	Description
Seattle Public Utilities - City of Seattle	12/7/2004	Resolution 3512. Water Purveyor Contract - Full requirements contract to purchase water from SPU until January 1, 2062.
Northshore Utility District and City of Everett	12/18/1996	Establishes the SRRWA and addresses development of the Weyerhaeuser surface water right for future water supply.
Cross Valley Water District, Alderwood Water District	5/17/1988	Resolution 2388. Policy statement on extension of service into Snohomish County.
Cross Valley Water District	9/30/1991	Letter from SPU to District. Response to the request to provide temporary water service to the Cross Valley Water District
Cross Valley Water District	3/4/1985	Resolution 1863. Water Service Agreement between Woodinville and Cross Valley Water District.
City of Bothell	9/10/2001	Interlocal Service Area and Emergency Intertie Agreement.
City of Redmond	7/13/1988	Resolution 2407. Establishes a service area boundary between the District and City of Redmond. Addenda establish District water service in specific Redmond neighborhoods.
King County		King County Franchise No. 9353 Authorizing the District to operate utility system facilities within King County right-of-ways.
King County	10/6/1992	Establishes the water service area boundaries as planned in the EKC CWSP.

1.6 Related Plans

To develop this Plan, several other plans were reviewed. These plans include:

- Woodinville Water District 2008 Comprehensive Water System Plan, PACE Engineers, Inc.
- King County Comprehensive Plan.
- Snohomish County Comprehensive Plan.
- City of Woodinville Comprehensive Plan.
- City of Redmond Comprehensive Plan.
- City of Kirkland Comprehensive Plan.
- City of Bothell Comprehensive Plan.

1.7 Public and Agency Input

A public meeting [will be] publicly advertised and conducted before the Board meeting to adopt this Plan. The Adopting Resolution and Ordinance for this Plan [will be] in Appendix A.

Draft copies of the Plan were sent to cities within the District, adjacent utilities, SPU, DOH, King County, and Snohomish County, and were made available to the public for review. The comments received and the responses to those comments [will be] included in Appendix B.

1.8 Environmental Assessment

A State Environmental Policy Act (SEPA) checklist was prepared for this Plan. According to the District, this Plan does not have adverse impacts on the environment. As a result, the District issued a Determination of Non-Significance (DNS) under WAC 197-340 (2). Many of the projects this Plan proposes are expected to require additional project-specific environmental review and SEPA checklists during the preliminary and final design process. Appendix C includes the SEPA checklist and DNS.

1.9 Acknowledgements

Carollo would like to acknowledge and thank the following individuals for their efforts and assistance in completing this Plan:

- Patrick Sorensen, General Manager.
- Ken Howe, former General Manager.
- Ken McDowell, District Engineer.
- Debborah Rannfeldt, former Public Information Coordinator.
- Steve Brown, Operations and Maintenance Manager.
- Jack Broyles, Finance Manager.

Section 2

PLANNING DATA AND WATER DEMAND PROJECTIONS

2.1 Introduction

This section describes the physical features of the Woodinville Water District's (District's) retail water service area (RWSA), presents the RWSA's existing and future land use, summarizes the District's historical water purchase and consumption trends, and predicts future District water demands for the 6-year, 10-year, and 20-year planning periods.

Projecting realistic future water demands is critical when evaluating a water system's ability to meet future water service requirements and planning for infrastructure projects. Demand projections are used as input conditions in water system analyses that help develop a capital improvement plan (CIP). Thus, to ensure accurate demand projections, the District's unique historical water consumption trends had to be thoroughly reviewed.

The District purchases all of its water from Seattle Public Utilities (SPU) through nine (9) active Tolt Taps. Based on billing records from 2006 to 2015, the District's average day demand (ADD) has not increased over the last decade despite a continual one percent annual increase in customer accounts. Maximum day demand (MDD) has trended slightly downward.

Based on the results of a demographic analysis of the RWSA using Puget Sound Regional Council data, the District expects residential growth over the 20-year planning period to range from 0.6 to 0.9 percent annually and non-residential growth to range from 1.0 to 1.3 percent annually.

To predict a range of future demands, historical consumption trends and results from the demographic analysis were used as inputs. Low, medium, and high demand projection scenarios were then developed.

The water system analysis described in Section 5 evaluated the system for capacity deficiencies based on the medium demand projections. The medium demand projection scenario predicted the 2015 ADD of approximately 4.0 million gallons per day (mgd) to increase to 4.4 mgd by 2037. MDD was predicted to increase from 8.6 to 9.5 mgd, a 0.4 percent annual increase in water demand.

2.1.1 Recommendations

The District collects detailed consumption records through their advanced metering infrastructure system. In order to continue to improve their consumption tracking, it is recommended that flushing water use be metered and recorded.

2.2 Physical Features of the RWSA

2.2.1 Watersheds and Surface Waters

The District's RWSA is within the Sammamish and Snoqualmie watersheds, which are made up of all basins feeding Lake Sammamish. As shown in Figure 2.1, the RWSA spans three (3) basins: Little Bear Creek, Bear Creek, and Sammamish River.

The Sammamish River is the largest river passing through the District's RWSA. Before joining the Sammamish River, Little Bear Creek passes through the northwest corner of the District's RWSA near highway 522. Within the Bear Creek Basin, Daniels Creek, Cottage Lake Creek, and Bear Creek flow southward through the eastern portion of the RWSA.

The RWSA also encompasses many small lakes, including Cottage Lake, Lake Leota, and Welcome Lake.

2.2.2 Topography

The District's RWSA is characterized by many hills and valleys, which necessitates the District's approximately 20 pressure zones. The lowest elevations occur in the Sammamish River Valley, which is in the District's western portion.

Traveling east from the Sammamish River Valley, the topography rises as high as 575 feet above sea level in the Hollywood area and extends into a plateau. The highest elevations (over 600 feet) occur near the RWSA's southeastern boundary.

2.2.3 Climate and Seasonal Demand Variation

According to precipitation data from two (2) National Oceanic and Atmospheric Administration (NOAA) weather stations inside the District RWSA, the District has received an average of approximately 45 inches of rainfall per year since 2009. Typically, November and December are the wettest months, and July and August are the driest.

Many customers in the District have large lots and use water for irrigation throughout the summer. As a result, the amount of rainfall, as shown in Figure 2.2, strongly affects District water consumption. During July, August, and September, when rainfall is lowest, consumption is highest. The rainfall and consumption values presented in Figure 2.2 are an average of the years 2009 through 2015.

2.3 Land Use

Within its RWSA boundary, the District serves customers from multiple jurisdictions, which include:

- City of Woodinville.
- City of Bothell.
- City of Kirkland.
- City of Redmond.
- Unincorporated King County.
- Unincorporated Snohomish County.

Each jurisdiction listed above provided existing land use designations and zoning data to the District. This information was then compiled and categorized into the following eight (8) land use categories:

- Agriculture.
- Commercial.
- Industrial.
- Multi-Family Residential (MFR).
- Park/Cemetery/Golf Course.
- Public/Quasi-Public.
- Single Family Residential (SFR).
- Vacant/Open Space.

Figure 2.3 shows the existing land use map for the District's RWSA according to the data. The future land use map, shown in Figure 2.4 portrays projected land use for the year 2037. Zoning land use information from the various jurisdictions within the District's RWSA were used to create the future land use map. In order to be conservative in the future water demand estimations, any parcel with an existing land use type that typically has higher water consumption per acre than the zoning land use type remained as its existing land use type on the future land use map. The land use types from highest to lowest typical water consumption per acre are: industrial, multi-family residential, commercial, single family residential. As such, any parcels with any existing land use of multi-family and a future land use of commercial was kept as multi-family to represent that the parcel may not redevelop to a lower water use, which would represent the highest water demand case.

Little change in land use is expected during the planning period. Only a few of the parcels change in land use between Figures 2.3 and 2.4; for instance, some of the currently vacant parcels in the southwest corner of the District's water system.

2.4 Historical Supply and Consumption

To establish historical demand, the District provided historical water purchase records, the number of accounts, and consumption data for the years 2006 through 2015. Data were then evaluated to characterize the unique water use of the District's customers. From the data, several key demand parameters were generated and used to project future demand.

2.4.1 Historical Water Purchase

Figure 2.5 shows water purchases from the nine (9) Tolt Taps used by the District in 2015. As the figure shows, the amount of water each Tolt Tap supplied to the system was distributed fairly evenly. Since 2015 the District has added TT-195 to supply the 510 West Zone and now uses TT-76 and TT-77 as back-up supply taps. There also exists one other Tolt Tap (TT-123) that is not active and is available for emergency purposes only, for a total of 11 Tolt Taps.

Table 2.1 shows the District's total annual water purchase for years 2006 through 2015. This total water purchase varies annually in response to system demand, which correlates with weather, development, economic conditions, and conservation activities.

Water purchase data for 2015 is the most reliable of the years shown in Table 2.1. Before 2015, the District noticed discrepancies between SPU and District meter records. After working diligently with SPU to resolve the discrepancies, the District believes the 2015 purchase data to be accurate.

2.4.1.1 Average Day Demand

The ADD represents a water system's average daily demand for a year. To calculate ADD, the total water purchased by the District in a year is divided by the number of days in a year. Table 2.1 and Figure 2.6 show ADD values for 2006 through 2015. Over the last decade, the District's ADD has remained steady, neither increasing nor decreasing.

2.4.1.2 Maximum Day Demand

Historical MDD values are the highest water purchase in a single day in a given year, usually occurring 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.

Table 2.1 shows the recorded MDD and date of occurrence for each year. As the table shows, MDD fluctuated, with a slight downward trend.

The historical MDD to ADD peaking factor is a key parameter used to determine future MDD projections. The District's 2015 peaking factor of 2.18 is the most reliable data point.

Table 2.1 Historical Water Purchase

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Annual Purchase (MG)	1,520	1,493	1,324	1,634	1,333	1,316	1,302	1,433	1,375	1,487
Average Day Demand (mgd)	4.16	4.09	3.62	4.48	3.65	3.61	3.56	3.93	3.77	4.07
Maximum Day Demand (mgd)	10.20	9.81	8.27	10.42	8.79	6.87	8.90	7.69	8.19	8.86
Date of Maximum Day Demand	7/24	7/11	7/16	7/30	8/16	8/21	8/16	7/24	7/13	7/6
MDD/ADD Peaking Factor	2.45	2.40	2.28	2.33	2.41	1.90	2.50	1.96	2.17	2.18

Note:
(1) MG: Million Gallons

2.4.2 Historical Customer Accounts

The District's water customers are divided into the following five (5) categories:

- Single-family residential (SFR)
- Multi-family residential (MFR)
- Commercial and industrial
- Government and education
- Irrigation

The SFR category comprises 92 percent of the District's water customer accounts.

Table 2.2 summarizes the number of accounts in each customer category for 2006 through 2015. Accounts correlating with the District's top eight largest customers are tallied separately under the row "Large Consumers." All of these accounts are commercial entities.

To generate the total accounts by customer class tallies, shown in Table 2.2, the eight (8) large consumer accounts were subtracted from the number of commercial accounts. Historical consumption data for large consumers was separated to more accurately predict the quantity and location of future demand. Section 2.4.3.1 describes this concept in more detail. Figure 2.7 shows the locations of the District's largest users and shows which parcels within the RWSA are served by the District.

Table 2.2 shows the account by customer type data, which is also shown graphically in Figure 2.8. In this figure, the vertical axis for the number of SFR accounts is on the right because there are significantly more SFR accounts than other types. The number of water accounts has risen steadily over the last decade, at about 0.5 percent annually.

For each pressure zone, Table 2.3 tallies the number of accounts by customer type for 2015. Zones with the most customers are 570 Central and 510 West; zones with the most commercial customers are 260 West and 420 Central NW.

Table 2.2 Historical Customer Accounts

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Residential										
Single-family	12,328	12,462	12,507	12,532	12,568	12,589	12,610	12,670	12,786	12,872
Multi-family	274	274	278	279	279	279	279	279	279	280
Non-Residential										
Commercial and Industrial	473	474	480	480	485	490	488	490	492	492
Government and Education	39	39	39	40	40	40	41	43	47	47
Irrigation	219	226	234	235	239	239	242	252	257	267
Large Consumers	8	8	8	8	8	8	8	8	8	8
Total Accounts	**13,341**	**13,483**	**13,546**	**13,574**	**13,619**	**13,645**	**13,668**	**13,742**	**13,869**	**13,966**

Table 2.3 Accounts by Pressure Zone for Year 2015

Pressure Zone	Number of Accounts						Total Accounts
	SFR	MFR	Commercial	Government	Irrigation	Large Consumers	
260 West	527	84	305	9	94	5	1,024
305 West	0	35	0	0	2	0	37
350 Central	164	0	2	0	2	0	168
420 Central	1,790	0	12	10	16	0	1,828
420 Central (NE)	7	0	0	0	0	0	7
420 Central (NW)	887	31	117	6	44	3	1,088
420 Central (S)	608	0	2	0	8	0	618
420 West (S)	88	0	0	0	0	0	88
420 West (N)	128	0	0	1	2	0	131
460 East	138	0	0	0	6	0	144
485 East	160	0	0	0	0	0	160
510 West	2,529	130	30	11	34	0	2,734
570 Central	3,289	0	22	6	33	0	3,350
570 Central (E)	524	0	0	1	1	0	526
570 East	33	0	0	0	3	0	36
570 East (N/S)	644	0	0	2	13	0	659
585 Central	59	0	0	0	1	0	60
650 Central	496	0	1	0	3	0	500
670 East	778	0	1	1	5	0	785
770 East	23	0	0	0	0	0	23
Total Accounts	**12,872**	**280**	**492**	**47**	**267**	**8**	**13,966**

2.4.3 Historical Water Consumption

For 2006 to 2015, Table 2.4 shows the historical annual water consumption data categorized by customer class. Figure 2.9 also shows this data in a graph. The data were obtained from the District's billing records. Table 2.4 shows water consumption for each customer class. It also shows the consumption of large users, other authorized use that is estimated by the District, and distribution system leakage. These categories of water use are described in detail below.

2.4.3.1 Large Consumers

Consumption of the District's eight (8) largest consumers was evaluated apart from other customer categories and thus appears in a separate row in Table 2.4. The District's eight (8) largest consumers are all commercial accounts. Table 2.5 shows the historical consumption for these accounts between 2006 and 2015. For these customers, consumption is separated from the other commercial accounts to more precisely predict the magnitude and location of future demands. On average, consumption by the District's largest consumers accounts for four (4) percent of the total consumption. Figure 2.7 shows the locations of the District's large consumers.

2.4.3.2 Other Authorized Use

In addition to billing data, the District tracks some unmetered water use, shown as "Other Authorized Use" in Table 2.4. Other Authorized Use includes unmetered water used by the District for activities such as water main flushing, new water main construction flushing, fire flow testing, and maintenance. Although Other Authorized Use is not metered, the District tracks and estimates it based on flow and the duration of use.

Over the last decade, Other Authorized Use has accounted for approximately 0.5 percent of total consumption on average.

2.4.3.3 Distribution System Leakage

Distribution system leakage (DSL) is the total water purchased minus the total authorized consumption. This value includes both authorized metered consumption and the authorized, tracked, and estimated consumption for the Other Authorized Use category.

All water not authorized for consumption is considered DSL, which includes both apparent and real losses. Apparent losses include water theft, meter inaccuracies, and data collection errors. Real losses are physical losses from the distribution system, such as reservoir overflows, water main breaks, and water main leaks.

Table 2.4 shows total water production, total authorized consumption, and DSL between 2006 and 2015. As previously mentioned, the District is aware of meter inaccuracies before 2015. Thus, the 2015 DSL value of 4.2 percent most accurately reflects real losses.

Table 2.4 Historical Water Consumption

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Residential										
Single-family (mgd)	2.65	2.49	2.51	2.94	2.49	2.47	2.54	2.52	2.71	2.78
Multi-family (mgd)	0.33	0.33	0.32	0.33	0.33	0.35	0.35	0.35	0.35	0.34
Non-Residential										
Commercial and Ind. (mgd)	0.43	0.35	0.35	0.37	0.32	0.33	0.33	0.33	0.36	0.39
Government and Edu. (mgd)	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Irrigation (mgd)	0.17	0.15	0.12	0.18	0.13	0.14	0.13	0.14	0.15	0.21
Large Consumers (mgd)	0.14	0.18	0.15	0.16	0.16	0.17	0.15	0.14	0.14	0.15
Other Authorized Use (mgd)	0.00	0.01	0.00	0.04	0.01	0.02	0.02	0.07	0.02	0.01
Other Authorized Use (%)	0.0%	0.2%	0.0%	0.9%	0.3%	0.6%	0.6%	1.8%	0.5%	0.2%
Total Consumption (mgd)	3.74	3.53	3.48	4.05	3.46	3.50	3.54	3.57	3.75	3.90
Total Production (mgd)	4.16	4.09	3.62	4.48	3.65	3.61	3.56	3.93	3.77	4.07
Distribution System Leakage (mgd)	0.42	0.56	0.14	0.43	0.19	0.11	0.02	0.36	0.02	0.17
Distribution System Leakage (%)	10.1%	13.7%	3.9%	9.6%	5.2%	3.0%	0.6%	9.2%	0.5%	4.2%
3-year Rolling Average (%)			9.4%	9.3%	6.5%	6.2%	3.0%	4.4%	3.6%	4.7%

2.4.3.4 Equivalent Residential Units

An equivalent residential unit (ERU) is the amount of water consumed by a typical full-time single-family residence. The Washington Administrative Code (WAC) 246-290-010 defines an ERU to express water use by non-residential customers as a multiple of the demand of a typical SFR customer.

To calculate ADD water use per ERU, also called the "ERU value", the total annual volume of water consumed in the SFR customer class is divided by the total number of active SFR accounts. This value defines the average annual SFR water use per account. To determine the number of ERUs used by other customer classes, the volume of water used by other customer classes is divided by the ERU value.

Table 2.6 shows the average daily consumption per account for each customer class between 2006 and 2015. The table also shows the average daily consumption per account for each customer class. The average SFR daily consumption volume was 207 gallons. This means the District's ERU value is 207 gallons per day (gpd).

The last column in Table 2.6 shows the average number of ERUs per account for each customer category the District serves. The typical MFR account consumes 5.9 ERUs, while commercial and industrial accounts equal 3.5 ERUs on average. On average, government and education accounts use 2.8 ERUs per account, and irrigation accounts use 3.1.

2.4.3.5 Urban Versus Rural Water Consumption

The District has noticed that its urban SFR customers use less water than its rural SFR customers. To quantify this difference, the District looked at two (2) different data sets. First, 2013 and 2014 billing records of residents within Woodinville's and Kirkland's city limits were used to estimate urban SFR consumption. On average, Woodinville SFR customers consumed 170 gpd, while Kirkland residents consumed 155 gpd as shown in Table 2.7.

Secondly, for each pressure zone, consumption per single-family account between 2010 and 2015 was calculated. As Figure 2.10 shows, each pressure zone was then categorized as urban or rural. All zones with an average consumption rate above 170 gallons per day per Single-Family Residential (gpd/SFR) account were categorized as rural. Urban zones had an average consumption rate of 170 gpd/SFR account or less. The urban zones are located in the western portion of the District, generally overlapping where the Cities of Woodinville and Kirkland are located.

Based on these calculations and categories, urban average SFR consumption was 162 gpd, 0.8 times the District-wide ERU value of 207 gpd. Rural average SFR consumption was 221 gpd, 1.1 times the District-wide ERU value. This data is shown in Table 2.8.

Table 2.5 Historical Large Consumer Water Consumption (Thousands of gpd)

No.	Customer Name	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	Redhook Ale and Brewery	74.7	105.2	84.6	74.0	74.8	82.9	71.0	58.3	65.0	47.1
2	Stimson Lane Vineyards	24.7	21.0	20.0	23.1	19.1	21.2	22.6	18.9	21.7	24.2
3	Garden Fresh Foods	16.3	15.9	16.6	23.7	27.9	21.2	19.7	17.6	16.8	17.3
4	Cuizina Foods	2.1	6.6	7.2	15.0	10.0	10.1	10.9	11.9	11.8	15.8
5	Bio-Rad Laboratories	1.9	2.1	2.4	1.7	2.2	5.4	5.8	6.6	7.6	14.6
6	Haggen, Inc.	9.5	8.6	8.2	9.4	10.1	9.3	5.5	6.9	5.5	10.6
7	Rehook Ale and Brewery	8.4	9.6	7.7	6.6	7.1	7.1	6.8	5.6	6.4	10.3
8	Willows Lodge	7.3	6.5	6.9	6.4	7.5	9.4	8.4	9.5	9.5	9.2
Total		**144.9**	**175.5**	**153.6**	**159.9**	**158.7**	**166.6**	**150.7**	**135.3**	**144.3**	**149.1**

Note:
(1) Redhook Brewery no longer operates within the Woodinville RWSA.

Table 2.6 Historical Water Consumption per Account (gpd/account)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Ave	ERUs/ Account
Residential												
Single-family	215	200	201	235	198	196	201	199	212	216	207	1.0
Multi-family	1,204	1,204	1,151	1,183	1,183	1,254	1,254	1,254	1,254	1,214	1,216	5.9
Non-Residential												
Comm. and Ind.	909	738	729	771	660	673	676	673	732	793	735	3.6
Gov. and Edu.	513	513	769	750	500	500	488	465	426	426	535	2.6
Irrigation (mgd)	776	664	513	766	544	586	537	556	584	787	631	3.0
Large Users	17,500	22,500	18,750	20,000	20,000	21,250	18,750	17,500	17,500	18,750	19,250	93.0

Table 2.7 Woodinville and Kirkland Single-family Water Consumption

Year	2014	2015	Ave	ERUs/Account
City of Woodinville (gpd/SFR account)	171	169	170	0.8
City of Kirkland (gpd/SFR account)	157	153	155	0.7

Table 2.8 Urban Versus Rural Single-family Water Consumption

Year	2010	2011	2012	2013	2014	2015	Ave	ERUs / Account
Urban Pressure Zones (gpd/SFR account)	164	165	161	161	158	161	162	0.8
Rural Pressure Zones (gpd/SFR account)	212	210	220	216	230	237	221	1.1

2.5 Demographic Analysis

The Puget Sound Regional Council (PSRC) publishes household, employee, and population growth forecasts for jurisdictions within its regional boundary, which includes all of the District's jurisdictions.

A demographic analysis of the District's retail water service area was performed using data from the 2015 PSRC Land Use Vision (LUV) dataset, a policy-directed forecast dataset that reflects each municipality's planned growth within its urban growth boundaries. The 2015 dataset contained the most recent forecasts at the time the demographic analysis was performed.

PSRC uses geographic information systems (GIS) data to crop demographic data for any defined geographic area. Using GIS, PSRC provided customized demographic data for each of the District's pressure zones.

Appendix F includes the PSRC's household and employment projections for each pressure zone. Table 2.9 summarizes District-wide household and employment projections. PSRC 2010 data estimates that there are 2.7 people per household within the District's retail water service area.

Table 2.9 PSRC Land Use Vision Projections for the Woodinville Water District

	2010	2025	2030	2035	2040
Households	16,959	19,276	20,017	20,905	21,952
Employees	21,361	25,378	26,999	29,257	31,795

To predict the District's future water demand, residential and non-residential annual growth rates were calculated using the PSRC LUV household and employee forecasts, respectively. While developing demand projections, the District's existing number of water accounts was grown by the annual growth rates to predict the future number of water accounts in the 6-, 10-, and 20-year planning periods.

However, the District anticipates that the number of water accounts will not grow as quickly as the PRSC LUV growth rates indicate. Due to this, the District developed two (2) different growth scenarios: the PSRC LUV Growth Scenario and the Reduced Growth Scenario.

The growth rates for each pressure zone in the Reduced Growth Scenario are 25 percent less than the PSRC LUV growth rates. This was proposed by the District to account for its experience that actual growth within the RWSA in the past has been less than PSRC projected rates due to unforeseen factors such as land use restrictions and economic challenges. For both scenarios, annual growth rates are shown in Table 2.10.

Table 2.10 Annual Growth Rates for the Woodinville Water District

Pressure Zone	2010-2025	2025-2030	2030-2035	2035-2040	Overall 2010-2040
PSRC LUV Growth Scenario					
Household Growth	0.86%	0.76%	0.87%	0.98%	0.86%
Employee Growth	1.16%	1.25%	1.62%	1.68%	1.33%
Reduced Growth Scenario					
Household Growth	0.65%	0.57%	0.65%	0.74%	0.65%
Employee Growth	0.87%	0.94%	1.22%	1.26%	1.00%

To determine water account projections, the District's existing number of water accounts in each pressure zone was grown using each growth scenario. Table 2.2 lists the historical number of accounts for each customer type. Table 2.11 and Table 2.12 show the PSRC Growth Scenario and Reduced Growth Scenario account projections, respectively.

Figure 2.11 graphs the same data shown in Table 2.11 and 2.12. In this figure, SFR accounts are plotted on a secondary vertical axis on the right side of the chart because the District serves significantly more SFR customers than any other customer type.

These account projections are critical for estimating the District's future water demand. The PSRC Growth Scenario is one parameter used to calculate the high demand projections, and the Reduced Growth Scenario is used for the medium and low demand projections.

Table 2.11 Projected Number of Accounts – PSRC Growth Scenario

Year	2015	2023	2027	2037
Residential				
Single-family	12,872	13,749	14,184	15,255
Multi-family	280	301	311	351
Non-residential				
Commercial and Industrial	500	623	681	838
Government and Education	47	56	59	63
Irrigation	267	330	355	401
Total	**13,966**	**15,059**	**15,590**	**16,908**

Table 2.12 Projected Number of Accounts – Reduced Growth Scenario

Year	2015	2023	2027	2037
Residential				
Single-family	12,872	13,523	13,841	14,611
Multi-family	280	295	303	331
Non-residential				
Commercial and Industrial	500	590	631	735
Government and Education	47	54	56	58
Irrigation	267	313	331	361
Total	**13,966**	**14,775**	**15,162**	**16,096**

2.6 Water Demand Projections

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

This section summarizes the ADD and MDD projections developed for the District's water system from historical water demand trends and future demographic growth assumptions. Demand projections are presented as a range in demands that may be experienced in the future.

Low, medium, and high water demand projection scenarios were developed by adjusting various demand projection parameters. The medium demand projection scenario was used for the system analysis described in Section 5, which determined future pumping storage and distribution system deficiencies and identified potential improvements to achieve the District's established capacity criteria. The low and high projection scenarios give a sense of the possible range of future demands.

2.6.1 Demand Projection Methodology

For this analysis, the water demand projections were developed in the following steps, which are also summarized in Figure 2.12:

1. Grow historical water account numbers for each pressure zone, shown in Table 2.3, by the zone-specific residential and non-residential growth rates from the demographic analysis. Table 2.11 and Table 2.12 show the resulting account projections for the PSRC Growth Scenario and the Reduced Growth Scenario, respectively. For the high demand projection scenario, the PSRC Growth Scenario was used, while the Reduced Growth Scenario was used for the low and medium demand projection scenarios.
2. Convert account projections into ERU projections and then ADD projections using demand projection parameters derived from historical data consisting of the District's ERU value, urban and rural SFR scaling factors, Other Authorized Use, DSL, and large consumer demand.
3. Apply the MDD to ADD peaking factor to convert ADD to MDD.

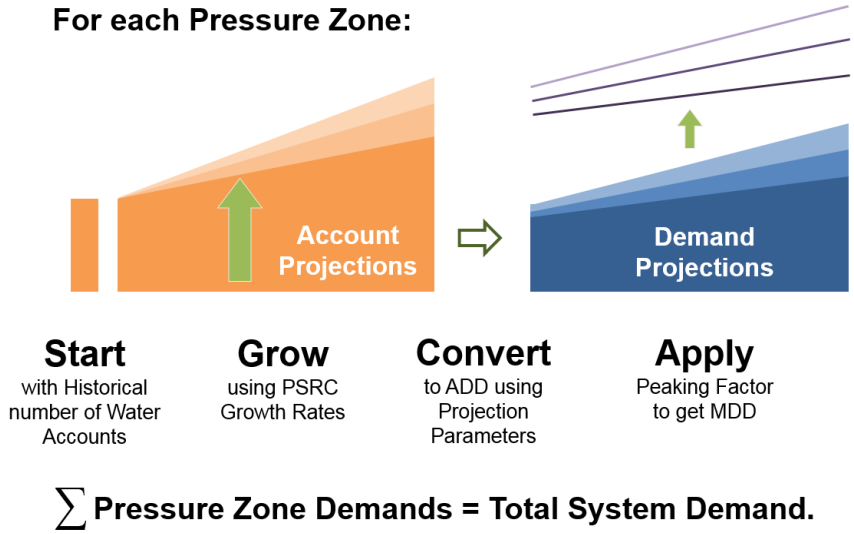

Figure 2.12 Demand Projection Methodology

2.6.2 Demand Projection Parameters

Numerous factors and assumptions affect the accuracy of projected future water demands. To project the District's future ADD and MDD, several parameters were used, which are listed in Table 2.13. These parameters include growth scenarios, ERU value, ERU annual reduction, urban and rural scaling factors, DSL percentage, Other Authorized Use, large consumer demand, and the MDD to ADD peaking factor.

For each demand projection parameter, low, medium, and high values were established for the future using historical data and assumptions. These parameters were then used to develop the low, medium, and high demand forecasts. For each parameter, Table 2.13 summarizes the values selected to develop the range of demand projections. They are also discussed in further detail in the following subsections.

Table 2.13 Demand Projection Parameters

Parameter	Low	Medium	High
Growth Scenario	**Reduced Growth Scenario**	**Reduced Growth Scenario**	**PSRC Growth Scenario**
ERU Value (gpd/ERU)	207	207	216
ERU Value Annual Reduction 2016-2027	1%	0.5%	None
ERU Value Annual Reduction 2028-2037	0.5%	0.25%	None
Urban SFR Scaling Factor	0.8	0.8	0.8
Rural SFR Scaling Factor	1.1	1.1	1.1
Large Consumer Demand (gpd)	114,600	153,900	218,600
DSL	5%	5%	10%
Other Authorized Use	0.2%	0.5%	1.8%
MDD/ADD Peaking Factor	2.00	2.18	2.26

2.6.2.1 Growth Rates

For the high demand projection scenario, the PSRC Growth Scenario was used to grow water accounts. The Reduced Growth Scenario was used to grow water accounts for the low and medium demand projection scenarios.

Table 2.11 and Table 2.12 show account projections for the PSRC Growth Scenario and Reduced Growth Scenario.

Figure 2.11 also shows these projections. ERU Value Historically, the District-wide ERU has been 207 gpd, as described in Section 2.4.3.4. The District anticipates that new customers will require less water than the historical average due to a range of factors including the smaller lots of new developments and water conservation. Thus, the low demand projection scenario includes an annual reduction in the ERU value (starting at 207 gpd) of one (1) percent for 2016 through 2026 and 0.5 percent for 2026 through 2037.

Similarly, the medium demand projection scenario includes an annual reduction in ERU value of 0.5 percent for 2016 through 2027 and 0.25 percent for 2028 through 2037. The high demand projection scenario uses an ERU value of 216 gpd with no reduction. This was the ERU value for the most recent year (2015) used in the analysis.

2.6.2.2 Urban and Rural Scaling Factors

Historical District billing records show that urban SFR customers use less water than rural SFR customers. Thus, to predict the water demand of the District's individual pressure zones more accurately, scaling factors were applied to the SFR demands.

An ERU scaling factor of 0.8 was applied to SFR demand in urban pressure zones, while a scaling factor of 1.1 was applied to SFR demands in rural pressure zones. The same scaling factors were used for all three (3) demand projection scenarios.

2.6.2.3 Distribution System Leakage

For DSL, the low and medium demand scenarios used five (5) percent of the total water purchase, corresponding to the 2015 calculated DSL value, which was the most reliable data point in the last decade. The high demand scenario used DOH's maximum acceptable DSL value of 10 percent.

2.6.2.4 Large Consumer Demand

Future demand for the District's large consumers was estimated from their historical demand. As recommended by District staff, for the high demand scenario, each consumer was assumed to use the same amount of water in the future as its highest demand year between 2006 and 2015. For the medium demand scenario, each large consumer was assumed to require its historical average consumption. For the low demand scenario, each consumer was assumed to use its minimum consumption from the past decade.

The data clearly show, however, that some companies ramped up their businesses in the last decade. As a result, future consumption for the low demand scenario was considered to be no less than 50 percent of their 2015 consumption.

2.6.2.5 Other Authorized Use

Historical records helped select future Other Authorized Use estimations. The low demand scenario used the historical 25th percentile value of 0.14 percent; the medium demand scenario used the historical average of 0.51 percent; and the high demand scenario used the historical maximum of 1.7 percent occurring in 2013.

2.6.2.6 MDD to ADD Peaking Factor

Based on historical data, the District decided that a peaking factor of 2.0 was the lowest it should plan for in the future for the low demand projection scenario. The 2015 peaking factor of 2.18 was used for the medium demand scenario, and the historical average peaking factor of 2.26 was used for the high demand scenario.

2.6.3 ERU Projections

When converting account projections to ADD projections, the first step is to convert the number of accounts into the number of ERUs. To calculate the projected number of ERUs for the RWSA, the projected number of accounts shown in Table 2.11 and Table 2.12 were multiplied by the number of ERUs per account shown in Table 2.13. Table 2.14 shows the ERU projections for the medium demand scenario.

Table 2.14 ERU Projections - Medium Demand Projection Scenario

Customer Category	2015	2023	2027	2037
SFR	12,912	13,545	13,853	14,567
MFR	1,652	1,743	1,787	1,954
Commercial and Industrial	1,771	2,094	2,241	2,615
Government and Education	122	139	145	151
Irrigation	801	939	992	1,082
Large Consumers	743	743	743	743
Total	**18,001**	**19,203**	**19,761**	**21,112**

2.6.4 Average and Maximum Day Demand Projections

To calculate the average day demand projections for each customer class, the ERU projections were multiplied by the ERU values unique to each demand projection scenario, as presented in Table 2.13. Non-revenue water consumption, including Other Authorized Use and DSL, was then added based on the low, medium, and high assumptions to establish total ADD projections. Finally, MDD projections were established by multiplying ADD projections by the appropriate MDD to ADD peaking factor for each demand projection scenario.

Table 2.15 shows ADD and MDD projections for the low, medium, and high demand projection scenarios. Projections are presented for 6-, 10-, and 20-year planning periods. Figure 2.13 shows a graph of District-wide demand projections.

The District's ADD was approximately 4.1 mgd in 2015. In 2037, it is estimated to be between 4 mgd and 5.5 mgd. The medium demand scenario predicts 4.3 mgd. In 2037, MDD is estimated to be between 8.1 mgd and 12.5 mgd. The medium demand scenario predicts 9.5 mgd in 2037.

Table 2.16 summarizes medium demand scenario projections according to their pressure zone. The demands shown in Table 2.16 are the basis for the water system capacity evaluation presented in Section 5.

Table 2.15 Demand Projections (mgd)

Customer Category	2015			2023			2027			2037		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
ADD												
SFR	2.67	2.67	2.79	2.59	2.69	2.97	2.54	2.70	3.06	2.54	2.77	3.28
MFR	0.34	0.34	0.36	0.36	0.36	0.38	0.37	0.37	0.40	0.40	0.40	0.45
Commercial & Industrial	0.37	0.37	0.38	0.43	0.43	0.48	0.46	0.46	0.52	0.54	0.54	0.65
Government & Education	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
Irrigation	0.17	0.17	0.17	0.19	0.19	0.21	0.21	0.21	0.23	0.22	0.22	0.26
Large Consumers	0.11	0.15	0.22	0.11	0.15	0.22	0.11	0.15	0.22	0.11	0.15	0.22
DSL & Authorized Use	0.20	0.22	0.53	0.20	0.22	0.58	0.20	0.23	0.60	0.21	0.24	0.65
Total ADD	**3.89**	**3.95**	**4.48**	**3.91**	**4.07**	**4.87**	**3.92**	**4.15**	**5.06**	**4.05**	**4.35**	**5.45**
MDD												
SFR	5.35	5.83	6.30	5.17	5.87	6.72	5.08	5.89	6.93	5.08	6.04	7.41
MFR	0.68	0.75	0.81	0.72	0.79	0.87	0.74	0.81	0.90	0.81	0.88	1.01
Commercial & industrial	0.73	0.80	0.86	0.87	0.94	1.08	0.93	1.01	1.18	1.08	1.18	1.46
Government & Education	0.05	0.06	0.06	0.06	0.06	0.07	0.06	0.07	0.08	0.06	0.07	0.08
Irrigation	0.33	0.36	0.39	0.39	0.42	0.48	0.41	0.45	0.52	0.45	0.49	0.59
Large Consumers	0.23	0.34	0.49	0.23	0.34	0.49	0.23	0.34	0.49	0.23	0.34	0.49
DSL & Authorized Use	0.40	0.47	1.19	0.41	0.49	1.30	0.41	0.50	1.35	0.42	0.52	1.48
Total MDD	**7.77**	**8.61**	**10.1**	**7.85**	**8.91**	**11.01**	**7.86**	**9.07**	**11.45**	**8.13**	**9.52**	**12.52**

Table 2.16 Summary of Demand Projections by Pressure Zone – Medium Demand Scenario (mgd)

Pressure Zone	2015		2023		2027		2037	
	ADD	MDD	ADD	MDD	ADD	MDD	ADD	MDD
260 West	0.64	1.39	0.71	1.55	0.75	1.61	0.87	1.90
305 West	0.05	0.10	0.05	0.10	0.05	0.10	0.05	0.11
420 West (N)	0.02	0.05	0.03	0.06	0.03	0.06	0.03	0.06
420 West (S)	0.02	0.03	0.01	0.03	0.01	0.03	0.01	0.03
510 West	0.66	1.45	0.68	1.48	0.68	1.49	0.73	1.58
350 Central	0.04	0.09	0.04	0.09	0.04	0.09	0.04	0.09
420 Central	0.46	1.00	0.45	0.99	0.45	0.98	0.44	0.97
420 Central (NW)	0.35	0.77	0.39	0.85	0.41	0.88	0.43	0.94
420 Central (NE)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
420 Central (S)	0.15	0.33	0.15	0.33	0.15	0.33	0.15	0.33
570 Central	0.83	1.82	0.87	1.89	0.88	1.91	0.91	1.98
570 Central (E)	0.13	0.28	0.13	0.27	0.12	0.27	0.12	0.26
585 Central	0.01	0.03	0.02	0.03	0.02	0.03	0.02	0.04
650 Central	0.12	0.27	0.13	0.27	0.13	0.27	0.13	0.28
460 East	0.04	0.08	0.04	0.08	0.04	0.08	0.04	0.08
485 East	0.04	0.08	0.04	0.08	0.04	0.08	0.04	0.08
570 East (N/S)	0.16	0.36	0.16	0.35	0.16	0.35	0.16	0.34
570 East	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.03
670 East	0.19	0.42	0.19	0.41	0.19	0.41	0.18	0.40
770 East	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.01
Total	**3.93**	**8.58**	**4.10**	**8.89**	**4.16**	**9.01**	**4.36**	**9.51**

Section 3

EXISTING WATER SYSTEM

3.1 Introduction

The undulating topography of the Woodinville Water District (District) necessitates a complex water system consisting of 20 individual pressure zones, eight (8) storage facilities, five (5) booster pump stations (PS), and 46 pressure reducing valve (PRV) stations within the 30 square miles of the District's retail water service area (RWSA). The District's pressure zones and water system facilities are shown on Figure 3.1.

Currently all water supply for the District is provided through a contract with Seattle Public Utilities (SPU). Out of the ten (10) active Tolt Taps, eight (8) Taps are along SPU's Tolt Pipeline Number 1 (TPL1) and two (2) are along the Tolt Eastside Supply Line (TESSL) supply the water system. One (1) additional tap is not active, does not have a meter, and is for emergency backup only (TT-123). Nine (9) emergency interties and one (1) emergency well remain on standby in case the SPU supply is ever interrupted or inadequate.

The hydraulic profile shown in Figure 3.2 through Figure 3.4 presents the details of how the various components of the water system work together to provide water service to every customer. Due to the complexity of the system, the hydraulic profile is split into West, Central, and East service areas.

This section of the Comprehensive Water System Plan (Plan) describes in detail each of the District's water system assets and presents a remaining useful life analysis of the District's water main. The results of this analysis indicate that between now and 2055 the District should prepare to replace approximately 4,400 linear feet (LF) of water main annually and will need to replace water main at an increased rate starting around 2075.

3.1.1 Updates to the Water System since the 2008 Water System Plan

Many updates have been made to the water system since the 2008 Water System Plan. Most of the capital improvement projects (CIP) from the last Plan have been implemented. A number of other improvements that have occurred include: security and lighting upgrades at all reservoir sites and main campuses including: cameras, intrusion alarms, access codes/card access, roads, and lighting.

3.1.1.1 Supply Improvements

The District brought Tolt Tap 195 online, acquired a permit for its emergency well, and acquired the Weyerhaeuser water right as a member of the Snohomish River Regional Water Authority (SRRWA).

3.1.1.2 Booster Pumping Improvements

The Kingsgate Booster PS construction was completed in 2017. The Ringhill East PS also underwent upgrades including pump replacement. Hollywood Pump Station upgrades are included in the current CIP and are scheduled for the short-term.

3.1.1.3 Storage Improvements

Since the last Plan update, the Kingsgate Reservoir and South Hollywood Reservoir underwent seismic upgrades.

3.1.1.4 Meter Replacement

The District deployed advanced metering infrastructure (AMI), replacing all customer meters.

3.1.1.5 Pipeline Repair and Replacement

The District's pipeline repair and replacement priority is to replace asbestos cement (AC) mains. The District's AC main replacement program began in 2008 with the hire of a Senior Project Engineer to focus on AC main replacement. The District's goal was to replace 5,000 to 7,000 LF of AC main each year until all AC main had been eliminated from the distribution system. Over the last decade from 2008 to 2017, 57,000 LF of AC main has been replaced, equaling approximately 5,700 LF per year.

3.1.1.6 Water Quality

The District added new sample stations for water quality monitoring.

3.1.1.7 Design Standards Update

The District updated its design standards and developed a new developer extension policy. Developers are now required to pig and flush new mains.

3.2 Sources of Water Supply

The District currently purchases its entire water supply from the SPU Tolt River Supply through ten (10) active metered Tolt Taps, whose characteristics are summarized in Table 3.1, as well as one (1) emergency backup tap (TT-123) that is not metered by the District (SPU does have an old meter of uncertain accuracy on this tap). As shown in Table 3.2, nine (9) emergency interties exist with neighboring water districts including five (5) with the City of Bothell, one (1) with the Cross Valley Water District, two (2) with the City of Redmond, and one (1) with the Northshore Utility District (NUD). The District also owns a surface water right as a member of the SRRWA for future water supply. For emergencies, the District has two (2) wells. Both were drilled in 1990, but only Well 1 currently has a pump.

3.2.1 Seattle Public Utilities

The majority of water purchased from SPU comes from the TPL1 that bisects the District from east to west. Eight (8) Tolt Taps are located along the TPL1 and two (2) taps are located on the TESSL, which runs north and south along the east side of Lake Washington and connects with the TPL1 at approximately NE 149th Street and 132nd Avenue NE. The TESSL links the Tolt River Supply with the SPU Cedar River Supply. The ten (10) taps feed their respective pressure zones through PRV stations, booster pump stations, and storage reservoirs. The Tolt Taps are metered on both the SPU and District side. Figure 3.1 shows the Tolt pipelines (TPL1 and TESSL) in brown and the Tolt Taps as yellow triangles. Table 3.1 provides pertinent information about each of the District's ten (10) active Tolt Tap facilities and its emergency backup tap. The available flow through each intertie is based on the District's November 30, 2004 Full Requirements Contract with SPU.

SPU has a contractual obligation to provide water supply up to the maximum flow rates and at the minimum hydraulic gradients specified in Table 3.1, except in emergencies.

During high head conditions in the SPU TPL1 - typically during the winter months - a few of the taps have adequate hydraulic head to convey water to higher pressure zones without pumping, conserving energy and providing a time frame for annual pump station maintenance. All source of supply facilities (pump stations and underground vaults) are equipped with intrusion alarms and other necessary security measures.

3.2.2 Groundwater

The District currently owns and maintains two (2) emergency standby wells located in close proximity to the District's Woodinville office properties. The purpose of these wells is to provide the District and its customers with an alternate source of water in the event that a natural disaster, such as an earthquake or other unforeseen event, disrupts the District's ability to receive safe and reliable water from SPU. Well 1 has a pumping capacity of 130 gpm. Well 2 does not yet have a pump installed, but will have a reliable pumping capacity of 500 gpm. The District has applied for a water right permit for an emergency water right of 500 gpm (Qi) and 84 acre-feet per year (Qa) that can be used at either well. A preliminary permit was issued April 21, 2014. Development of Well 2 must be completed by Aug 31, 2021.

As an emergency standby source, the District would utilize these wells only when necessary to address public health and safety emergencies arising within District boundaries. Analysis of the well's water quality indicates that the water is acceptable for use as a public water supply in times of emergency. When receiving the water, consumers will be given instructions to purify the water by boiling or adding bleach. The District performs periodic water quality tests on the emergency standby well to ensure that the water quality will meet acceptable standards in the case of an emergency.

Table 3.1 Tolt Taps

Tolt Tap No.	Minimum HGL (ft)	Available Flow	Meter Size and Type(1)	Primary Pressure Zones Served	Primary Function
TT-53	590	690	10 - M	570 Central, 650 Central, 585 Central	Fill Wellington Reservoir
TT-57	595	1,870	8 - M	570 Central	Fill South Hollywood Reservoir
TT-76	570		6 - M	510 West	Backup
TT-77	570		6 - M	510 West	Backup
TT-78	615	1,080	8 - M	670 East, 570 East (N/S)	Feed Ringhill PS
TT-79	600	180	12 - M	570 Central (E), 420 Central	Supply 570 Central (E)
TT-80	590	610	8 - M	650 Central, 585 Central	Fill Hollywood Reservoir and Feed Hollywood PS
TT-125	595	1,230	6 - M	420 Central	Fill Brookside Reservoir
TT-167	570	1,840	8 - P	260 West	Fill Sammamish Reservoir
TT-195	560	1,770	8 - M	510 West	Fill Kingsgate Reservoir
TT-123	570				Emergency Backup

Notes:
(1) "M" stands for magnetic flow meter, "P" stands for propeller-type flow meter.

3.2.3 Snohomish River Regional Water Authority

The Snohomish River Regional Water Authority (SRRWA) is a joint administrative entity comprised of the Northshore Utility district, the City of Everett, and the Woodinville Water District that was formed in 1996. The SRRWA's purpose is to promote regional cooperation in the planning and development of new water sources.

The SRRWA acquired the Weyerhaeuser Timber Company Surface Water Rights S1-10617C in November 1996. This certificated water right authorizes an instantaneous withdrawal of 36 million gallons per day (mgd)/56 cubic feet per second (cfs) from the Snohomish River for manufacturing purposes. The SRRWA interlocal agreement allocates to the District approximately 11 mgd instantaneous flow and 6.6 mgd average annual flow. The water quality of the Snohomish River requires treatment before it can be used for municipal purposes. Supply and treatment facilities for municipal use have not yet been developed.

On December 23, 1996, the SRRWA submitted to Ecology a Plan of Use and application to change the place of use and purpose of the Weyerhaeuser water right to the "area served by the SRRWA" and "municipal purposes". In 2001 the change application was approved by Ecology in a Report of Examination (ROE) that described the project's environmental affects, associated mitigation measures, and a 50-year development schedule. The ROE authorized an instantaneous quantity (Qi) of 36 mgd and an annual quantity (Qa) of 24.3 mgd.

The application for change was appealed by the Tulalip Tribes (Tribes) to the Pollution Control Hearings Board (PCHB) in 2001, shortly after it was approved by Ecology. In April 2002, the PCHB upheld Ecology's approval of the SRRWA change, but reduced the annual quantity cited in the ROE from 24.3 mgd to 23.7 mgd. The Tribes appealed the PCHB decision in 2002 to the Thurston County Superior Court. The court affirmed the PCHB decision in full and no further appeal has been made by the Tribes. Ecology filed a Superseding Certificate of Water Right for the SRRWA's Weyerhaeuser water right in December 2014 that denotes the purpose as municipal and the place of use as the service areas of the Snohomish Regional Water Authority.

3.2.4 Emergency Interties

The District has nine (9) emergency interties with adjacent utilities; five (5) with the City of Bothell, one (1) with the Cross Valley Water District, one (1) with the Northshore Utility District, and two (2) with the City of Redmond.

Four (4) of the interties with the City of Bothell are manually opened and closed using in-line valves during emergency situations. One (1) of the interties with the City of Bothell is controlled by a PRV with bidirectional metering between the two (2) jurisdictions. Historically these interties have provided water to the District under high demand periods such as fire events.

The NUD emergency intertie consists of a 10-inch diameter main downstream of PRV Station 19 that reduces pressure from the NUD system to the District's system. The connection is metered and rarely used. The PRV 19 setting requires a very large, unusual drop in system pressure in the 510 West Pressure Zone in order to open.

Two (2) interties with Redmond were installed in 2004 and have never been used in an emergency. These interties have bidirectional meters that record flows moving in either direction. The Cross Valley #1 intertie is a manually close in-line valve that was formerly used to serve Spectrum Glass before it began being served by the Cross Valley Water District.

Table 3.2 Emergency Interties

Intertie	From	Pressure Zone Served	Intertie Type
Bothell #1	Bothell	260 West	Closed Valve
Bothell #2	Bothell	260 West	Closed Valve
Bothell #3	Bothell	260 West	Closed Valve
Bothell #4	Bothell	260 West	Closed Valve
Woodin Elementary Intertie	Bothell	420 Central (NW)	Metered On Demand
Cross Valley #1	Cross Valley	420 Central (NW)	Closed Valve
NUD Intertie	NUD	510 West	Bi-directional PRV
232nd Vault Intertie	Redmond	570 East	Metered On Demand
133rd Vault Intertie	Redmond	670 East	Metered On Demand

3.3 Pressure Zones

The District's distribution system is divided into 20 distinct pressure zones at 12 different hydraulic grade lines (HGL), meaning that in some cases there are multiple isolated pressure zones at the same HGL. This is due to the undulating topography of the service area and the rural setting having significant undeveloped areas. The District serves customers at elevations ranging from approximately 20 feet to 625 feet.

For the purpose of naming the pressure zones and for system analysis, the distribution system is divided into three (3) service areas: West, Central, and East. The pressure zones are named by HGL, service area, and in the case of pressures zones in the same service area with the same HGL, its location within the service area in parenthesis. For example Zone 420 Central (NE) is a pressure zone with an HGL of 420 in the northeast corner of the Central service area.

Table 3.3 lists each of the pressure zones and identifies the primary source of water for each pressure zone, whether it is a Tolt Tap, a PRV from another zone, or a pump station from another zone.

Table 3.3 Pressure Zones

Pressure Zone	HGL (ft)	Primary Water Source
260 West	260	TT-167 - PRV 43
305 West	305	510 West - PRV 44
350 Central	350	420 Central - PRVs 32 and 38
420 Central	420	TT-125
420 Central (NE)	420	570 Central (E) - PRV 21
420 Central (NW)	420	570 Central - PRVs 8, 13, 24, and 27
420 Central (S)	420	570 Central - PRVs 29, 31, 23, and 22
420 West	420	510 West - PRV 36
420 West (N)	420	510 West - PRV 2
460 East	460	570 East (N/S) - PRV 45
485 East	485	570 East (N/S) - PRV 10
510 West	510	TT-195
570 Central	570	TT-53 - PRVs 33 and 35 TT-57 TT-80
570 Central (E)	570	TT-79 - PRV 41
570 East	570	670 East - PRV 42
570 East (N/S)	570	TT-78 - PRV 25, PRVs 9 and 39
585 Central	585	TT-80 - PRV 7
650 Central	650	TT-80, Hollywood PS
670 East	670	TT-78 - Ringhill PS
770 East	770	670 East - Ringhill East PS

Note:
(1) TT: Tolt Tap

3.4 Storage Facilities

The District's eight (8) storage facilities have a combined capacity of 14.9 million gallons (MG). All of the storage reservoirs are above ground, cylindrical, and made of steel. The reservoirs range in size from 1.1 MG to 2.8 MG. Each of their capacities is listed in Table 3.4. Many of them are fed directly from a Tolt Tap including the Hollywood Reservoir, South Hollywood Reservoir, Brookside Reservoir, Kingsgate Reservoir, and Sammamish Reservoir. Three of the reservoirs have PS located at the reservoir site including Hollywood Reservoir, South Hollywood Reservoir, and Kingsgate Reservoir.

The construction dates of the reservoirs range from 1972 to 1998. The District maintains the exterior coatings and cathodic protection of its reservoirs and has remodeled many of them for seismic protection as necessary.

Seven of the eight (8) reservoirs are controlled by altitude valves located in underground vaults near the respective reservoir. The Aspenwood Reservoir on the other hand is controlled by the Ringhill PS. All reservoirs have duplicate sources of supply - either directly or indirectly.

Seven of the District's eight (8) reservoirs have been equipped with seismic valve protection packages. Five of the reservoirs, including Hollywood, Wellington, Sammamish, Aspenwood, and the James Bard Memorial Reservoir, were equipped with seismic valve protection packages in 2006. The Brookside Reservoir is the only District reservoir without seismic protection because the current vault is too small.

The District leases a portion of the Wellington Reservoir site for telecommunications equipment.

3.5 Pump Stations

The District has five (5) pump stations. They consist of Ringhill East, Ringhill, South Hollywood, Hollywood, and Kingsgate. Table 3.5 summarizes the characteristics of each of the five (5) pumping facilities. All of the facilities have full back up power provided by onsite diesel generators with automatic transfer switches.

The Kingsgate PS is the District's newest. It was constructed in 2016 on the site of the Kingsgate Reservoir. The Kingsgate PS boosts water from the 100-foot tall Kingsgate Reservoir to the 510 West Pressure Zone in order to utilize the dead storage in the bottom of the tank. The pump station consists of two 500 gpm jockey pumps and three 2,500 gpm fire pumps.

The District constructed the South Hollywood Pump Station in 2004 to make better use of the adjacent South Hollywood Reservoir, an 88-foot-tall steel standpipe. Like the Kingsgate PS, the South Hollywood PS's three (3) fire pumps free up low elevation storage for use during emergencies. It also contains one 300-gpm jockey pump.

The Hollywood Pump Station is located adjacent to the Hollywood Reservoir and is fed by the reservoir to provide supply to the 650 Central Pressure Zone. It contains a 400-gpm jockey pump and two 800-gpm fire pumps. The Hollywood Pump Station generator was replaced in 2007.

Zone 770 East is the only closed pressure zone in the District's distribution system. It is supplied by the Ringhill East PS, which pumps from the 670 East Pressure Zone. The PS contains one (1) fire pump and two (2) jockey pumps that charge two 200 gallon-capacity hydropneumatic storage tanks. The Rignhill East PS is currently under design to replace its pumps, control package, pumping manifold, and piping within the station. Its existing pumps will be replaced with two 90-gpm domestic pumps and a 1,000-gpm fire pump.

The purpose of the Ringhill PS is to boost water from Tolt Tap 78 into the 670 East Pressure Zone to fill the James Bard Memorial Reservoir, the Aspenwood Reservoir located at the north end of the pressure zone, and keep pressures adequate at the north boundary of the District's service area. 2013 upgrades to the Ringhill PS consisted of replacing existing roll seals with Cla-Val PRVs and replacing the existing magnetic flow meters.

Table 3.4 Storage Facilities

Reservoir	Capacity (MG)	Overflow Elevation (ft)	Diameter (ft)	Height (ft)	Year Constructed	Primary Pressure Zone Served	Notes
Aspenwood	1.1	670	40	116.5	1998	670 East	Ringhill Pump Station fills and controls reservoir.
Brookside	2.5	420	154	18	1979	420 Central	
Hollywood	2.4	570	125	27	1978	650 Central	Gravity inlet, pumped outlet.
James Bard Memorial	1.8	575	125	20	1993	570 East (N/S)	
Kingsgate	1.13	510	44	100	1972	510 West	
Sammamish	2.8	300	115	34.5	1991	260 West	
South Hollywood	1.74	579	58	88	1985	570 Central	Gravity inlet, gravity, or pumped outlet.
Wellington	1.4	570	56	78	1977	570 Central	Telecomm equipment leased on-site. Two test wells onsite.
Total Storage Capacity	**14.87**						

Table 3.5 Pumping Facilities

Pump Station	Year Constructed	Pumping From	Pumping To	Number of Pumps	Pump Number	Pump Capacity (gpm)	Year Pump Installed	Standby Power Type
Ringhill East[(1)]	1997	670 East	770 East	3	1	95	2018	Diesel Generator
					2	95	2018	
					3	1,100	2018	
Ringhill	1988	TT-78	670 East	3	1	695	1988	Diesel Generator
					2	695	1988	
					3	695	1988	
South Hollywood	2004	South Hollywood Reservoir	570 Central	4	1	300	2004	Diesel Generator
					2	1,250	2004	
					3	1,250	2004	
					4	1,250	2004	
Hollywood	1978	Hollywood Reservoir	650 Central	3	1	400	2005	Diesel Generator
					2	800	1998	
					3	800	1998	
Kingsgate	2016	Kingsgate Reservoir	510 West	5	1	500	2016	Diesel Generator
					2	500	2016	
					3	2,500	2016	
					4	2,500	2016	
					5	2,500	2016	

Note:
(1) The pump station capacities for the Ringhill East Pump Station were used for the system analysis, which resulted in the recommendation for a Ringhill East PS CIP project in 2018.

3.6 Pressure Reducing Valves

Most of the District's pressure zones are supplied by PRV stations. The distribution system has 46 PRVs whose characteristics are summarized in Table 3.6.

Table 3.6 Pressure Reducing Valve Stations

PRV No.	Supplying Pressure Zone	Receiving Pressure Zone	Valve Size (inches)	Valve Setting (psi)	Notes
1	TT-76	510 West	6 3	72.0 77.0	
2	510 West	420 West (N)	6 3	45.0 51.0	Sole source of supply to 420 West (N).
3	420 West (N)	260 West	6 3	28.0 34.0	
4	420 Central (NW)	260 West	6 3	28.0 34.0	
5	650 Central	570 Central	6 3	43.0 47.0	
6	650 Central	570 Central	6 4	21.0 26.0	PRV was rebuilt and moved north in 2015.
7	TT-80	585 Central	6 3	63.0 68.0	Sole source of supply to 585 Central.
8	570 Central	420 Central (NW)	6 3	39.0 44.0	
9	670 East	570 East (N/S)	6 3	48.0 53.0	
10	570 East (N/S)	485 East	6 3	59.0 65.0	Sole source of supply to 485 East.
11	TT-79	570 Central, 420 Central	12	227	Currently not pressure reducing.
12	570 Central	420 Central	6 3	60.0 65.0	Relocated in 2011 changing the 570 Central Zone boundaries and settings.
13	570 Central	420 Central (NW)	8 4	48.0 53.0	
14	420 Central (NW)	260 West	8 4	30.0 35.0	
15	570 Central	420 Central	8 4	47.0 530	
16	TT-77	510 West	6 3	47.0 50.0	
17	420 Central (NW)	260 West	6 3	46.0 51.0	

Table 3.6 Pressure Reducing Valve Stations (continued)

PRV No.	Supplying Pressure Zone	Receiving Pressure Zone	Valve Size (inches)	Valve Setting (psi)	Notes
18	420 Central (NW)	260 West	6 3	22.0 22.0	
19	NUD	510 West	8	53.0	Emergency NUD Intertie.
20	-	-	-	-	Abandoned
21	570 Central (E)	420 Central (NE)	6 3 1	50.0 55.0 60.0	Sole source of supply for 420 Central (NE).
22	570 Central	420 Central (S)	6 3	31.0 37.0	
23	570 Central	420 Central (S)	6 3	31.0 37.0	
24	570 Central	420 Central (NW)	6 3	46.0 51.0	
25	TT-78	570 East (N/S)	8 3	48.0 53.0	
26	650 Central TT-53	570 Central	6 4 3	39.0 45.0 45.0	Has a 6 inch and 4 inch PRV fed from the 650 Zone and a 3 inch PRV fed from TT-53.
27	570 Central	420 Central (NW)	6	35.0	
28	420 Central (NW)	260 West	6 3	35.0 40.0	
29	570 Central	420 Central (S)	6 3	37.0 41.0	
30	570 East (N/S)	420 Central	6 3	35.0 39.0	
31	570 Central	420 Central (S)	6 3	21.0 25.0	
32	420 Central	350 Central	6 3	72.0 76.0	
33	TT-53	570 Central	6 3	53.0 58.0	
34	TT-53	650 Central	6	60.0	Provides fire flow for 650 Central.
35	TT-53	570 Central 650 Central	6 4 3	78.0 83.0 83.0	
36	510 West	420 West	6 3	62.0 67.0	Sole source of supply for 420 West.
37	485 East	420 Central	6 3	82.0 86.0	

Table 3.6 Pressure Reducing Valve Stations (continued)

PRV No.	Supplying Pressure Zone	Receiving Pressure Zone	Valve Size (inches)	Valve Setting (psi)	Notes
38	420 Central	350 central	6 3	85.0 89.0	
39	670 East	570 East (N/S)	8 3	50.0 54.0	
40	TT-79	420 Central	6 3	56.0 59.0	
41	TT-79	570 Central (E)	12 4	35.0 38.0	
42	670 East	570 East	6 3	42.0 45 (56)	Sole source of supply for 570 East.
43	Sammamish Reservoir	260 West	10 4	9.0 5.0	
44	510 West	305 West	6 4	45.0 60.0	Sole source of water for 305 West.
45	570 East (N/S)	460 East	6 3	50.0 55.0	Sole source of water for 460 East.
49	TT-167	Sammamish Reservoir	8	5.0	

Note:
(1) psi: pounds per square inch.

3.7 Distribution System

The District's distribution system consists of approximately 300 miles of water main ranging in size from 2 to 18 inches in diameter (Table 3.7). The water main network is relatively new. The oldest pipes are AC constructed in the 1960s with a majority of the water mains constructed of cast iron and ductile iron in the 1970s and 1980s. Currently, the District constructs primarily ductile iron water mains, which comprise nearly 85 percent of the distribution system. Cast iron pipe comprises 5 percent of the water system, and despite the District's active program to replace AC pipe, it consists of about 10 percent of the system. The material of water main throughout the distribution system is identified on Figure 3.5. The decade of installation for each pipe segment is shown on Figure 3.6.

AC water main replacement is an ongoing project of the District. Since the last Comprehensive Water System Plan update in 2008, the District has replaced over 57,000 LF of AC water main with ductile iron pipe. A vast majority of the District's AC water mains were installed in the 1960s. The District aims to replace these AC water mains by 2040.

Table 3.7 Linear Feet of Pipe by Diameter and Material

	Material							
Diameter	HDPE	Ductile Iron	Asbestos Cement	Cast Iron	PVC	Unknown	Total	%
Unknown	0	40	0	0	0	2,560	2,600	0.2%
< 3-inch	0	580	0	340	0	0	920	0.1%
4-inch	0	62,530	4,660	8,300	0	90	75,580	4.8%
6-inch	0	34,100	73,270	17,610	0	870	125,850	8.1%
8-inch	1,060	940,390	67,380	46,110	1,650	1,340	1,057,930	67.7%
10-inch	560	58,900	7,670	12,270	0	1,170	80,570	5.2%
12-inch	0	173,580	4,010	190	330	0	178,110	11.4%
16-inch	0	38,490	0	0	0	0	38,492	2.5%
18-inch	0	2,300	0	0	0	0	2,302	0.1%
Total	**1,620**	**1,310,870**	**156,990**	**84,820**	**1,980**	**3,470**	**1,562,350**	**100%**
%	**0.1%**	**83.9%**	**10.0%**	**5.4%**	**0.1%**	**0.2%**	**100%**	

Note:
(1) HDPE: High-Density Polythylene PVC: Polyvinyl Chloride.

3.7.1 Water Main Remaining Useful Life

The District maintains thorough asset records that include pipe material, length, and installation year for over 99 percent of the water main in the District's distribution system. Using this data along with the District's pipe useful life assumptions shown in Table 3.8, the remaining useful life of the District's existing water main was estimated to help the District prepare a long-term pipeline replacement strategy.

Table 3.8 Water Main Useful Life Assumptions

Pipe Material	Original Useful Life Assumption (yrs)
Asbestos Cement (AC)	70
Cast Iron Pipe	75
Ductile Iron Pipe	100
HDPE	100
PVC	60
Unknown	60

The length of time that a pipe is anticipated to remain functional after installation is called the useful life. Useful life depends largely on the pipe material, but can also depend on soil conditions, water constituents, and installation. Theoretically, when a pipe is in service beyond its useful life, the increasing costs of maintenance associated with a failing pipe justify replacement. While pipe age and material were the only factors used for this remaining useful life analysis, it provides a foundation for long-range planning.

In Table 3.9, the LF of water main in the District's system is organized by material and installation decade. The cells of this table are color-coded to show the replacement timeline for each category of pipe. For example, the red cells indicate the linear feet of pipe that will reach the end of their useful life within the 20-year planning period of this Plan, or by 2037. Orange cells indicate pipe that will not need to be replaced until after the 20-year planning period.

According to Table 3.9, within the 20-year planning period the District should prepare to replace approximately 77,000 feet of pipe that will reach the end of its useful life. All of this pipe is asbestos cement along with 20 feet of pipe of unknown material. To accomplish this, the District will need to replace an average of approximately 3,800 LF of pipe per year for 20 years.

Figure 3.7 shows how many feet of water main will reach the end of its useful life during each 5-year replacement period for the next 100 years. The chart shows that a small portion (14 percent) of the system's water main will reach the end of its useful life by 2055. A majority of the mains in the system will not need to be replaced until after 2075. Based on the pipe material useful life assumptions of Table 3.8, between 2075 through 2120, on average nearly 30,000 LF of water main will reach the end of its useful life annually.

It is recommended that the District conduct a conditional assessment program to analyze pipe that may be reaching the end of its useful life based on age. Figure 3.8 color codes the District's water main by replacement period to help the District locate water main whose condition should be assessed during the 20-year planning period. Only sections of pipe found to be in poor condition need to be replaced. The District prioritizes replacement of asbestos cement pipe.

Table 3.9 Linear Feet of Pipe by Material and Installation Decade

	Installation Decade								
Material	1960-1967	1968-1977	1978-1987	1988-1997	1998-2007	2008-2017	Unknown	Total	Percent
Ductile Iron	0	86,020	545,060	407,750	186,390	103,510	4,520	1,333,250	85.4%
HDPE	0	0	0	0	1,460	160	0	1,620	0.1%
Cast Iron	520	75,120	3,680	160	0	20	1,040	80,540	5.2%
Asbestos Cement	76,600	66,290	0	0	0	0	120	143,010	9.2%
PVC	0	0	0	1,990	0	0	0	1,990	0.1%
Unknown	20	0	20	0	1,080	0	150	1,270	0.1%
Total	77,140	227,430	548,760	409,900	188,930	103,690	5,830	1,561,680	100.1%
Percent	4.9%	14.6%	35.1%	26.2%	12.1%	6.6%	0.4%	100%	0.0%
LEGEND End of Useful Life Timeline	2017-2027	2028-2037	Beyond 2037	Unknown					

Section 4

POLICIES AND CRITERIA

4.1 Introduction

This section summarizes the policies and criteria that govern the operation and expansion of the Woodinville Water District's (District) water system. The District's policies are presented in four (4) categories:

1. Service Area Policies. Policies pertaining to the District's duty to serve within its retail water service area (RWSA), and the extension of the distribution system to serve new customers.
2. Performance Criteria. These criteria set a minimum standard for the performance of the District's existing system. Section 5 describes the evaluation of the existing system's ability to meet the performance criteria. Operational changes or capital improvements may be required to meet the District's performance criteria.
3. Design Criteria. These criteria set a minimum standard for the design of new facilities within the water system. All new facilities must also meet the District's performance criteria.
4. Rules and Regulations. This section summarizes federal, state, county, and city regulations that govern the District's operation of its water system.

4.2 Service Area Policies

The District's service area policies have been carefully crafted to help the District achieve the goals mentioned in Section 1. The purpose of these policies is to ensure that the District's customer base understands their rights as they apply to the use or obtainment of water services within the District.

4.2.1 Duty to Serve

Pursuant to Revised Code of Washington (RCW) 43.20.260, the District is committed to providing retail water service to all property within its defined RWSA when 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 supply quantity to provide water 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.

The owners of properties that may directly connect to the District's existing water system without the need for the extension of that system should be able to obtain water service within 120 days after the District receives an application for a water meter and the property owner requesting water service has complied with all applicable District water service policies and procedures and has paid all applicable connection charges.

The District defines "reasonable" retail water service as follows:

- Water service that is consistent with applicable local land use plans and development regulations;
- The conditions of water service and associated fees, costs and charges are consistent with the conditions of service described in this Plan and applicable adopted District resolutions, policies and procedures; and
- The conditions of service and associated fees, costs and charges are consistent with the District's requirements applied to other property owners requesting water service who are similarly situated and are requesting the same type or level of water service from the District.

As discussed in Section 5 of this Plan, the District has sufficient supply quantity and water system capacity to provide retail water service within its service area for the 20-year planning period.

4.2.2 Emergency Service

Resolution No. 2333 (January 18, 1988) defines the conditions under which an emergency service connection can be provided for a resident located within District boundaries. This connection is intended only for a single family residence served by an individual well in which the groundwater supply is contaminated and poses a threat to the health and safety of the residency. Emergency service will only be provided following demonstration of a health hazard from the contaminated groundwater supply. The emergency service connection is a temporary connection to the District's water system until permanent water facilities are extended to the property requesting service.

4.2.3 Annexations

The District's policy is to only serve properties located within the District's corporate boundary. Annexation is the procedure for expanding the District's service area to include additional connections not currently within the District boundary, except in the case of interlocal agreements with the cities of Kirkland, Redmond, and Bothell, Northshore Utility District and Cross Valley Water District. Territory adjacent to the District that is within the District's retail water service area may be annexed, except if it is already part of another service area as defined by the East King County Coordinated Water System Plan (EKC CWSP).

4.2.4 System Extensions

Anyone seeking to connect to the existing water system is required to install improvements to assure orderly development of the utility system. These improvements must comply with the requirements for water quantity and pressure established by the District and with fire protection requirements contained in the District standards and/or King County Ordinance No. 5828 (or latest edition). Water main extensions must extend to and through the extremes of the property being developed, unless specifically waived by the District due to physical constraints, or other site limitations. Each building lot must have frontage on a permanent water main.

Under Woodinville Water District Resolution No. 3028, the developer will extend the existing public system through or adjacent to developer's property when necessary to meet existing district standards and comprehensive plan requirements or whatever offsite improvements are necessary to serve developer's property. Whenever an extension is prerequisite to further extension or may connect to existing district facilities for the purpose of looping or establishing a grid, the developer shall construct the extension to the end of the developer's property or as otherwise necessary to connect to existing facilities, future facilities, or anticipated facilities.

An extension to the District water system is required under the following conditions:

- Where the subject property, under existing conditions, is unable to comply with fire protection requirements established by the District or other applicable fire protection requirements.
- When an existing water main is a material type no longer accepted by the District, (i.e. Asbestos Cement (AC) or Cast Iron).
- When an existing water main is unable to adequately serve the property being developed and meet the District flow and pressure standards.
- When the property to be served will connect to a water main that is scheduled for upgrading as specified in the adopted Water Comprehensive Plan.
- When a water main extension is needed to complete the existing system of water mains or to further the orderly development, gridding, or looping of the water system.

There are four options for extending the District's water system: developer extension, Utility Local Improvement District (ULID) extension, fire hydrant extension, and District public works project.

4.2.4.1 Developer Extensions

Pursuant to Chapter 57.22 of the RCW, constructed and financed by the property owner or developer, Developer Extensions are the primary method used by property owners to extend water service. Annexation is required for developer extensions that are located outside current District boundaries AND inside the District's designated retail water service area. The steps for obtaining a Developer Extension are as follows:

- Developer obtains water availability certificate from District.
- Developer and District enter into signed agreement per District standards.
- Developer pays administrative and other applicable fees.
- Project is designed and permits obtained. All costs are to be paid by the developer.
- Project plans are reviewed and approved by the District.
- Project constructed (District inspection). All costs are to be paid by the developer.
- Developer to furnish recorded or recordable easements, title insurance and fees.
- Project is accepted by District and ownership of the extension is conveyed to the District by the bill of sale.

The written Developer Extension agreement with the District sets forth the terms and conditions under which the system will be extended. The developer extension agreement addresses fees, plan reviews, insurance and indemnity, warranties, ongoing bonds, conditions of acceptance, technical specifications, standards and other applicable issues.

Under certain circumstances, the District may participate financially in the construction of the extension such as when it is determined that "oversizing" of the line or Extended Service Agreement removal is in the best interests of the District as a whole.

If a water main extension is planned in the vicinity of properties with extended or temporary service agreements, the District may require those properties to hook up to the new permanent water main upon completion of the extension in accordance with District Resolution. The District gives additional notice to the owners of property subject to an extended or temporary service agreement. This notice reminds those owners that their water service from the District is temporary and that their properties and they may be subject to certain obligations. The District will hold a public hearing prior to determining whether a temporary service will be terminated. A temporary water service connection will be terminated upon advance notice to the owner of the property that is temporarily connected, whenever:

- A permanent water main has been installed and made operative, and
- That permanent main satisfies the standards of the District for permanent service to the property that is temporarily connected.
- The Board of Commissioners (Board) determines that it is in the District's interest to terminate such service.

Before the property subject to an extended or temporary service agreement may be connected to the permanent main, the owner(s) of that property must first:

"Satisfy all prerequisites of the District for water service, and pay the District the actual cost of the new connection, other connection charges as allowed, and any applicable fees for reimbursing property owners who contributed to the construction of the permanent water main, as required by District resolutions."

4.2.4.2 Utility Local Improvement District

The District Board is empowered to determine whether to form ULIDs. This determination is made on the basis of the facts and circumstances pertinent to each particular ULID proposed for formation. The two (2) methods available for initiating a ULID are the petition method and by the Board resolution method. The petition method requires signatures of property owners representing at least 51 percent of the land area within the boundary of the proposed ULID. The Board initiates the resolution method by passing a resolution of formation.

Following the receipt of a petition for the formation of a ULID, a public hearing is held by the District. This hearing is held for the purpose of generally explaining the procedures that the District follows in forming a ULID. Notice of the hearing is sent to the occupants and/or owners of property included within the boundaries of the proposed ULID. The District also provides notice to these occupants and/or property owners of the hearing at which the Board plans to determine the sufficiency of a petition for the formation of a ULID. (The Board then determines the sufficiency of the petition or adopts a resolution of its intent to form the ULID.)

A property owner desiring to initiate a petition for the formation of a ULID has the option of preparing the form and contents of the petition himself or herself or of contracting with the District to prepare the form and contents of the petition. There is an administrative charge for this service. This charge is not refundable, and is not credited against the assessment or any other fees or charges imposed by the District.

4.2.4.3 Fire Hydrant Extension

A fire hydrant extension is the installation of a water main and/or fire hydrant for the purpose of providing additional fire protection to the area. This scenario normally occurs in commercial or industrial areas where additional buildings are added to a site in which the Fire Marshall requires a fire hydrant or sprinkler system in order to meet fire codes. This is a special extension done in lieu of a developer extension at the discretion of the District. A need or desire for this special extension must be expressed to the District. The criteria for considering a fire hydrant extension are as follows:

- The length of water main between fire hydrants must be no more than 300 feet in commercial areas; 600 feet in residential areas.
- The maximum distance from hydrant to structure is 150 feet in commercial and industrial areas.
- Number of fire hydrants required - limited to one fire hydrant for every 300 feet.
- The property has previously extended the water system in accordance with District standards and service polices. If determined by the District that the extension does not meet one of these requirements, then another method of water system extension must be used.

The developer or property owner is responsible for all costs associated with Fire Hydrant Service/Extension in accordance with District Resolution.

4.2.4.4 Extended Service Agreement

During the early years of the District, another mechanism for system extension was used and termed an Extended Service Agreement (also called an Emergency Service Agreement or a Temporary Service Agreement). This method is no longer available and it is the District's policy to eliminate those existing agreements where it is possible to do so in an orderly, consistent fashion. One of the conditions under which an Extended Service Agreement was granted for a particular property was an agreement not to oppose or protest formation of a future ULID when the use of this method became appropriate, and temporary service would be disconnected once permanent service was available.

It is the District's policy to cease service to properties currently served under Extended Service Agreement within 60 days of the date permanent service becomes available. The property owner is given an opportunity to connect to the new permanent service with the attendant connection, latecomer, or other charges and fees as established by District Resolution.

4.2.5 Satellite System Management Program

In accordance with the EKC CWSP, the District may be called upon to provide some level of response to adjacent areas beyond District boundaries that require a public water supply. The EKC CWSP outlines a Satellite System Management Program (SSMP), under which an existing, viable water provider may provide operation and management services to areas outside of its corporate and water service area boundaries on a contractual basis.

The District supports the concept of satellite management and may provide satellite management services after evaluating requests or applications on a case-by-case basis. The District reviews requests for satellite management of separate and self-contained water systems based on the following considerations:

1. Economic Feasibility. Economic feasibility is gauged by the distance between the project site and the District's system, engineering variables that might affect cost, the size of project to be served by the water system, possible participation by other interested parties, and other factors the District considers relevant. Whenever connection to the District's system is economically feasible, the District will not provide satellite management services. Instead, those properties would be required to extend the District's permanent water main system to obtain water service.
2. Existing systems. The condition of the existing system and its compatibility with the District's system must be determined by the District. The ability of property served by the system to fund necessary upgrades, either privately or through municipal funding mechanisms will also be evaluated. Supply adequate in quantity and quality must be available, and water rights must ultimately be transferred to the District.
3. New systems. The applicant must possess water rights adequate to supply the project and be willing to transfer those rights to the District. This would generally only apply to those systems that collectively have an average daily use of more than 5,000 gallons. In typical scenarios, public water systems with fewer than seven connections are not required to have water rights. The system must be constructed according to District standards and specifications.

Except when otherwise approved by the Board, the District will own all systems which it agrees to manage, and rates and charges will be established by the Board according to law. Satellite systems will be subject to all rules and regulations of the District, and will be connected to the District's system when public service is available to the property or properties.

Because satellite management will not benefit the District's customers, the District will consider various financing options to provide satellite management services. Satellite System Management will have no rate impacts to current customers. The August 12, 1993 Addendum to the EKC CWSP suggests the following potential financing options for satellite management services:

- District to advance cost of satellite system improvements which would be paid back by remote system customers through rates, or acting as an intermediary to help the system secure state or federal grant money.
- Low interest loans from such programs as the State Public Works Trust Fund.
- Conventional loans.
- Community Development Block Grant funds for qualified low income residents.
- The formation of ULIDs.

4.2.6 Service to Existing Group A or B Water Systems within the District's RWSA

The District may assume ownership and operation of a Group A or B private water system at the request of the owners of such water system if the following conditions are met. Any such assumption is subject to the approval of the District Board of Commissioners:

1. The private water system is located within the District's RWSA.

2. The private water system's facilities meet the District's water system performance criteria and engineering standards, or the District approves a plan requiring the facilities to be brought up to and comply with the District's water system standards, and the owners of the private water system agree to perform the plan at their expense, or pay all costs to have the District perform the plan.
3. The connection of the private water system to the District's water system shall not have any adverse impact on the District's existing water service customers or level of water service to existing District customers.
4. The District's assumption of the private water system and provision of water service to the owners of such system is permitted by applicable State law.

In addition, the District may condition the approval of the assumption of a private water system and the provision of District water service to the owners of the private water system on the following:

1. If the properties served by the private water system are located outside of the District's corporate boundary, require the owners of such property to annex their properties to the District at the owners' expense, or, at the District's election, provide the District with a written "no protest to future annexation" on a District-approved form.
2. District water supply adequate in quantity and quality must be available to serve the properties served by the private water system, and, if required by the District, any water rights associated with the private water system must be transferred to the District.
3. The District may require that any well or other facility serving the private water system be abandoned in compliance with District policies and applicable State law.
4. The District may allow the existing or upgraded water system to connect to the District's existing water system, unless the District determines a direct connection to the District's existing water system is not financially feasible, and provided all other District conditions to operate the private water system are satisfied.

4.3 Performance Criteria

The District's performance criteria establish how the District's existing water system should operate on a daily basis. Section 5 of this Comprehensive Water System Plan (Plan) evaluates the capability of the existing water system to meet these performance standards using spreadsheet calculations and the District's hydraulic model. Where deficiencies are identified, capital or operational improvements will be proposed that eliminate performance deficiencies.

The District's performance criteria are presented in three categories: supply and pumping criteria, storage criteria, and distribution system criteria. The District's performance criteria are consistent with the Washington State Department of Health (DOH) Water System Design Manual.

4.3.1 Supply and Pumping

The following are the District's supply and pumping performance criteria.

4.3.1.1 Fire Storage Replenishment

Sources shall be capable of replenishing depleted fire suppression storage within 72 hours while concurrently supplying maximum day demand (MDD) for the water system.

4.3.1.2 MDD in 18 Hours

The water system shall be capable of delivering MDD within 18 hours of pumping.

4.3.1.3 Open Zone BPS Capacity

Pumping stations supplying open zones shall contain multiple booster pumps of sufficient capacity to meet the maximum day demands with the largest pump out of service.

4.3.1.4 Closed Zone BPS Capacity

Pump stations supplying closed zones shall contain multiple booster pumps of sufficient capacity to meet PHD with fire flow conditions with the largest pump out of service. Pump stations supplying closed zones that have reliable back up power are not required to have a redundant fire pump.

4.3.2 Storage

As defined in the DOH Water System Design Manual (December 2009), storage requirements are based on the following five (5) components:

1. Operational storage,
2. Equalizing storage,
3. Standby storage,
4. Fire suppression storage, and
5. Dead storage.

Operational and equalizing storage must be available to all customers at a residual pressure of at least 30 pounds per square inch (psi) at the customer's meter under peak hour demand (PHD) flow conditions. Standby and fire suppression storage must be available to all customers at a residual pressure of at least 20 psi at the customer's meter under MDD.

Figure 4.1 shows the components of storage required by DOH as well as the hydraulic grade lines (HGL) in a tank that represent the minimum water surface elevations that can supply water at 20 psi or 30 psi to all customers. Dead storage is the volume in a tank that cannot be used to serve the highest customer in the water system with a pressure of at least 20 psi.

4.3.2.1 Operational Storage

Operational storage is the volume of water available to supply the system under normal operating conditions while the source is considered "off". This volume varies according to the sensitivity of the water level sensors controlling the source pumps and the configuration of the tanks designed to provide the required volume while preventing excessive cycling of the pump motor(s). It must be available to all customers at a residual pressure of at least 30 psi under PHD flow conditions.

4.3.2.2 Equalizing Storage

The volume of equalizing storage must be sufficient to meet hourly water system demands in excess of the rate of supply and must be at an elevation sufficient to meet these demands at a minimum delivery pressure of 30 psi. The amount of required equalizing storage is to be calculated in accordance with the DOH Water System Design Manual. The method for calculating equalizing storage is described in detail in Section 5.

4.3.2.3 Standby Storage

Standby storage is the volume of storage required to supply reasonable system demands during a system emergency, such as disruption of the water supply. Disruptions could be caused by transmission pipeline or equipment failure, power outage, valve failure, or other system interruptions. The computation of emergency/standby storage requirements includes consideration of reasonable system disruptions that can be expected to occur within normal planning contingencies, and does not consider major system emergencies, such as earthquakes that result in shutdown of water supplies and multiple distribution system breaks. These types of emergencies should be covered under emergency system operation planning. The District's policy is to have standby storage volumes for the water system equal to 200 gallons per equivalent residential unit (ERU). An ERU is the volume of water used by a typical single family residential customer during a normal day. The District's specific ERU value is given in Section 2.

4.3.2.4 Fire Suppression Storage

Fire suppression storage must be equal to the amount of water required to accommodate fire demand while maintaining a minimum system pressure of 20 psi. Fire flow requirements are determined by the EKC CWSP, the Fire Marshal having jurisdiction, and generally conform to the procedures utilized by the Washington Surveying and Rating Bureau as set forth in a pamphlet entitled "Guide for Determination of Required Fire Flow" published by the Insurance Services Office, Municipal Survey Service. The CWSP specifies a minimum fire flow of 1,000 gallons per minute (gpm) for urban areas and 500 gpm for rural areas. Actual fire flow for a proposed development shall be determined by the Fire Marshal.

The District's minimum fire flow requirements are listed in Table 4.1. The fire suppression storage volumes shown in this table are used in the system analysis, which is discussed in Section 5 of this Plan.

Table 4.1 Minimum Fire Flow Requirements

Land Use Type	Fire Flow Rate (gpm)	Fire Flow Duration (hr)	Equivalent FSS Volume (gallons)
Single-family Residential	1,000	2	120,000
Multi-family Residential	2,500	3	450,000
Commercial	2,500 gpm	3	450,000
Schools	2,500 gpm	3	450,000
Industrial	3,500 gpm	4	840,000

4.3.2.5 Nested Storage

The District nests standby storage and fire suppression storage, which means that the volume reserved for emergencies consists of whichever requirement is greater between fire suppression storage and standby storage.

4.3.2.6 Dead Storage

Dead storage is the amount of water not available to all customers at the minimum pressure of 20 psi. Dead storage is not considered when determining available volumes to provide operational, equalizing, standby, and fire suppression storage.

4.3.3 Distribution System

4.3.3.1 Maximum Velocity

Maintain water main velocity below 10 feet per second (fps) during PHD.

4.3.3.2 Minimum Pressure

Maintain system pressure above 30 psi during PHD.

4.3.3.3 Maximum Pressure

Maintain system pressure below 100 psi at all times.

4.3.3.4 Fire Flow

Under fire flow conditions, with storage levels at the bottom of the fire suppression storage component, the distribution system shall be designed to provide the MDD with required fire flow at a minimum residual pressure of 20 psi to all service connections measured at the meter.

4.4 Design Criteria

Minimum design criteria are established to ensure all new water system improvements are designed in a manner consistent with District goals and to provide a current and future benefit to the system. In addition to the minimum design criteria listed in this section, all new water system improvements must be designed to meet the District's performance criteria as defined in the section above. These criteria are in addition to the District's guidelines for developer extensions. All distribution related projects are reviewed by a consulting engineer under contract to the District.

The design criteria at a minimum must follow the requirements and standards put forth by the U.S. Environmental Protection Agency (EPA), DOH, King County, the International Fire Code (IFC), and the cities within which the District serves.

4.4.1 State Agency Regulations

The DOH Water System Design Manual is the primary document governing the sizing and design of public water systems within the State of Washington. This Design Manual sets the minimum reliability considerations for water systems. This section includes discussions of these criteria and includes the District's specific design standards and criteria. In addition, the District must meet the minimum design and performance standards of the EKC CWSP for the East King County Critical Water Supply Service Area.

4.4.2 Reference Datum

The datum used for design of District facilities is NAD83 for horizontal and NAVD88 for vertical.

4.4.3 Facility Reliability and Security Considerations

Design and maintenance of water facilities, existing and proposed, shall take into account the following:

- Looping of water mains increases reliability, increases fire flow availability, and improves water quality through increased circulation. Looping water mains should be required on all new water facilities construction or replacement projects, except where not practicable, as determined by the District. In those cases, sufficient capacity to meet the highest design flows should be provided in dead-end mains.

- All water system facilities, both-above ground and below-ground shall be designed such that access is limited to authorized personnel only and shall include appropriate remote alerts for intrusion or tampering of facilities as deemed necessary by the District.

4.4.4 Water Pressure

Uniform Plumbing Code (UPC) provisions recommend installation of individual pressure reducing valves at customer connections whose pressure is expected to exceed 80 psi. This is due to the rating of household water appliances.

4.4.5 Pipeline Velocities

DOH recommends that the design of distribution mains maintain velocities less than or equal to eight (8) fps under PHD conditions, unless otherwise specified by the pipe manufacturer. DOH recognizes that velocities may be greater than 8 fps in mains under fire flow conditions, in short sections of main (less than 50 lineal feet), or piping within pump and valve station facilities. Transient analyses should be considered for long sections of transmission main where pipe velocities exceed 8 fps.

4.4.6 Pipe Sizing and Materials

Design of water main projects, whether new construction or replacement, shall follow the following criteria which is ultimately governed by State Law and the criteria established by DOH's Water System Design Manual:

- For new or replacement water main construction, water main size shall be a minimum 8-inches nominal inside diameter and shall be determined through analyses of the water system hydraulic model and such analyses shall include consideration of build-out scenarios using PHD without fire flow conditions and MDD with fire flow conditions, whichever is greater. In the case of PHD without fire flow conditions, the maximum allowed velocity is 8 fps and minimum pressures throughout the system must be greater than or equal to 40 psi. In the case of MDD with fire flow conditions, the maximum allowed velocity is 8 fps and minimum pressures throughout the system must be greater than or equal to 20 psi.
- New water mains shall be constructed of cement lined, Class 52, ductile iron pipe with "lead-free" materials (less than 8 percent lead content). If McWane Ductile pipe is used, it shall be manufactured with the "Seattle" stamp. McWane Ductile pipe shall not be permitted on dead-end runs due to taste issues reported and confirmed at district headquarters.
- Dead end mains are generally not accepted by the District, except in phased development projects. Approved dead end mains that will not serve fire hydrants may be sized as hydraulically appropriate in residential areas and be a minimum of 8-inches in commercial areas.
- Minimum cover over pipes shall be 36-inches from the top of pipe to the finished grade, unless otherwise approved by the District.
- Whenever practicable, transmission and distribution pipelines or water service lines shall be at least ten (10) horizontal feet from any existing or proposed waste disposal facilities. On crossings, at least 18 inches of vertical separation shall be maintained between the top of a sewer main and the bottom of a water line. In any case, separation between water and sanitary sewer pipelines shall be in accordance with the State Department of Ecology's "Criteria for Sewage Works Design".

- Water source pumping facilities and storage facilities must be designed so that, in combination, they can supply the maximum instantaneous flow demand at any time to all parts of the system.
- Polyethylene encasing or cathodic protection shall be utilized in areas of corrosive soil conditions that may affect the service life of pipelines, as determined by the District.

4.4.7 Valves

Valves perform many functions throughout a water system. For isolation of pressure zones or stretches of water main, for system flushing, and release of air from the pressurized system, valves are a necessary tool. The following criteria are required for the design and construction of valves:

- Valves larger than 12 inches in size shall be butterfly valves and valves 12 inches and smaller shall be resilient seat gate valves. Valves shall be installed in a configuration that permits isolation of water main segments and with a recommended maximum valve spacing of 600 feet. Additional isolation valves may be required by the District and will be determined on a case-by-case basis.
- Air-vacuum relief valves are to be installed at appropriate points of high elevation in the system. All piping in the system shall be sloped a minimum of one-half percent to permit escape of any entrained air. One-half percent constitutes six (6) inches of vertical relief over a horizontal distance of 100 feet.
- Zone isolation valves shall be installed at pressure zone boundaries to permit future pressure zone realignment without the need for pipeline reconfiguration.
- A blow-off assembly or fire hydrant shall be installed on all dead end runs and at designated points of low elevation to provide a means for adequate flushing of the system. The blow-off assembly shall be installed in a utility right-of-way, except where a written access and construction easement is provided to the District.
- System pressure reducing valves (PRV) shall be installed as deemed necessary by the District to create new zones or expand existing zones and shall be set such that all services downstream of the PRV fall within the minimum and maximum pressures specified above.
- Individual, or end-user, pressure reducing valves are used for individual customer pressure regulation and are the property and responsibility of the customer. Consistent with DOH and UPC requirements, as the District becomes aware of pressures in excess of 80 psi, they shall recommend to the customer the need for an individual PRV. Should the customer agree to install the individual PRV, the customer and District shall enter into an agreement that details specific information regarding responsibility, maintenance, and ownership of the individual PRV.

4.4.8 Fire Hydrants

Fire hydrants shall comply with the minimum requirements established by the Cities of Woodinville, Kirkland, Redmond and Bothell, the local Fire Marshall, or any other municipality (in the event an annexation warrants incorporation of another municipality's requirements), and meet the type, location and spacing requirements of the agency having jurisdiction in the project area. In general, maximum spacing for hydrants in commercial and multi-family areas shall be 300 feet on center and 600 feet on center in residential areas.

4.4.9 Water Meters

In 2014 all meters older than 10 years were replaced and new advanced metering infrastructure (AMI) registers were installed on all meters. As battery life on newly installed AMI meters is approximately 20 years, the District will begin replacing the meters on a 20-year cycle starting in 2024.

4.4.10 Residential Fire Sprinkler Systems

Residential sprinkler systems are permitted. Separate meters with approved backflow devices may be required for these services.

4.4.11 Cross Connection Control

Where the possibility of contamination of potable water exists, water services shall be equipped with an appropriate cross-connection control assembly in accordance with State requirements, District Resolution and the "Cross-Connection Control Manual, Accepted Procedure and Practice", published by the Pacific Northwest Section of the American Water Works Association (AWWA) and the Washington Administrative Code (WAC) 246-290-490. The need, size, and location of cross-connection assemblies shall be determined by the District. More information related to the District's policy on cross-connection may be found in Appendix G.

4.4.12 Water Storage

Storage facilities must be designed to meet the District's storage performance criteria as described in Section 4.3.2.

4.4.13 Pump Stations

In order to ensure uninterruptible service, the following provisions are required for construction of all new pump stations or remodeling of existing pump stations:

- Pump stations that are crucial in maintaining system pressure or providing water service must contain an emergency backup power source adequately designed to power the full range of pump station functions. Emergency power supply can be accomplished by either permanent on-site power generators or by pump station wiring that allows for an efficient connection to a portable emergency power generator. All pump stations shall be designed with appropriate security measures to notify the District by remote alert of station intrusion and/or tampering of equipment settings.

4.4.14 General Facility Placement

All piping, pumping, source, storage, and other facilities shall be located in public rights-of-way, dedicated utility easements or on District-owned property. Utility easements shall be a minimum of 15 feet in width, and piping shall be installed no less than five (5) feet from the easement's edge. Any exceptions to this minimum easement will be at the discretion of the District. Unrestricted access shall be provided to all public water system lines and their appropriate appurtenances and all public fire hydrants.

The location of utilities shall be in accordance with the standards and guidelines established by the appropriate jurisdictional criteria. Where existing utilities or storm drains are in place, new facilities shall conform to these standards as nearly as practicable and yet be compatible with the existing installations. Where practical, there shall be at least five (5) feet horizontal separation from other utilities.

4.4.15 Standard Plans and Specifications

In accordance with WAC 246-290-120, the District maintains standard plans and specifications. The Standard Plans and Specifications constitute a waiver from formal DOH submittal and approval of specific distribution main improvements consisting of the installation of hydrants, valves, fittings, and meters; repair or replacement of system components with similar components; or maintenance or painting of surfaces not contacting potable water, provided that construction of such projects are certified by a registered professional engineer and provided that the District retains the required documentation for placing the distribution pipeline into service. All other water system improvement projects require submittal to, and approval from, the DOH. The most current District water construction specifications and standard plans are available at https://www.woodinvillewater.com/for-developers/standard-specifications-for-developer-extensions.html. Copies of these standards as of February 2019 are also included in Appendix O.

4.5 Rules and Regulations

The District operates under a myriad of regulations and requirements pertaining to the supply of safe drinking water and fire protection service. A brief summary of key regulations affecting day-to-day operations of the District is provided in the following paragraphs.

4.5.1 Federal Regulations

Public Law 93-523, the Safe Drinking Water Act (SDWA), directs the EPA to establish minimum national drinking water standards limiting the amount of potentially harmful substances which may be present in drinking water sources. These limits are regulated by the DOH and adhered to by the District. Complete details of current regulations and the District's water quality monitoring program are provided in Section 7 of this Plan. Water quality documentation is provided to customers in the District's Consumer Confidence Report (CCR), a copy of which is included in Appendix I.

Because of the listing of the Puget Sound Chinook Salmon and Bull Trout as a "threatened species", rules and regulations under the authority of the Endangered Species Act (ESA) can affect the District's water system operations. As part of its ESA compliance program, the District operates consistent with best management practices as appropriate to protection of endangered species.

4.5.2 State of Washington Requirements

The rules and regulations regarding public water supplies are a part of the WAC and are adopted pursuant to the provisions in the RWC 43.20.050 for the protection of public health. The rules and regulations provide the minimum standards for design, construction, operations, and maintenance of public water systems and conform with the SDWA of 1974 and all subsequent amendments thereto.

RCW Title 57 governs the operation of water and sewer districts within the State of Washington and provides the authority for the District to operate a public water system. Title 57 specifies a variety of planning and operational characteristics such as establishment of boundaries, annexations, consolidations, mergers, formation of utility local improvement districts, comprehensive planning requirements, officer elections, contracts, system extensions, etc.

The Growth Management Act (GMA) of 1990 (RCW 36.70A) has a direct impact on utility system planning by requiring a complete inventory of existing system facilities and a comprehensive effort toward determining the capability of utility systems to support anticipated growth. Although the majority of growth management activities are the responsibility of counties and cities, data and information from special purpose districts such as Woodinville is required in order to make decisions on future growth potential and corresponding levels of service. The GMA requires cities and counties to discuss and plan for seven (7) key elements in their comprehensive plans: (1) Land Use, (2) Housing, (3) Capital Facilities, (4) Utilities, (5) Transportation, (6) Economic Development, and (7) Parks and Recreation.

While utility planning addresses a majority of the primary concerns for the District, several other of those key elements are indirectly related to planning for water utility services. The requirements under Title 57 allow utility districts such as Woodinville Water District to provide some planning consistency with the cities and counties they serve. A primary outcome of the growth management planning in King County is the delineation of an Urban Growth Area (UGA) boundary within which an urban level of service is required. GMA rules and regulations will be crucial to projecting future water demands within the District. Even though a majority of the District lies outside the UGA boundary and in unincorporated King County, the pressure for growth will remain substantial.

4.5.3 King County Requirements

Because the District operates in unincorporated King County, it must operate within the rules and regulations established by King County and utilize County planning data in developing growth projections for those portions of the District that are within the County. Specifically, the King County Comprehensive Plan has a direct impact on the District and its planning efforts. King County Code Titles 13.24 (Sewer and Water Comprehensive Plans) and 17.08 have been utilized in the development of this document to ensure that District operations are in conformance with King County requirements. The District must also operate within the terms of its current right-of-way franchise with King County.

King County's Countywide Planning Policies were originally developed in 1992 as a response to the GMA and were most recently updated in 2012. The document represents a collaborative effort between King County, the City of Seattle, and the Suburban Cities of King County, who met jointly as the Growth Management Planning Council. The resulting policies, as they relate to the provision of utility service, mandate that an urban level of services be provided within the UGA boundary.

Additional goals and polices from the Countywide Planning Policies are adhered to as appropriate for various District actions such as provision of sanitary sewer service within the UGA, annexation requirements, coordination with land use authorities, etc.

4.5.4 City Requirements

Woodinville Water District operates within the limits of four (4) cities, requiring constant coordination with and adherence to city standards and requirements. The land use plans, codes, construction standards, and permitting requirements of the cities of Woodinville, Bothell, Kirkland, and Redmond are essential considerations in the design and construction of new facilities as well as in daily operation and maintenance activities.

The entire city limits of Woodinville are contained within the District, thus all planning and development within the City have an impact of the District's water system planning. Woodinville requires all new development to connect to the municipal water system. The City of Woodinville and the District collaborate closely to ensure that the District's Water System Plan is consistent with the City of Woodinville Comprehensive Plan.

The District serves two small, built-out, single-family residential neighborhoods within the City of Bothell. One is located directly north of Woodmoor Elementary School. The other is located in the northwest corner of the District's RWSA. The District coordinates with the City of Bothell to comply with all City of Bothell policies for water service and provides fire flows adequate to meet the requirements of Bothell's land use designations within the neighborhoods served.

Since the 2008 Comprehensive Water System Plan Update, Kirkland has annexed a significant area in the south west corner of the District's RWSA. This area consists of single-family residential, multi-family residential, commercial, schools, and parks. The demand projections and fire flow requirements of this Plan take into consideration new zoning within this area since annexation. The District has a franchise agreement with the City of Kirkland.

Unlike Kirkland, Redmond has not annexed new area within the District's RWSA since the last Plan update. The District still serves only a few customers within Redmond. However Redmond has a Potential Annexation Area (PAA) that extends deep into the District. The District recognizes that upon annexation, zoning changes may occur that may affect future water system planning.

Section 5

WATER SYSTEM ANALYSIS

5.1 Introduction

Carollo Engineers, Inc. (Carollo) evaluated the Woodinville Water District (District) water distribution system for its ability to meet the District's reliability criteria under 2023, 2027, and 2037 future conditions using the medium demand projection scenario presented in Section 2. The distribution system was evaluated for its supply and pumping capacity and reliability, the capacity of its storage facilities, and for adequate pressures and fire flow capacity using the District's updated hydraulic model.

This section discusses recommendations to eliminate each of the deficiencies identified as part of the system analysis for this Comprehensive Water System Plan (Plan). These recommendations form the basis of the District's Capital Improvement Plan (CIP) outlined in Section 8.

The pumping analysis found that additional pumping is required for Zone 650 Central to provide redundancy when the Hydraulic Grade Lines (HGL) in the Tolt Pipeline is insufficient to serve the 650 Zone directly. The storage analysis found that the Aspenwood Reservoir does not have sufficient available storage for its fire suppression storage requirement. The distribution system analysis identified many pipeline upsize and new pipe installation projects that are recommended to ensure required fire flows and pressures are available to all water mains in the service area.

5.2 Service Areas

For the system analysis, the District's distribution system was divided into six (6) areas referred to as "service areas". Each service area has its own supply and storage facilities and was evaluated against the District's pumping and storage criteria independently. The six (6) service areas, which are shown on Figures 5.1 through 5.4, are:

1. 510 West Service Area. Consists of Zone 510 West, Zone 420 West, Zone 305 West, and Zone 420 West (N). It is supplied by Tolt Tap (TT)-195 and the Kingsgate Reservoir.
2. 260 West Service Area. This service area consists of only Zone 260 West and is served by TT-167 and the Sammamish Reservoir.
3. 570 Central Service Area. This is the District's largest service area and consists of Zone 570 Central, Zone 420 Central (NW), Zone 585 Central, Zone 650 Central, Zone 420 Central (S), Zone 420 Central (NE), Zone 570 Central (E). This zone is supplied by TT-80, TT-53, TT-57, and TT-79. Three (3) reservoirs serve the zone: Hollywood Reservoir, Wellington Reservoir, and South Hollywood Reservoir.
4. 420 Central Service Area. The 420 Central Service Area consists of Zone 420 Central and Zone 350 Central. It is served by TT-125 and Brookside Reservoir.

5. 570 East (N/S) Service Area. This service area consists of Zone 570 East (N/S) and its two (2) sub-zones 485 East and 460 East. It is served by the James Bard Memorial Reservoir and shares supply from TT-78 with the 670 East Service Area.
6. 670 East Service Area. Consists of Zone 670 East, Zone 770 East, and Zone 570 East.

5.3 Supply and Pumping Analysis

5.3.1 Supply and Pumping Criteria

The capacity of pumping into each of the District's service areas was evaluated against the following criteria that are included in Section 4:

1. Maximum day demand (MDD) + Fire Suppression Storage Replenishment. Two or more supply sources are available with a capability to replenish depleted fire suppression storage within 72 hours while concurrently supplying MDD for the water system.
2. MDD in 18 hours of pumping. The water system shall be capable of delivering MDD within 18 hours of pumping.
3. Open Zone Booster Pump Station (BPS) Capacity. Pump stations supplying open zones shall contain multiple booster pumps of sufficient capacity to meet the MDD demands with the largest pump out of service.
4. Closed Zone BPS Capacity. Pump stations supplying closed zones shall contain multiple booster pumps of sufficient capacity to meet peak hour demand (PHD) with fire flow conditions with the largest pump out of service. Pump stations supplying closed zones that have reliable back up power are not required to have a redundant fire pump.

5.3.2 MDD + Fire Suppression Storage Replenishment

All of the District's service areas are capable of replenishing fire suppression storage within 72 hours while concurrently supplying MDD for the service area. Calculations for the evaluation of this criterion are shown in Table 5.1. For this criterion, 570 East (N/S) and 670 East are evaluated as one (1) service area because they are both supplied by the same source, TT-78.

5.3.3 MDD in 18 Hours of Pumping

Most of the District's service areas are served directly by Tolt Taps without any pumping. The only service area that relies on pumping for its supply is the 670 East Service Area, which is supplied by the Ringhill Pump Station (PS). The Ringhill PS has a larger capacity than TT-78, so the amount that can be pumped to the 670 East Service Area is limited by the TT-78 capacity. The Ringhill PS pumping at a rate to match the capacity of TT-78 can provide MDD to the 670 East Service Area in less than 18 hours of pumping. Calculations for the evaluation of this criterion are shown in Table 5.2.

Table 5.1 MDD Plus Fire Suppression Storage Replenishment Calculations

Service Area	510 West			260 West			570 Central			420 Central			570 East (N/S) & 670 East		
Planning Year	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037
MDD (gpm)	1,160	1,170	1,235	1,075	1,115	1,315	2,540	2,575	2,665	750	750	735	670	660	655
Fire Suppression Storage (FSS) (gal)	450,000	450,000	450,000	840,000	840,000	840,000	840,000	840,000	840,000	450,000	450,000	450,000	450,000	450,000	450,000
FSS Replenishment (gpm)	105	105	105	195	195	195	195	195	195	105	105	105	105	105	105
Total Demand (gpm)	1,265	1,275	1,340	1,270	1,310	1,510	2,735	2,770	2,860	855	855	840	775	765	760
Total Supply (gpm)	1,770	1,770	1,770	1,840	1,840	1,840	3,350	3,350	3,350	1,230	1,230	1,230	1,080	1,080	1,080
Surplus/(Deficit) Experienced (gpm)	**505**	**495**	**430**	**570**	**530**	**330**	**615**	**580**	**490**	**375**	**375**	**390**	**305**	**315**	**320**
Additional Supply Needed (gpm)		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note:
(1) gpm: gallons per minute gal: gallons.

Table 5.2 MDD in 18 Hours of Pumping Calculations

Service Area	670 East		
Planning Year	2023	2027	2037
MDD (gpm)	310	305	305
MDD in 18 hrs (gpm)	415	405	405
Tolt Tap Capacity	1,080	1,080	1,080
Pump Capacity (gpm)	2,085	2,085	2,085
Total Supply (gpm)	1,080	1,080	1,080
Surplus/(Deficit) Experienced (gpm)	**665**	**675**	**675**
Additional Supply Needed (gpm)	**0**	**0**	**0**

5.3.4 Open Zone BPS Capacity

An open zone is a zone that has a storage tank that dictates the zone's HGL. The only open pressure zone that is supplied by pumping is Zone 670 East. Ringhill PS has sufficient capacity to meet MDD demands with its largest pump out of service (i.e. firm capacity) as shown in Table 5.3.

Table 5.3 Open Zone BPS Capacity Calculations

Service Area	670 East		
Planning Year	2023	2027	2037
MDD (gpm)	310	305	305
Firm Pump Capacity (gpm)	1,390	1,390	1,390
Surplus/(Deficit) Experienced (gpm)	**1,080**	**1,085**	**1,085**
Additional Pump Capacity Needed (gpm)	**0**	**0**	**0**

5.3.5 Closed Zone BPS Capacity

A closed zone is one that's HGL is not determined by the elevation of a storage tank. Zone 510 West is considered a closed zone because when the Kingsgate PS is in operation, the zone's HGL is not controlled by the Kingsgate Reservoir. Zone 650 Central and Zone 770 East are the other two (2) closed zones in the District's system. Calculations for this criterion are presented in Table 5.4.

The Kingsgate PS has sufficient capacity to supply PHD to Zone 510 West plus fire flows of 2,500 gpm with its firm capacity. The firm capacity of Ringhill East PS is able to supply Zone 770 East PHD plus a 1,000 gpm fire flow.

Zone 650 Central, on the other hand, does not meet this criteria. While 650 Central is usually supplied by TT-80 and TT-53 in addition to the Hollywood PS, the District's contract with Seattle Public Utilities does not guarantee that the HGL at these TT will be above 590. As a result, the firm capacity of the Hollywood PS alone must be capable of supplying PHD plus fire flows to Zone 650 Central (approximately 1,400 gpm). With a firm capacity of 800 gpm, the Hollywood PS cannot meet this requirement. Additional pumping capacity to the 650 Central Zone should be installed to provide supply redundancy.

Table 5.4 Closed Zone BPS Capacity Calculations

Service Area	510 West			650 Central			770 East		
Planning Year	2023	2027	2037	2023	2027	2037	2023	2027	2037
PHD (gpm)	1,735	1,745	1,845	390	395	400	40	40	40
Required Fire Flow (gpm)	2,500	2,500	2,500	1,000	1,000	1,000	1,000	1,000	1,000
Total Requirement (gpm)	4,235	4,245	4,345	1,390	1,395	1,400	1,040	1,040	1,040
Firm Pump Capacity (gpm)	6,000	6,000	6,000	800	800	800	1,050	1,050	1,050
Surplus/(Deficit) Experienced (gpm)	1,765	1,755	1,655	(590)	(595)	(600)	10	10	10
Additional Pump Capacity Needed (gpm)	0	0	0	600	600	600	0	0	0

5.3.6 Pumping Recommendations

The pumping analysis identified that in situations where the Tolt Pipeline has insufficient pressure to supply the 650 Central Zone directly, the Hollywood PS does not have sufficient capacity to supply PHD plus fire flow with the largest pump out of service. To provide sufficient redundancy it is recommended that additional pumping from either the Tolt Pipeline or the 570 Central Zone to Zone 650 Central be installed. This is CIP project PS-3 listed in Section 8.

5.4 Storage Analysis

The District's storage system was evaluated based on their criteria described in Section 4. The District's storage requirements are dependent on the District's supply capacity, booster pump operation, water demands, fire flow requirements, and pressure requirements. The following sections summarize the available storage of the water system, describe the required storage components, and present recommendations to address identified storage deficits.

5.4.1 Storage Components and Governing Criteria

As described in Section 4, the five (5) components of storage listed below and illustrated in Figure 5.5 must be considered for any water system:

1. Operational storage.
2. Equalizing storage.
3. Standby storage.
4. Fire Suppression storage.
5. Dead storage.

DOH requires that operational and equalizing storage are available to all customers at a residual pressure of at least 30 pounds per square inch (psi) under PHD flow conditions. Standby and fire suppression storage must be available to all customers at a residual pressure of at least 20 psi under MDD. Each storage component is described in detail in Section 4. The following sections present the equations used to calculate each storage component.

5.4.1.1 Operational Storage

Operational storage bands were provided by the District and are shown in Table 5.5.

5.4.1.2 Equalizing Storage

Equalizing storage volume requirements are shown in Table 5.6 and were calculated using the following equation from the DOH Water System Design Manual:

$ES = (PHD - MDD)*150$ minutes, but in no case less than zero

Where: ES = Equalizing storage component, in gallons

PHD = Peak hourly demand, in gpm

MDD = Maximum day demand, in gpm

PHD is also calculated using an equation from the DOH Water System Design Manual:

$PHD = MDD/N(C*N+F) +18$

Where: N = Number of Equivalent Residential Units (ERUs) served

C, F = Factors defined in DOH Water System Manual

5.4.1.3 Standby Storage

The District's standby storage policy is that the reservoirs in the water system should have enough standby storage to supply 200 gallons per ERU (gal/ERU). Standby storage requirement are shown in Table 5.7.

5.4.1.4 Fire Suppression Storage

The maximum fire flow requirements and durations for each service area are provided in Table 5.8.

5.4.2 Available Storage

The District's water system has eight (8) storage tanks with a total capacity of 14.9 MG.

The available storage in each service area is controlled by the elevation of the highest customer in the system and the HGL required to serve that customer with a pressure of at least 30 psi. The District's total available storage above the 20 psi HGL is 13.4 MG and the available storage above the 30 psi HGL is 10.6 MG. Table 5.9 shows the highest service elevation and the amount of available storage in each service area.

5.4.3 Required Storage

The operational, equalizing, fire suppression, and standby storage requirements are summarized in Table 5.9 for each service area and each planning year. The total required storage above the 30 psi HGL is the sum of operational and equalizing storage. The total required storage above the 20 psi HGL is the sum of operational, equalizing, and the maximum between fire suppression and standby storage.

Table 5.9 shows that every service area with the exception of 670 East has sufficient storage to meet demands throughout the planning horizon. The 670 East Service Area has a storage deficit of 0.2 MG. This is because of the Aspenwood Reservoir's total 1.1 MG volume, only 0.4 MG (or less than 40 percent) is available at 20 psi to the highest customer. The fire suppression storage requirement alone for this service area is 0.45 MG for schools in the area.

Table 5.5 Operational Storage Calculations

Service Area	510 West	260 West	570 Central				420 Central	570 East (N/S)	670 East
Facility	Kingsgate Reservoir	Sammamish Reservoir	Hollywood Reservoir	South Hollywood Reservoir	Wellington Reservoir	**Total**	Brookside Reservoir	James Bard Memorial Reservoir	Aspenwood Reservoir
Storage Capacity (gal)	1,130,000	2,800,000	2,400,000	1,740,000	1,400,000	**5,540,000**	2,500,000	1,800,000	1,100,000
Elevation of Overflow (ft)	510	300	570	579	570	**0**	420	575	670
Base of Tank (ft)	410	265	543	491	492	**0**	402	555	554
Nominal Diameter (ft)	44	117	123	58	55	**0.0**	154	124	40
Operating Band (ft)	18.0	9.0	5.0	15.0	14.0		4.0	4.0	18.0
Operating Volume (gal)	203,400	720,000	444,000	296,591	251,000	**991,591**	556,000	360,000	171,000
Percent of Total Storage	18%	26%	19%	17%	18%	**18%**	22%	20%	16%

Note:
(1) ft: feet.

Table 5.6 Equalizing Storage Calculations

Service Area	510 West			260 West			570 Central			420 Central			570 East (N/S)			670 East		
Planning Year	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037
ERUs	3,590	3,665	3,935	3,255	3,430	4,010	7,920	8,180	8,625	2,350	2,380	2,405	1,120	1,130	1,140	970	980	1,000
MDD (gpm)	1,160	1,170	1,235	1,075	1,115	1,315	2,540	2,575	2,665	750	750	735	360	355	350	310	305	305
C[(1)]	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
F[(1)]	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225	225
PHD (gpm)	1,945	1,960	2,065	1,810	1,875	2,195	4,155	4,210	4,350	1,290	1,290	1,265	665	655	645	585	575	575
Required Equalizing Storage (gal)	**118,000**	**119,000**	**125,000**	**110,000**	**114,000**	**132,000**	**242,000**	**245,000**	**253,000**	**81,000**	**81,000**	**80,000**	**46,000**	**45,000**	**44,000**	**41,000**	**41,000**	**41,000**
Percentage of Total Storage	**10%**	**10%**	**11%**	**4%**	**4%**	**5%**	**4%**	**4%**	**5%**	**3%**	**3%**	**3%**	**3%**	**3%**	**2%**	**4%**	**4%**	**4%**

Note:
(1) DOH-defined variable

Table 5.7 Standby Storage Calculations

Service Area	510 West			260 West			570 Central			420 Central			570 East (N/S)			670 East		
Planning Year	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037
ERUs	3,590	3,665	3,935	3,255	3,430	4,010	7,920	8,180	8,625	2,350	2,380	2,405	1,120	1,130	1,140	970	980	1,000
Standby Storage 200 gal/ERU	**718,000**	**733,000**	**787,000**	**651,000**	**686,000**	**802,000**	**1,584,000**	**1,636,000**	**1,725,000**	**470,000**	**476,000**	**481,000**	**224,000**	**226,000**	**228,000**	**194,000**	**196,000**	**200,000**
Percent of Total Storage	**64%**	**65%**	**70%**	**23%**	**25%**	**29%**	**29%**	**30%**	**31%**	**19%**	**19%**	**19%**	**12%**	**13%**	**13%**	**18%**	**18%**	**18%**

Table 5.8 Fire Suppression Storage Requirements

Service Area	Largest Fire Flow Requirement (gpm)	Fire Flow Duration (minutes)	Fire Suppression Storage Required (MG)
510 West	2,500	180	0.45
260 West	3,500	240	0.84
570 Central	3,500	240	0.84
420 Central	2,500	180	0.45
570 East (N/S)	2,500	180	0.45
670 East	2,500	180	0.45
770 East	1,000	120	0.12
650 Central	1,000	120	0.12

Note:
(1) MG: Million Gallons.

Table 5.9 Storage Analysis Results

Service Area	510 West			260 West			570 Central			420 Central			570 East (N/S)			670 East		
Planning Year	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037	2023	2027	2037
Available Storage (MG)																		
Total Storage	1.13	1.13	1.13	2.80	2.80	2.80	5.54	5.54	5.54	2.50	2.50	2.50	1.80	1.80	1.80	1.10	1.10	1.10
Highest Service Elevation	420	420	420	180	180	180	490	490	490	345	345	345	490	490	490	580	580	580
Meeting 30 psi Requirement	1.13	1.13	1.13	2.80	2.80	2.80	4.33	4.33	4.33	0.79	0.79	0.79	1.41	1.41	1.41	0.20	0.20	0.20
Meeting 20 psi Requirement	1.13	1.13	1.13	2.80	2.80	2.80	4.75	4.75	4.75	2.50	2.50	2.50	1.80	1.80	1.80	0.42	0.42	0.42
Dead Storage	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.79	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.69	0.69
Required Storage Components (MG)																		
Operational Storage	0.20	0.20	0.20	0.72	0.72	0.72	0.99	0.99	0.99	0.56	0.56	0.56	0.36	0.36	0.36	0.17	0.17	0.17
Equalizing Storage	0.12	0.12	0.12	0.11	0.11	0.13	0.24	0.25	0.25	0.08	0.08	0.08	0.05	0.05	0.04	0.04	0.04	0.04
Fire Suppression Storage	0.45	0.45	0.45	0.84	0.84	0.84	0.84	0.84	0.84	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Standby Storage	0.71	0.73	0.78	0.64	0.68	0.79	1.57	1.63	1.72	0.47	0.48	0.48	0.22	0.23	0.23	0.19	0.20	0.20
Required Storage Components (MG)																		
To meet 30 psi Requirement	0.32	0.32	0.33	0.83	0.83	0.85	1.23	1.24	1.24	0.64	0.64	0.64	0.41	0.41	0.40	0.21	0.21	0.21
To meet 20 psi Requirement	1.04	1.06	1.12	1.67	1.67	1.69	2.82	2.87	2.97	1.11	1.11	1.12	0.86	0.86	0.85	0.66	0.66	0.66
Storage Surplus / (Deficit) (MG)																		
Meeting 30 psi Requirement	0.81	0.81	0.80	1.97	1.97	1.95	3.10	3.10	3.09	0.16	0.16	0.16	1.01	1.01	1.01	(0.02)	(0.02)	(0.02)
Meeting 20 psi Requirement	0.09	0.07	0.01	1.13	1.13	1.11	1.93	1.87	1.78	1.39	1.39	1.38	0.94	0.95	0.95	(0.25)	(0.25)	(0.25)

5.4.4 Storage Recommendations

To provide sufficient storage to the 670 East Service Area, the District has two (2) options:

1. Make dead storage available by constructing a pump station to pump storage out of the Aspenwood Reservoir.
2. Construct a new 670 East reservoir with a volume of at least 0.2 MG.

As described later in this section, the hydraulic model system analysis recommends that both options be implemented to provide sufficient pressure and fire flow to customers at high elevation in the 670 East Zone when the Ringhill PS is not actively pumping. These are projects ST-1 and PS-1 of the CIP.

5.5 Limiting Capacity Analysis

The capacity of many water system components can be expressed as the number of ERUs that can be served. As described in Section 2, an ERU for the District's system is one that consumes 207 gallons per day (gpd) on an average demand day. On a maximum day, an ERU consumes 451 gpd. These values do not include distribution system leakage.

To determine how many ERUs the District's sources can serve on a maximum demand day, the supply to each service area from the Tolt Taps was divided by the MDD ERU value of 451 gpd. The MDD ERU value was also used to calculate the capacity of the District'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 2037 demand conditions from its total available storage capacity.

The capacity of each service area is either limited by source supply or standby storage. None of the service areas are limited by the amount of equalizing storage available. The 510 West and 670 East service areas are limited by their standby storage capacity, while the 260 West, 570 Central, 420 Central, and 570 East (N/S) are limited by the capacity of the Tolt Taps. In total, based on sources, equalizing storage, and standby storage, the District's water system has a limiting capacity of approximately 28,000 ERUs. This is shown in Table 5.10.

As presented in Section 2, the District predicts serving approximately 21,000 ERUs in 2037. Adding the additional ERUs associated with distribution system leakage and other authorized use, 2037 ERU projections come to about 22,300. Considering sources, equalizing storage, and standby storage, the District's water system has sufficient capacity to meet expected growth within the 20-year planning period.

Note that Table 5.10 does not show a storage deficit for the 670 East Service Area even though a deficit was identified in the storage analysis above. This is because the Aspenwood Reservoir deficit is governed by the fire suppression storage needs. Fire suppression storage is not a function of ERUs and therefore is not represented in Table 5.10.

Table 5.10 Calculated Capacity in ERUs for Each Water System Component

Service Area	510 West	260 West	570 Central	420 Central	570 East (N/S)	670 East	System-wide
Sources	5,655	5,879	10,703	3,930	3,450		29,617
Equalizing Storage	15,690	31,190	50,980	5,420	14,830	1,320	119,430
Standby Storage(1)	4,010	9,740	17,510	9,320	6,980	1,095	48,655
Limiting Capacity	4,010	5,880	10,705	3,930	3,450		27,975

Notes:
(1) Standby Storage available was calculated by subtracting 2037 required equalizing storage and operational storage from available storage above the 20 psi HGL.

5.6 Hydraulic Model Update

The District's hydraulic model is the primary tool for evaluating the District's distribution system. The model evaluates how the District's water infrastructure handles future demands and verifies that recommended improvements will eliminate system deficiencies.

The District maintains the hydraulic model of their distribution system in InfoWater by Innovyze. The hydraulic model was updated and calibrated by RH2. A letter describing RH2's model update, calibration, and existing demand allocation is included in Appendix J. This letter describes that the model had challenges converging on a solution for some nodes when it was provided to Carollo for the analysis of this Plan. Carollo made some adjustments to the supply sources in the model to address the convergence challenge, resulting in a stable model that was able to provide results for all nodes. Carollo then created future scenarios and allocated future demands to the model.

5.6.1 Demand Allocation Process

Demands for planning years 2023, 2027, and 2037 from the medium demand projection scenario presented in Section 2 were allocated to the District's hydraulic model.

The demand projections were calculated based on number of accounts. These demands were converted to a demand per acre factor for each customer class and then existing demands were allocated to parcels in a shapefile representing the District's existing customers. Then demand for each parcel was assigned to its closest model node. Demands for the District's eight largest consumers were applied to the model at the precise location of these customers.

For future planning years, demands for existing customers were scaled down to account for water conservation and additional future demands for future customers were allocated to vacant parcels.

The resulting model demand allocation does not represent actual water use for individual customers. Rather, it represents typical water use based on large groups of customers. Similarly, the actual sites of future development within the planning period is not known, therefore future demands are spread across all vacant parcels.

For future modeling efforts, it may be possible to use the District's new advanced metering infrastructure (AMI) data to allocate actual use per customer to the model nodes for a more refined analysis.

5.6.2 Fire Flows

Fire flow demands were also confirmed in the model. The quantity of water available for firefighting establishes an important level of service for a water system. The District's established criteria for fire flow were used to update the hydraulic model. The following criteria are minimum requirements:

- 1,000 gpm for all single-family residential areas of the District.
- 2,500 gpm for multi-family residential (MFR) and commercial areas of the District
- 3,500 gpm for industrial areas of the District.
- Parks and open spaces within the District were not allocated fire flows.

Figure 5.5 shows the fire flow requirements throughout the distribution system.

5.7 Distribution System Analysis

The hydraulic model was used to evaluate the distribution system under future demand conditions. The distribution system was evaluated against four performance criteria. Areas not meeting the criteria are considered deficient and system improvements are identified to achieve the desired level of service.

5.7.1 Evaluation Criteria

These four evaluation criteria are from the District's policies and criteria presented in Section 4. These policies are at least as stringent as the DOH Design Manual and WAC 246-290 requirements. The distribution system was evaluated for the following criteria:

1. High average day demand (ADD) Pressure. Maximum recommended pressure is 100 psi during ADD.
2. Low PHD Pressure. Minimum allowed pressure is 30 psi during PHD.
3. High Velocity. Maximum allowed velocity is 8 feet per second (ft/s) during PHD.
4. Available Fire Flow. System pressures must remain above 20 psi during MDD plus fire flow conditions.

5.7.2 Identified Deficiencies

5.7.2.1 High ADD Pressures

International plumbing code requires the installation of individual pressure reducing valves (PRVs) when the meter pressure exceeds 80 psi. Although the District has no maximum pressure criteria, system pressure above 80 psi (in orange), and 100 psi (in yellow) are identified for informational purposes. The model was run in extended period simulation during ADD to identify the range of pressures typically experienced in the system. Figure 5.6 shows model nodes with pressures above 100 psi during 2023 ADD, which is the planning year where demands will be the lowest and therefore pressures will be the highest. High pressure nodes under both 2027 ADD and 2037 ADD are the same as those for 2023 ADD.

Areas of high pressure in the system are largely due to topography and are located throughout the system concurrently with drops in elevations. Residences located in the south of Zone 510 West also experience high pressures.

This criterion is a guideline rather than a requirement. The results are provided for the District's information. No improvements are recommended.

5.7.2.2 Low PHD Pressure

PHD conditions were simulated for each planning year to identify areas with operating pressures below 30 psi.

Low pressure nodes under 2027 and 2037 PHD scenarios are the same as those during 2023 PHD. Figure 5.7 illustrates the locations of the areas where pressures drop under 30 psi during PHD in 2037, in pink. Areas dropping below 40 psi during PHD in 2037 were also identified in green for informational purposes. This is the planning year of highest demand and therefore lowest pressure. Areas of low pressures flagged during the analysis are located:

- At the boundary between two (2) pressure zones,
- At high elevation points in the middle of a zone,
- Near the Wellington Reservoir,
- In the 670 East Zone, which is mainly caused by headloss through the system from Aspenwood Reservoir when the reservoir is feeding the zone and Ringhill Pump Station is not actively pumping.

5.7.2.3 High Velocity

The District's goal is to maintain velocities under eight (8) feet per second (fps) in distribution pipes during the PHD. No pipes were found to exceed the velocity criteria in any planning year. Therefore, no improvements are recommended.

5.7.2.4 Available Fire Flow

The District criterion requires fire flows to be met while supplying MDD and maintaining 20 psi throughout the distribution system. Fire flows are typically the largest flows a system experiences and often a major factor in pipe sizing and configurations. The hydraulic model was used to systematically simulate a fire at each model node representing a fire hydrant for each of the planning years. Deficient nodes that cannot provide required fire flows while maintaining system pressures everywhere else in the system above 20 psi are shown in Figure 5.8. Fire flow deficiencies by 2023 are shown in red. Fire flow deficiencies that are not expected to appear until 2027 and 2037 are shown in orange and yellow, respectively.

During the fire flow analysis, reservoirs are set at the 20 psi HGL, which is the bottom of the fire suppression storage component. This is often much lower than typical operating levels. Therefore, locations that may have sufficient pressure and flow during annual hydrant testing may be deficient with these lower reservoir levels.

Fire flow deficiencies were identified throughout the system. Areas of particular susceptibility are 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. Most deficiencies occur in planning year 2023. Additional deficiencies in the later planning years 2027 and 2037, occur in the industrial area of Zone 420 Central (NW). Improvements to address fire flow deficiencies identified to appear in 2027 and 2037 will be needed as redevelopment of these industrial parcels occurs.

5.7.3 Capacity Improvements

Improvements have been recommended to meet the deficiencies identified in the previous section. Improvements include pipe upsizing, main looping, and modifying pressure zone boundaries. The recommended improvements are shown in Figure 5.9. Detailed information on each recommended pipe improvement can be found in Table 5.11, where individual projects may be referenced based on the Project Identification shown in Figure 5.9. Once implemented, these projects eliminate the identified deficiencies and the model predicts that adequate fire flow is available to all junctions except those presented in Figure 5.10. As described in more detail in Section 5.7.3.7, the locations identified in Figure 5.10 are dead ends with a fire flow requirement of 2,500 gpm or greater. It is recommended that the District programmatically consider solutions for these customers.

Each of the recommended improvements require further site-specific and project level engineering analysis before implementation.

Recommended improvements are summarized for each of the District's service areas in the following sections.

5.7.3.1 510 West Service Area Recommended Improvements

Only minor deficiencies are found in the 510 West Service Area. Improvements recommended in this service area mainly concern the piping in the 305 West Zone that appears to experience significant headloss. Improvements to the north of the service are also recommended to mitigate deficiencies observed at the church on 124th Ave Northeast in Zone 420 West (N). Figure 5.9 shows the locations of the proposed improvements needed to mitigate deficiencies in this area.

5.7.3.2 260 West Service Area Recommended Improvements

Deficiencies in the 260 West Service Area are mainly driven by the high required industrial fire flows of 3,500 gpm. The 2,500 gpm required fire flow for multi-family residential customers located on 132nd Ave Northeast also create fire flow deficiencies. The fire requirements can be met with piping improvements, as shown in Figure 5.9.

5.7.3.3 570 Central Service Area Recommended Improvements

Deficiencies in the 570 Central Service Area are mainly driven by the high required industrial fire flows of 3,500 gpm, especially in the 420 Central (NW) Zone. Pipes in this area are too small for the required industrial fire flows and experience too much headloss during fire conditions. The fire requirements can be met with piping improvements as shown in Figure 5.9.

5.7.3.4 420 Central Service Area Recommended Improvements

Deficiencies in the 420 Central Service Area are largely due to a combination of high service elevations and headloss during fire flows along dead-end piping. Figure 5.9 shows the locations of the proposed improvements needed to mitigate deficiencies in this area.

5.7.3.5 570 East (N/S) Service Area Recommended Improvements

Deficiencies in the 570 East (N/S) Service Area are mainly driven by the high required fire flows of 2,500 gpm, required by Laura Ingalls Wilder Elementary School. The fire requirements can be met with upsizing pipes and creating new loops to limit headloss as shown in Figure 5.9.

5.7.3.6 670 East Service Area Recommended Improvements

Deficiencies in the 670 East part of the District's service area were largely due to a combination of high service elevations and headloss during fire flows when the Aspenwood Reservoir is feeding the 670 East pressure zone and Ringhill PS is not actively pumping.

Due to high elevation and headloss throughout the zone, the area located south of Northeast 166th Street does not receive the minimum service pressure of 30 psi, and required fire flow at 20 psi. Further study is proposed to investigate operational and capital improvements that will address low pressures in this area. Preliminary recommendations include building a new elevated tank (CIP project ST-1) in the southern part of Zone 670 East and constructing a new pump station (CIP project PS-1) at the Aspenwood Reservoir to pump out dead storage during a fire.

5.7.3.7 Dead-end Pipes in Non-Single Family Areas Requiring Upsize or Looping

The District has multiple older 6-inch or 8-inch diameter dead-end pipes in non-single family areas that do not have the capacity to provide the District's fire flow requirements of 2,500 gpm or 3,500 gpm. It is recommended that the District 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. In that case, as long as the total fire flow from the multiple hydrants meet the fire flow requirement, not improvement is necessary. In other cases where only one (1) water main serves the customer, looping may been to be installed, or the dead-end main may need to be upsized to 12-inch in order to meet the fire flow requirements.

Figure 5.10 identifies the location of dead-end pipes that cannot meet their fire flow requirement of 2,500 gpm or greater.

5.7.3.8 Improvements to Address Low Peak Hour Pressure

Project ST-1, which involves constructing a new standpipe in the southern portion of the 670 East Pressure Zone resolves the low future pressures identified in that zone.

Some nodes within the District's service area that are located near pressure zone boundaries on the downstream side of PRVs experience low pressure during future peak demands. The District will evaluate these customers on a case by case basis. The District may be able to serve some of these customers from the higher pressure zone. In other cases individual booster pumps may need to be installed.

Some nodes near the Wellington Reservoir experience low pressures. The reservoir needs to be operated above a level of 70 feet in order to maintain 30 psi for all customers.

Other nodes in the middle of pressure zones may experience future low pressures. The only way to increase the pressure to these customers is to install community or individual booster pumps.

Table 5.11 Recommended Improvements

Improvement ID	CIP ID	Location	Improvement Type	Pipe Length (LF)	Existing Diameter (inches)	Proposed Diameter (inches)	Purpose
1	D-39	East Ridge Elementary School along 159th Street, the East end of 156th Place, and the small portion of 223rd Ave between 156th Place and 157th Street.	Distribution Pipe Upsize	1,702	8	12	Improvement needed to serve 2,500 gpm to East Ridge Elementary School.
2	D-1G	Along 128th Street, west of Avondale Road.	New Pipe	747	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
3	D-40	Along 216th Way, in between 141st Street and 216th Ave.	Distribution Pipe Upsize	595	8	12	Improvement recommended due to headloss observed when serving 2,500 gpm fire at the Laura Ingalls Wilder Elementary School.
4	D-1H	West of 184th Ave, south of 182nd Ave, and north of the end of 138th Place.	New Pipe	553	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
5	D-12	Along Woodinville-Snohomish Rd and 200th Street.	Distribution Pipe Upsize	1,995	8	12	Upsize distribution system to meet the 3,500 gpm industrial fire flows in the 260 West Zone.
6	D-1J	Located in between the south ends of 159th Ave and 173rd Street.	New Pipe	341	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
7	D-40	North of 133rd Street, and south of 137th Street.	Distribution Pipe Upsize	929	8	12	Improvement needed to serve 2,500 gpm to Laura Ingalls Wilder Elementary School.
8	D-13	In between Woodinville Redmond Road and 156th Ave.	New PRV	728		12	New PRV station with 728 ft of pipe between Zone 420 Central (S) and Zone 260 West. Required to provide fire flow to Zone 260 West.
9	D-12	Extending past the eastern end of 200th Street, west of 201st Street.	Distribution Pipe Upsize	780	8	12	Upsize pipes from PRV#27 to feed Zone 420 Central (S) 3,500 gpm industrial fire flow.
10	D-12	South of 263rd Street, along 144th Ave, ending at Des Volgne Cellars.	Distribution Pipe Upsize	1,950	8	12	Upsize pipes from PRV#27 to feed Zone 420 Central (S) 3,500 gpm industrial fire flow.
11	D-1B	East of 227th Ave, and west of 152nd Place.	New Pipe	287	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
12	D-3	Along 184th Place, east of cul de sac.	Distribution Pipe Upsize	165	4	8	Upsize 4-inch pipe to 8-inch. The section of 4-inch pipe creates significant headloss and upsizing it will help mitigate fire flow deficiencies in the area.
13	D-15	Along 171st street, in between 143rd Place and 146th Place.	Distribution Pipe Upsize	952	6	12	Upsize currently 6-inch AC pipe feeding Zone 260 West from PRV#4 with 12-inch pipe.
14	D-3	Along 192nd Place, 133rd Place, 193rd Place, 131st Ave, and just north of 195th Street.	Distribution Pipe Upsize	2,035	6	8	Upsize 6-inch AC to 8-inch. This area shows low C factors and this project will decrease headloss and help mitigate fire flow deficiencies in the area.
15	D-3	Along 132nd Place, meeting with 184th Place.	Distribution Pipe Upsize	264	6	8	Upsize section of pipe to serve the 2,500 gpm fire flow at the multi-family complex.
16	D-7	Along 124th Ave, north of 165th Street.	Distribution Pipe Upsize	211	8	12	Recommend upszing pipe downstream of PRV#2 feeding 2,500 gpm to the church on 124th Ave NE. High velocities observed when 2,500 gpm is flowing.
17	D-9	Along 145th Place, meeting 129th Ave from the east.	Distribution Pipe Upsize	400	4	8	Recommend replacing 4-inch dead-end to mitigate 1,000 gpm fire flow deficiency.
18	D-18	South of 173rd Street and east of 148th Ave.	New Pipe	842	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
19	D-40	Along 133rd Street, west of 227th Ave.	New Pipe	1,058	N/A	12	New loop to improve system reliability and mitigate dead-end deficiency. Loop needed to help connection with Redmond 133rd Intertie supply fire flow to the Laura Ingalls Wilder Elementary School.

Table 5.11 Recommended Improvements (continued)

Improvement ID	CIP ID	Location	Improvement Type	Pipe Length (LF)	Existing Diameter (inches)	Proposed Diameter (inches)	Purpose
20	D-31	Along 146th Street, between 181st Place NE and 183rd Avenue NE.	Hydrant Zone Switch, Distribution Pipe Upsize	505	8	12	Pipe serves long dead-end with high elevations for the zone. Recommend switching the fire hydrant to the higher neighboring zone (Zone 570 Central). The customer meter should be left in its current pressure zone because pressures would higher than 100 psi if changed. Pipe upsize is required to supply sufficient pressure to the customer at the end of this main.
21	D-36	West of Avondale Road, along 172nd Street.	Distribution Pipe Upsize	955	6	8	Recommend replacing 6-inch AC dead-end to mitigate 1,000 gpm fire flow deficiency.
22	D-1C	South of 226th Ave, and north of 227th Ave.	New Pipe	348	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
23	D-33	East of 204th Ave, along 176th Street and 201st Street.	Pipe Replacement	1,131	8	8	This improvement concerns a dead-end pipe. Low C factor is causing significant headloss. Recommend performing hydrant test to check C factor and residual pressures at hydrant #0951. This project might be eliminated after field testing. Consider replacing pipe to increase low C factor. Looping of this dead-end to the distribution system is not easily feasible as it would require a private easement from property owner to make the connection and it is not very likely as lots are small and structures are close to property lines.
24	D-30	Along 174th Ave, also running along 160th Street.	Distribution Pipe Upsize	1,505	6	8	Currently 6-inch AC dead-end (low C Factor), recommend replacing with 8-inch to serve 1,000 gpm.
25	D-17	Located near the Ringhill Pump Station.	Pump Station Upgrade				Upgrade fire flow pump at the Ringhill East PS - not enough head to serve fire flow in the 770 Zone.
26	D-17	East of 148th Ave, along 177th Drive.	Distribution Pipe Upsize	921	8	8	Replace 8-inch dead-end pipe with low C factor creating high headloss and fire flow deficiencies. C factor is causing significant headloss and triggers deficiency, recommended performing hydrant test to check C factor and residual pressures at hydrant #1267. This project might be eliminated after field testing if not needed.
27	D-17	Along 178th Street, in between 147th Ave and the end of 151st Way.	New PRV and piping	520	N/A	8	New PRV station between Zone 585 Central and Zone 420 Central (S) with replacement of approximately 520 feet of 4-inch pipe with 8-inch.
28	D-13	North of Woodinville-Duvall Road, and south of North Woodinville Way.	New Pipe	132	N/A	8	8-inch pipe with low C factor creating high headloss and fire flow deficiencies. Recommend looping this dead-end with the water line across the street on NE North Woodinville Way.
29	D-13	Along 148th Ave, in between 195th Street and 198th Street.	New Pipe	639	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency. Help increase fire flow availability to the 3,500 gpm industrial locations from PRV#13.
30	D-13	North of Woodinville-Duvall Road, along 148th Ave.	New Pipe	730	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency. Help increase fire flow availability to the 3,500 gpm industrial locations from PRV#13.
31	D-13	Along 152nd Ave, in between 190th Street and Woodinville-Duvall Road.	Distribution Pipe Upsize	893	6	8	Recommend upsizing 6-inch AC pipe to 8-inch to limit headloss and help mitigate fire flow deficiencies in the area.
32	D-18	Along 173rd Street, near the intersections of 173rd - 151st and 173rd - 172nd.	Distribution Pipe Upsize	639	8	12	Upsize pipe to provide fire flow to Hollywood Hill Elementary School.
33	D-1D	Along 140th Street and 232nd Ave.	New Pipe	844	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
34	D-16	East of the North end of 142nd Ave, and west of Woodinville-Duvall Road.	New Pipe	222	N/A	12	New loop to improve system reliability and mitigate dead-end deficiency.
35	D-16	Along 140th Ave, in between 178th and Woodinville-Snohomish Road.	Distribution Pipe Upsize	1,165	6	8	Replace 8-inch AC with low C factor causing H headloss in the system. This improvement will help mitigate fire flow in the area.
36	D-12	North of 200th Street, along 142nd, ending before the curve.	Distribution Pipe Upsize	693	10	12	Upsize distribution system to provide the 3,500-gpm industrial fire flows in the 260 West Zone.

Table 5.11 Recommended Improvements (continued)

Improvement ID	CIP ID	Location	Improvement Type	Pipe Length (LF)	Existing Diameter (inches)	Proposed Diameter (inches)	Purpose
37	D-03	Along 132nd Ave, in between 190th and 182nd.	Distribution Pipe Upsize	1,984	8	8	Replace 8-inch AC with low C factor causing H headloss in the system. This improvement will help mitigate fire flow in the MFR area located south of the line. Recommend performing fire hydrant test to confirm low C factor in the area.
38	D-22	In between 160th and 164th Ave, along 175th Street.	Distribution Pipe Upsize	1,132	8	12	To provide fire flow to northern part of Zone 650 Central.
39	D-7	Extending off of the end of 165th Street to the east, in between 126th Ave and 124th Ave.	New Pipe	497	N/A	8	Same location as project 16. Create a loop by installing 497 LF of 8-inch pipe extending off of the end of 165th Street to the east, in between 124th Ave NE and 126th Ave NE. Connect to pipe along 124th Ave NE downstream of PRV #2. Provides fire flow to church.
40	D-8	Network for improvement is located on 135th Place, 133rd Place, 154th Drive, and 134th Place, near the Sammamish Reservoir.	Distribution Pipe Upsize	2,741	8	8	305 West Zone shows low C factor. Recommend conducting fire hydrant tests to check headloss. If headloss is as low as indicated by model, pipes may need to be replaced.
41	D-1E	Perpendicular to NE Woodinville Duvall Road and east of the end of 177th Street.	New Pipe	345	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
42	D-14	In between 141st Ave and Woodinville-Snohomish Road.	New Pipe	364	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
43	D-1F	East of 194th Ave and west of the end of 169th Street.	New Pipe	244	N/A	8	New loop to improve system reliability and mitigate dead-end deficiency.
44	D-33	Starting by the Safeway off of Avondale Road, runs north along Avondale Road.	Distribution Pipe Upsize	1,256	8	12	Improvement needed to serve 2,500 gpm fire flow to Bear Creek Elementary School.
45	D-38	Extending past the end of 164th Street, running west ending at Mink Road.	Distribution Pipe Upsize	1,228	6	8	Currently 6-inch AC dead-end with low C factor. Recommend replacing with 8-inch to serve 1,000 gpm fire flows.
46	D-35	In between the west end of 161st Street and 183rd Place, running east/west.	Distribution Pipe Upsize	873	6	8	Currently 6-inch AC dead-end (low C Factor), recommend replacing with 8-inch to serve 1,000 gpm.
47	PS-1	Located southwest of the Aspenwood Reservoir.	New Pump Station	37	N/A	12.5	Build a new pump station at the Aspenwood Reservoir (similar concept to the Kingsgate PS). This pump station would be used in a fire to access dead storage while isolating the Aspenwood Reservoir from the distribution system.
48	ST-1	Southern part of Zone 670 East. Exact location has not been determined.	New Standpipe				New 0.2 MG standpipe to maintain the HGL in the southern part of Zone 670 East.
-	ST-1		Zone 670 Study				Recommend study for service of the 670 East Zone with new standpipe and emergency pump station at the Aspenwood Reservoir.

Note:
(1) LF: Linear Feet.

Section 6

WATER USE EFFICIENCY AND REUSE

6.1 Introduction

Woodinville Water District (District) recognizes the importance of water use efficiency efforts and is in compliance with annual submissions of its Water Use Efficiency (WUE) report to the Washington State Department of Health (DOH).

The District first implemented a water conservation program in 1992 and continues to maintain a comprehensive, proactive program in water conservation, as detailed in the following section. The District further recognizes the importance of regional coordination and supports the development of regional, as well as local, water conservation programs. The District endorses and participates in conservation programs through the Saving Water Partnership (SWP) with Seattle Public Utilities (SPU), and as such, is committed to supporting the current water conservation goal developed by the Seattle Water Supply Operating Board for the years 2013 - 2018. The current regional goal is to reduce per capita water use from current levels so that the total average annual retail water use of the members of the SWP is less than 105 million gallons per day (mgd) from 2013 – 2018 despite forecasted population growth. This goal was also formally adopted by the District at a public meeting held on May 21, 2013. The District plans to participate in the next Saving Water Partnership Regional Water use Efficiency Goal and Program, which will cover 2019 through 2028.The District publicizes regional program opportunities and participates in local events to increase awareness of water saving measures their customers can implement themselves.

This water conservation plan is not intended to be used as a response to a water shortage emergency. A separate Water Shortage Contingency Plan has been created to address emergency situations and is on file with the District.

6.2 Past WUE Performance

The District's customers continue to use water more efficiently. For example, between 2006 and 2015 the number of connections in the District increased by 4.7 percent, however during that same time period the District's total water purchase decreased by 2.2 percent.

6.2.1 Distribution System Leakage

Since 2008 the District has maintained distribution system leakage (DSL) levels under 10 percent. Table 2.4 of Section 2 documents the District's DSL levels over the last decade.

6.3 Water Use Efficiency Goals

6.3.1 Regional Goals

As a wholesale customer of SPU, the District is a member of the SWP, which conducted its "1% Water Conservation Initiative" from 2000 to 2010, and continued its water conservation program to meet WUE goals in 2007 – 2012 and 2013 – 2018. The District will remain a partner in the next established regional goal for conservation, which will cover 2019 – 2028. As such, the requirements under the WUE Rule are being met by the District through its regional partnership with SPU.

Current Goal – as stated earlier, the current SWP goal is to: Reduce per capita water use from current levels so that total average annual retail water use of members of the SWP is less than 105 mgd from 2013 – 2018 despite forecasted population growth. As of the end of 2017, the SWP met its goal using 96.6 mgd in 2017.

When the SPU water use efficiency goals are updated at end of 2018 the District will adopt the new goals at that time.

6.3.2 District Targets

In addition to regional goals, the District has its own water use efficiency targets. The first target is to reduce the District's Equivalent Residential Unit (ERU) value (starting at 207 gallons per day (gpd)) by one (1) percent annually for 2016 through 2027 and 0.5 percent annually for 2028 through 2037. This target is reflected in the low demand projection scenario described in Section 2 and corresponds to an ERU value of 183 gpd in 2027 and 175 gpd in 2037.

The District's second WUE target is to maintain a DSL level below 5 percent. This goal is also incorporated into the District's low demand projections.

6.4 Water Use Efficiency Measures

Conservation activities the District has implemented or is currently administering are described below. The District has had an active Water Conservation Program since 1992. The current Conservation Program is built around the regional SWP Program and includes requirements for House Bill 1338, also referred to as the Municipal Water Law (MWL). For current planning requirements, the District is classified as a medium Municipal Water System because it has between 1,000 and 25,000 service connections. Table 6.1 outlines the current planning requirements and applicable conservation programs for the District.

Table 6.1 Summary of Current Conservation Programs and Planning Requirements

Public Education	Technical Assistance	System Measures	Incentives/Other Measures
Local Coordinated Programs: *School Outreach Programs*(1)*:* K-12 water conservation programs coordinated through the District's consultant, Nature Vision. --- *Speakers Bureau*(1)*:* District's educational consultant "Nature Vision" provides group presentations as needed for Science Fairs, etc. Other speakers from the District available upon request. --- *Program Promotion:* Newsletter three times per year, free brochures available at District office, website information and press releases. --- Waterwise Gardening Classes with instruction by local horticulturists; Celebrate Woodinville annual event, and other fairs upon request.	*Bills Showing Consumption History:* Each bill shows previous year and billing cycle usage.	*Source Meters:* All Tolt Tap meters are in place and operating continuously. --- *Service Meters:* All customers in the District have service meters that report consumption in gallons rather than CCF. --- *Distribution System Leakage (DSL):* DSL in the District averages under 10%. District is not required to implement leak detection program.	Regional Programs: *Customer Education:* Classroom presentations for K-12 grade students; Community festivals and events; water efficient gardening classes for residents; garden hotline to answer questions about water-efficient gardening and other topics; landscape professional training; gardening brochures and fact sheets, technical assistance to residential and commercial customers on irrigation efficiency issues; technical assistance to commercial customers on indoor efficiency issues; regional website full of comprehensive information, tips, rebate information, etc. (www.savingwater.org); regional conservation hotline 206-684-SAVE. --- *Rebate Programs:* Toilet rebates for single family, multi-family, and commercial customers; Urinal rebates; Commercial Dishwasher Rebates; Commercial Ice Machine Rebates; Food Steamer Rebates; Coin-Operated Clotheswasher Rebates; Cooling Tower Improvement Rebates; Water Smart Technology Program for businesses that provides rebates up to 50% of installed cost for water related equipment; Irrigation System Rebates for single family, multi-family and commercial customers, all administered by the SWP. --- *Conservation Pricing:* A Winter and Summer consumption charge is in place to discourage unnecessary use in summer. Also an Excess Capacity Charge applies to all usage greater than 25 CCF or 18,700 gallons per billing cycle and is in addition to consumption charges.

Notes: These programs are discussed in detail in the following sections. Planning requirements taken from "Conservation Planning Requirements" DOH Guidebook, 1994.
(1) The District implements these types of programs even though they are not required for medium sized public water systems.

6.4.1 Public Education

Public education includes school outreach, speakers' bureaus, publishing information on the District website, promotions through local media outlets, and participation in theme shows and fairs. The District considers participation in public events and/or school outreach programs on a case-by-case basis.

6.4.1.1 School Outreach

Several educational programs have been offered through the District's various educational consultants at the elementary, middle school and high school level. The District's current environmental education consultant, Nature Vision, provides instruction upon request to ten (10) public elementary schools, two (2) junior high schools, and two (2) high schools. Instruction is also provided, upon request to private schools and home-school programs, as budget allows. Topics range from the "Water Cycle" at the elementary level to "Groundwater" and "Water Conservation" at the junior high school level and by specific request for the high school level. Curriculum for all ages was developed using funding from the SWP.

Other Educational Programs: Since 1992, the District has implemented many water conservation education projects throughout our service area. With the installation of our first waterwise garden in 1994 we were able to begin holding Spring Garden Open Houses with gardening classes presented by local horticulturists. This grew so much it became a north end regional Spring Garden Fair held at UW Bothell. The District also wrote grants for school water conservation projects and assisted with the installation of waterwise gardens at four (4) local Northshore School District schools. The District continues hosting waterwise gardening classes at the District office.

6.4.1.2 General Public Outreach

Distributing materials relating to water conservation efforts is a major component of the District's conservation program. The District office maintains a supply of various conservation materials available for interested parties at its office. Also located adjacent to the Demonstration Garden at the District office is a kiosk of brochures available at all hours of the day to anyone that wishes to stop by the office for waterwise gardening and landscaping ideas.

The District's website (www.woodinvillewater.com) provides links to various resources, online guidebooks, and partner websites for water conservation advocates and authorities, such as the SWP, U.S. Environmental Protection Agency (EPA), and Seattle Tilth (an organic, sustainable gardening resource). For the most part, the District's conservation information is derived from the SWP, the American Water Works Association (AWWA), and other similar organizations.

Customer Newsletter.

Three times per year the District mails a newsletter to customers. Each newsletter includes information on water conservation. The newsletter announces rebate programs, classes, gives tips on conserving water and water efficient gardening, and lists available resources for more information.

Speakers Bureau.

The District looks for opportunities to utilize speakers who are available to attend a variety of service and community groups. Speakers are available to discuss District programs, rates, water supply, water conservation and water quality.

Program and Project Promotion.

The District works regionally with SPU and its wholesale purveyors and other agencies to publicize the need for water conservation. Regional promotion is done through many avenues, including the savingwater.org website. District staff works with SPU and its wholesale purveyors to develop summer campaign messages for regional consistency. In addition, the District promotes programs and/or classes and provides information through the local newspaper, the Woodinville Weekly.

The District has also participated in local science fairs and the City of Woodinville's annual event, Celebrate Woodinville, in order to promote water conservation.

6.4.2 Technical Assistance

Technical assistance includes any of the following activities: customer assistance, technical assistance, studies and bills showing consumptive history. Any customer may receive technical assistance, upon request, through the District.

Customers can participate in all aspects of the water conservation program through the regional SWP Program. The District continues to participate in the SWP's Regional Conservation Program, the details of which are described in the following paragraphs.

6.4.2.1 Customer Assistance start here

The District offers customer assistance as needed upon customer request.

Water Efficient Demonstration Garden.

Originally installed in the Fall of 1993, the Water Efficient Demonstration Garden was reconstructed in 2003 along with the updated District office. The self-guided tour allows customers to see first-hand what water efficient plants look like in a garden setting, and additional information on water-efficient gardening practices is available inside and outside the office at no cost.

Bill Showing Consumptive History

Customer bills show consumption data for the previous year so customers can track their conservation efforts. This allows ratepayers to see if their conservation efforts are working. Abnormally high usage also alerts customers to possible leaks or sprinkler system deficiencies that waste water.

6.4.3 System Measures

System measures are in place to promote conservation through accurate record keeping of source meter volume, service meter volume and unaccounted for water/leak detection.

6.4.3.1 Metering

The District currently has master source meters from SPU along the Tolt and Eastside Pipelines that are maintained and tested periodically. All District customers are metered and the District has a meter replacement program that includes annual testing and replacement of meters. The District also has irrigation meters available for purchase by interested customers. Non-revenue water, which is the sum of water used but not metered by the District and unaccounted-for water (UAW), is monitored continuously and averaged.

In 2014 the District replaced all of their meters with an Advanced Metering Infrastructure (AMI). This change has allowed the District to be informed if a meter has continuous usage over a period of time set by the District. Once the District receives an alarm, the customer is notified of a potential leak. This has resulted in reduced water running to waste and reduced water bills for customers with identified leaks as they are able to make repairs quicker.

With the installation of AMI meters in 2014, customer bills now show consumption in gallons rather than CCF. This is a major step in customer awareness of their consumption patterns since gallons are a much more familiar unit than CCF.

6.4.3.2 AC Replacement Program

The District has observed that asbestos-cement (AC) pipes are more prone to leakage than ductile iron or cast iron water pipes. The District has an aggressive AC pipe replacement program. Since the 2008, the District has replaced approximately 57,000 linear feet of AC Water Distribution Pipe with Ductile Iron Pipe. Approximately 143,000 feet of AC pipe remain in the distribution system. The District's goal is to replace all of its AC pipe by 2037.

6.4.4 Incentives and Other Measures

There are several other ways in which the District promotes water conservation by all customers of the District. Incentives and other measures taken by the District include:

6.4.4.1 Conservation Pricing

Having implemented a summer/winter rate structure, the District encourages conservation by charging a higher unit price for water during the summer months. In addition, the District charges customers an Excess Capacity Charge for all usage greater than 25 hundred cubic feet (CCF), or 18,700 gallons, per billing cycle and is in addition to consumption charges. For Non-Residential customers, the District charges a summer per gallon rate that is a certain price up to the customer's average winter bi-monthly usage and then any usage over that amount is billed at a higher rate. The District periodically evaluates the rate structure to maintain its conservation rate structure.

6.4.4.2 Seasonal Demand Management

Through program promotion and pricing strategies, the District encourages seasonal demand management to help control peak season use by its customers. The District supports landscaping regulations by the agencies governing building and landscaping codes.

6.4.4.3 Data Collection, and Monitoring

As previously described, all of the District's billed customers have AMI service meters installed. While some of the new developments in the District are installing separate meters for irrigation purposes, most single family homes have only one connection with one meter, so it is difficult to know whether conservation improvements are occurring inside or outside of the home. The primary goal of the water use data collection effort, as it relates to conservation, is to determine the average amount of water used on either a per capita or connection basis, depending on the type of connection. The District achieves this through a monthly review of water use records and comparison to previous years. Water use by customer classification is compiled in order to identify annual trends for summer and winter water use. This data, coupled with information regarding weather and implementation of any new conservation programs, provides the District with a mechanism for monitoring overall water conservation efforts. The District had an Evapotranspiration (ET) weather station installed in 1995 to assist commercial and municipal customers with Maxicom software to irrigate efficiently and to provide residential customers with information to irrigate their landscapes efficiently. This weather station was decommissioned in 2016 as it was aged and in need of major improvements if it was kept. Since the development of the new smart irrigation controllers, it was decided to remove the weather station and hold classes to provide customers with information on the new smart controllers and how they can be used to save water and dollars for landscape water use. Regionally, rebates are available for these new controllers. The SPU Resource Conservation Office wanted to test the new smart controllers, so, with District permission, installed two (2) different models for testing in the District's waterwise garden.

6.4.5 Regional Conservation Program

SPU and 18 of its wholesale utility customers operate regional conservation programs collaboratively as the SWP. The regional SWP water conservation program is a comprehensive program that includes education, technical assistance, and financial incentives to help residents and businesses use water more efficiently. The SWP recognizes that the utilities and their customers benefit from a regional conservation program that ensures staff expertise and strong industry partnerships are available to meet a variety of water system needs. This "conservation infrastructure" prepares the region for potential water supply challenges, helps customers use water wisely, and preserves the ethic of stewarding natural resources. The District has adopted the SWP regional 2013 – 2018 WUE Goal established by SPU and its Water Supply Operating Board. The Goal is to: "Reduce per capita water use from current levels so that total average annual retail water use of members of the Saving Water Partnership is less than 105 mgd from 2013 – 2018 despite forecasted population growth." The District plans to participate in the next Saving Water Partnership regional Water Use Efficiency Goal and Program, which will cover 2019 – 2028.

Incentive Programs: The SWP 2013 – 2018 WUE Program customer financial incentives include:

- Toilet rebates for single family, multi-family, and commercial customers.
- Irrigation system rebates for single family, multifamily and commercial customers.
- Urinal rebates.
- Commercial dishwasher rebates.
- Commercial ice machine rebates.
- Food steamer rebates.
- Coin-operated clothes washer rebates.

- Cooling tower improvement rebates.
- Water Smart Technology program for businesses that provides rebates up to 50 percent of installed cost for water related equipment.

Customer Education Programs - Regional programs include:

- Classroom presentations for K-12 grade students.
- Community festivals and events.
- Water efficient gardening classes for residents.
- Garden hotline to answer questions about water-efficient gardening and other topics.
- Landscape professionals training.
- Gardening brochures and fact sheets.
- Technical assistance to residential and commercial customers on irrigation efficiency issues.
- Technical assistance to commercial customers on indoor efficiency issues.
- Regional website full of comprehensive information, tips, rebate information, etc. (www.savingwater.org).
- Regional conservation hotline 206-684-SAVE.

6.5 Water Reuse

The District supports the concept of water reuse by its customers where appropriate, cost effective, and consistent with regulations put forth by the DOH and Washington State Department of Ecology. The Brightwater Treatment Facility currently serves reuse water to customers within the District's service area and others may be served in the future.

Section 7

OPERATIONS AND MAINTENANCE

7.1 Introduction

This Section outlines the operations and maintenance (O&M) programs of Woodinville Water District (District) and provides an overview of the day-to-day operation of the District, routine maintenance of the system, and emergency operating procedures of the District. Specific operation of individual system components are not included herein and are detailed in the O&M manuals for each specific component of the system. Water quality monitoring programs are maintained in accordance with a variety of regulations and in coordination with the District's wholesale water provider, Seattle Public Utilities (SPU). The summary of these activities provided in this section in no way supersedes the authority or procedures detailed in District resolutions and water quality programs. Similarly, the District maintains a separate emergency response plan that details the mitigation and emergency response activities. Sufficient detail is provided to give the reader an overview of operations activities. More detailed information is provided in District O&M Manuals and emergency planning documents that are considered confidential for security reasons.

7.2 District Organization and Management

The District is authorized under the Revised Code of Washington (RCW) Title 57 to operate and maintain a public water and sanitary sewer system. Official Contact Information for the District is as follows:

Address:	Woodinville Water District 17238 NE Woodinville-Duvall Road Woodinville, Washington 98072
Telephone:	(425) 487-4100
Contact Person:	Patrick Sorensen, General Manager
Public Water System Identification Number:	41600Y

The District operates under a Commissioner system wherein five (5) Commissioners are elected by the residents of the District. By resolutions, the Board of Commissioners (Board) makes and establishes policies that govern the operation of the District. The Board holds its regular public meetings on the first and third Tuesday of each month.

Figure 7.1 presents an organization chart for the District while Table 7.1 outlines the specific job responsibilities of each position. Legal counsel and some engineering services for the District are provided by outside consultants approved by the Board. These consultant's report to and coordinate with the District Manager and/or other staff as directed. Financial consultants are utilized as needed for rate analyses, bond counsel, and related tasks.

Table 7.1 Personnel Responsibilities

Position	Responsibilities
General Manager	• Manages and directs the overall operation of the District to ensure compliance with State statutes, District goals and polices, and applicable governmental regulations. • Supervises O&M Manager, District Engineer, Finance Manager, Information Technology (IT) & Customer Service Manager, and Executive Assistant. • Manages the District to achieve goals with available personnel and within budgeted funds; plans and organizes workloads and staff assignments, reviews progress and directs changes in priorities and schedules as needed. • Manages the selection, supervision, and evaluation of staff. Administers work rules, safety requirements, and performance standards. Conducts or oversees performance evaluations; initiates and implements disciplinary actions as warranted. Resolves grievances and other sensitive personnel matters. • Recommends policies, procedures and plans to the Board and carries out directives and policies of the District.
District Engineer	• Leads, plans, organizes, and manages the Engineering department of the District including engineering projects, developer extensions coordination, construction inspection and Geographic Information Systems (GIS) development and maintenance. • Supervises the Senior Project Engineer, Senior Construction Inspector, Safety Officer, and Senior Engineering Technician. • Supervise assigned staff to achieve goals, with available personnel and within budgeted funds; plans and organizes workloads and staff assignments, reviews progress and directs changes in priorities and schedules as needed. Prepare performance evaluations, recommend hires, and make disciplinary recommendations. • Provides leadership, direction, and mentoring. • Recommends the development of short and long range plans; gathers, interprets and prepares data for studies, reports and recommendations.
Senior Project Engineer	• Performs and directs engineering, construction, and related functions within the District; managing capital improvement projects; and coordinating District's engineering projects with state and local agencies. • Develops or reviews the engineering plans and specifications for projects proposed by the District, including capital improvement projects, utility local improvement districts requested by property owners and other projects; directs the collection of all field data and background information for projects. • Performs preliminary project engineering including written project analysis, preliminary drawings and specifications, preliminary cost estimates, and preliminary legal/boundary research. • Develops final project engineering construction drawings and detail specifications either in-house or by directing the activities of outside consultants.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
GIS Supervisor	• Responsible for management of the District's GIS and supervision of the GIS Analyst; which involves overseeing activities related to the design, development and maintenance of the District's GIS; to recommend and implement related policies and procedures; and coordinate information sharing with other government agencies. • Supervises and provides instruction/work assignments to GIS Analyst. • Develops and assures communication and coordination with other District departments involving GIS. Acts as the District wide technical resource for GIS development and integration. • Plans, organizes, coordinates, assigns, and evaluates the work of the GIS Analyst.
Senior Engineering Technician	• Responsible for administrative duties for water and sewer Developer Extension (DE) Agreements, permit application processing, customer inquiries and providing other engineering support services to District Engineers, customers and staff. • Responds to inquiries from contractors, engineers and developers for information and technical assistance with feasibility of water and sewer installations in proposed developments; researches and provides information regarding existing water and sewer facilities and coordinate information through Development Review Consultants. • Assists the public by providing information on infrastructure and development processes, procedures, and regulations.
Senior Construction Inspector	• Inspects the construction of District's water and sewer systems to ensure that contractors meet the requirements of the engineering drawings and contract specifications, and that quality of materials and standards of workmanship conform to District standards. • Inspects construction projects, determines compliance with all permits and standards, issues, and corrections that are needed; resolves disputes with contractors, and approves modifications and changes in the field. Maintains daily log of construction and inspection activities. • Coordinates the activities of contract inspectors and District staff regarding technical job knowledge, methods, techniques, and procedures. Assists the contract inspectors in resolving complex problems. Assists with creating and implementing new procedures and enforces current procedures. • Reviews design drawings for constructability. Provides information and recommendations regarding field installation of water/sewer systems. Discusses construction implications of proposed plans with engineers, provides background and information on property sites and knowledge of construction practices for difficult or unique water or sewer installations.
GIS Analyst	• Facilitates all activities related to the design and maintenance of the GIS. This includes responsibility for documentation, maintenance and reliability of the GIS and related data; provides advanced analysis, digitizing, cartographic design, scripting, programming, geodatabase design and administration; and implementation of standards and procedures to create and maintain the District's GIS. Performs technical updates and contributes content to the Districts Web, Intranet and Internet pages. Provides assistance and backup for essential functions of the Senior Engineering Technician as required. • Maintain and enhance GIS databases. • Update and distribute District hard copy water/sewer map books and associated tables and details. • Organize, maintain, update, analyze and retrieve information from various sources for use with and for the District's GIS.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
Safety Officer	• Responsible for performing a variety of safety oriented activities in meeting the goals and objectives of the District that ensures compliance with applicable laws, ordinances, policies, and guidelines concerning safety and health. • Administers a comprehensive District-wide Safety and Emergency Preparedness programs; assists with the development, writing and implementation of these programs. • Recommends proper measures to assure a safe work environment and safe work practices for District employees and conducts appropriate follow up activities. • Develops, prepares materials, conducts or coordinates safety related training dealing with a variety of safety/emergency preparedness related topics with an emphasis on training to eliminate or reduce job-related injuries.
O&M Manager	• Leads, plans, organizes, and manages the maintenance and operation of water and wastewater departments of the District. • Supervises and provides instruction/work assignments to the Water Quality Technician and Utility Supervisor. • Supervise assigned staff to achieve goals, with available personnel and within budgeted funds; plans and organizes workloads and staff assignments, reviews progress and directs changes in priorities and schedules as needed. Prepare performance evaluations, recommend hires, and make disciplinary recommendations. • Provides leadership, direction and mentoring. • Recommends the development of short and long range plans; gathers, interprets and prepares data for studies, reports and recommendations.
Utility Supervisor	• Responsible for planning, supervising, organizing, and managing the maintenance, repair or construction, and operation of District facilities, including electronic and mechanical systems, and collecting water usage data. • Responsible for planning, supervising, organizing, and managing the maintenance, repair or construction, and operation of the water activities of the District, including electronic and mechanical systems, and collecting water usage data. • Coordinates, schedules, and oversees all activities in area of assignment to assure that work is performed efficiently and according to appropriate guidelines, procedures, and regulations. • Assigns, supervises, and evaluates the work of assigned staff; advises, assists, and trains subordinates as necessary; participates in the selection of new employees and makes recommendations regarding the hiring, discipline, transfer, and termination of subordinate employees. Prepares performance evaluations for assigned staff. • Assures work sites are prepared for work; checks locates. Monitors work in progress and completed assignments; assures that work sites are returned to original condition.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
Utility Systems Supervisor	• Monitors, maintains, and repairs District facilities including Supervisory Control and Data Acquisition (SCADA) system, a variety of electrical and mechanical equipment used in the water distribution system to provide quality and adequate water service to the District and its customers. • Supervises and provides instruction and work assignments to the Utility Systems Technician. On occasion, may provide work assignments and instruction to Utility Worker Lead and Utility Workers. • Assigns, supervises, and evaluates the work of assigned staff; advises, assists, and trains subordinates as necessary; participates in the selection of new employees and makes recommendations regarding the hiring, discipline, transfer, and termination of subordinate employees. Prepares performance evaluations for assigned staff. • Conducts routine inspections and maintenance of all electrical, mechanical, and hydraulic devices at pump stations, Pressure Reducing Valve (PRV) stations, flow stations, and reservoirs. Able to troubleshoot problems and take each station off and on line to perform maintenance including disassembly and assembly of valves and controls and inspect and replace parts. Provides maintenance schedules and documentation on all pumps and generators hours; performs repairs, adjustments, and maintenance on all components of each facility and station. • Monitors and maintains all remote site SCADA systems to ensure fully functioning and responsive systems. Performs analytical and diagnostic tasks on the SCADA site computer and troubleshoots hardware and software problems associated with the system remote site components.
Utility Foreman	• Responsible for planning, supervising, organizing, and managing the maintenance, repair, and operation of District facilities, vehicles, and equipment. • Supervises and provides work assignments and instruction to the Utility Worker Leads, Utility Workers, temporary and seasonal employees. • Supervises, recommends hiring, makes disciplinary recommendations, trains, monitors, and evaluates work performance and prepares performance evaluations. • Coordinates, schedules, and oversees activities in areas of assignment to assure that work is performed efficiently and according to appropriate guidelines, procedures, and regulations. • Meets and confers with contractors, developers, state, county, and city officials, to schedule and plan District jobs; responds to customer inquiries and complaints; responds to emergency situations and troubleshoots problems and projects.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
Water Quality Coordinator	• Responsible for developing, overseeing, and maintaining the District's cross connection control and water quality programs to maintain compliance with state and federal regulations. • May provide work assignments and instruction to Utility Worker Leads and Utility Workers. • Develops implements and monitors the District's cross connection control program to maintain adequacy and compliance. • Communicates in person or in writing to businesses and homeowners on required installation of backflow prevention devices. • Inspects and tests backflow prevention devices to assure proper installation. • Maintains paper, spreadsheet, and database records involving all aspects of the water quality and cross connection programs.
Utility Systems Technician	• Responsible for the on-site O&M of the District's water distribution system, sewage collection system, plants, and reservoirs. Assists Utility Systems Supervisor in utility operations and maintenance activities. Participates in the maintenance of electronic equipment and systems, including the SCADA system. Performs varied manual work and operates heavy and specialized equipment to maintain and/or repair water distribution and wastewater collection systems. • Assists the Utility Systems Supervisor with monitoring, maintaining, and repairing of District facilities including the SCADA system and electrical and mechanical equipment used in the water distribution system. • Responds to customer calls, and assists in running flow tests and fire flow requirements. • Prepares accurate daily work reports, recording time, materials, and equipment requirements.
Utility Worker Lead	• Responsible for the on-site O&M of the District's water distribution system, sewage collection system, facilities, and reservoirs. Assists in training other employees in utility O&M activities. Participates in the maintenance of electronic equipment and systems. Performs varied manual work and operates heavy and specialized equipment to maintain and/or repair water distribution and wastewater collection systems. This is a journey level position which requires only moderate supervision. • May provide work assignments and instruction to Utility Workers and temporary seasonal workers, but does not supervise other positions. • Installs, services, and repairs the District's water and sewer facilities; repairs water and sewer line leaks, flushes water systems, operates vacuum jetting truck to clean out manholes and plugged sewers; installs valves, sets meters; services, installs, and repairs hydrants, taps water and sewer mains for new connections and cut ins for new water mainline construction; repairs curbs and sidewalks; maintains and repairs water and sewer lines, lift and pump stations, roadways and other District-owned buildings and property; locates other utilities for job completion. Restores work area to original condition. • Responds to on-site inquiries and talks with property owners and contractors regarding work being performed and the impact work may have on their property. • Operates, services, and maintains a variety of heavy equipment and small equipment and tools used to repair water and sewer facilities.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
Utility Worker	• Participates in the on-site O&M of the District's water distributions system, sewage collection system, and reservoirs. Performs varied manual work. Maintains accurate records of activities in assigned area; operates heavy and specialized equipment to maintain and/or repair water distribution and wastewater collection systems. Reads and locates water meters as needed. • Installs, services, and repairs the District's water and sewer facilities; repairs water and sewer line leaks, flushes water systems, operates vacuum jetting truck to clean out manholes and plugged sewers; installs valves, sets meters; services, installs, and repairs hydrants, taps water and sewer mains for new connections and cut ins for new water mainline construction; repairs curbs and sidewalks; maintains and repairs water and sewer lines, lift and pump stations, roadways and other District-owned buildings and property; locates other utilities for job completion. Restores work area to original condition. • Responds to on-site inquiries and talks with property owners and contractors regarding work being performed and the impact work may have on their property. • Operates, services, and maintains a variety of heavy equipment and small equipment and tools used to repair water and sewer facilities.
Executive Assistant	• Responsible for developing, administering, and managing administrative functions including: insurance claims, emergency preparedness, and providing executive assistance and support to the General Manager. • Recommends the development of short and long-range plans; gathers, interprets and prepares data for studies, reports and recommendations. • Develops and recommends policies, procedures and budgets to meet goals and objectives. • Serves as the District's Claims Manager and Emergency Preparedness Coordinator. Designated representative to apply for disaster relief.
Public Information Coordinator	• Plans and administers the District's Conservation, Education and Public Information programs. • Develops conservation goals for the District that meet State and Regional mandates. • Administers and monitors the District's Conservation program including budget development. • Develops and administers the Public Information program. • Coordinates with outside consultant and related agencies to provide for public education, outreach and program evaluation.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
Finance Manager	• Responsible for planning, directing, managing and overseeing the accounting and financial functions of the District. • Supervises Billing Associate, Collections Associate, Accounting Supervisor and Customer Service Supervisor. • Supervises assigned staff to achieve goals, with available personnel and within budgeted funds; plans and organizes workloads and staff assignments, reviews progress and directs changes in priorities and schedules as needed. Prepares performance evaluations, recommends hires, and makes disciplinary recommendations. • Provides leadership, direction, and mentoring. • Recommends the development of short and long range plans; gathers, interprets and prepares data for studies, reports and makes recommendations. • Develops and recommends policies, procedures and budgets to meet department objectives and overall goals. • This position supervises and provides instruction/work assignments to the Customer Service Supervisor and IT Support personnel.
Accounting Supervisor	• Responsible for supervising, planning, and overseeing finance functions; provides financial accounting support specifically in the reconciliation and maintenance of the General Ledger and subsidiary ledgers. • Supervises the Senior Accounting Associate and Accounting Associate. • Supervises assigned staff to achieve goals, with available personnel and within budgeted funds; plans and organizes workloads and staff assignments, reviews progress and directs changes in priorities and schedules as needed. Prepares performance evaluations, recommends hires, and makes disciplinary recommendations. • Prepares, maintains and posts financial data to the General Ledger; analyzes and reconciles accounts and prepares journal adjustments; records all accruals, reversals, cash receipts and other accounting transactions in the General Ledger system. • Initiates transfers of funds between King County accounts; reconciles bank balances with District cash accounts and King County Treasurer records; researches errors and initiates corrective action; records monthly bank and credit card fees.
Senior Accounting Associate	• Performs a variety of administrative and technical accounting duties, including accounts payable, purchasing, payroll, maintain employee benefits records, and assisting with annual budget preparation/document production. Ensures purchases are in compliance with District policy and State statutes. Accurately convert requisitions into purchase orders and signs purchase order numbers. Provides purchasing assistance to departments as required. • Verifies accuracy of invoices received by the District prior to entering them into the automated system. Prepares vouchers for approval. • Prepares year-end 1099 forms according to state and federal regulations. • Prepares District payroll for all employees and commissioners. Prepares journal entries to record payroll data in the general ledger.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
Billing Associate	• Performs various duties to coordinate and support ongoing customer billing system operations. • Initiates process to generate weekly billing file; reviews meter reading data for possible errors; issues service orders to check meters that are not transmitting reads, or other billing questions. • Completes Final Read Service Orders, posting reads for Final Bill process. • Reviews back flow and non-communicating meter events in the Automated Meter Reading system. Follow up with service order as needed. • Trouble shoots issues, test processes and update procedures for billing and Automated Meter Reading system.
Accounting Associate	• Performs a variety of accounting duties to support areas of District Finance Department operations. • Processes customer payment files from outsource vendor; enters payments to customer accounts; reconciles system output and resolves/corrects payment errors; researches payment issues. • Compiles necessary data and prepares summaries of daily cash receipts and customer payments; determines total receipts to be deposited to each District fund; prepares the daily bank deposit; delivers the daily deposit to the bank. • Process employee hours into the payroll system; reviews time edits for accuracy; verifies that necessary approval of hours worked and leave are provided; assists with payroll system processing as needed.
Collections Associate	• Performs various duties to coordinate and support ongoing customer billing system operations. • Initiates process to generate weekly billing file; reviews meter reading data for possible errors; issues service orders to check meters that are not transmitting reads, or other billing questions. • Completes Final Read Service orders, posting read for Final Bill process. • Establish new accounts in billing system. Maintains customer account information. Processes billing adjustments.
IT & GIS Manager	• Responsible for planning for District needs and leading, managing and administering the information technology functions of the District. • Supervise assigned staff to achieve goals, with available personnel and within budgeted funds; plans and organizes workloads and staff assignments; reviews progress and directs changes in priorities and schedules as needed. Prepare performance evaluations, recommend hires, and make disciplinary recommendations. • Provides leadership, direction and mentoring. • District-wide IT strategic planning. • Perform the maintenance, oversee the operation, and database management of Customer Information System/Financial Information System (CIS/FIS), it's components and peripherals (hardware and software) including upgrades, integration, troubleshooting, database maintenance, systems integration support, data backup, vendor contacts and maintenance contracts.

Table 7.1 Personnel Responsibilities (continued)

Position	Responsibilities
Customer Service Supervisor	• Responsible for supervising, planning, directing, and overseeing Customer Service employee's daily activities and performing a variety of complex administrative support functions for District Departments. • Supervises and provides instruction/work assignments to Administrative Assistant and Customer Service Associate positions. • Supervise assigned staff to achieve goals, with available personnel and within budgeted funds; plans and organizes workloads and staff assignments; reviews progress and directs changes in priorities and schedules as needed. Prepare performance evaluations, recommend hires, and make disciplinary recommendations. Provide training and development opportunities. • Creates, maintains and organizes various databases/spreadsheets. Performs data entry, modifications and updates; implements database design changes; creates functional queries and reports; verifies accuracy and cross referencing database information with other District applications. • Manipulate data, create/develop, and run reports in the Customer Billing/Financial Information System. Troubleshoot irregularities and problems. • Coordinates and schedules workload assignments for administrative support needs.
Administrative Assistant	• Responsible for performing a variety of complex administrative/clerical support functions for District Departments in meeting the goals and objectives of the District. • Creates, maintains, and organizes various databases/spreadsheets. Performs data entry, modifications and updates; implements database design changes; creates functional queries and reports; verifies accuracy and cross referencing database information with other District applications. • Provides complex administrative support. May conduct research, compile data and prepare documents. • Prepare responses to correspondence containing routine inquires.
Customer Service Associate	• Responsible for performing a variety of customer service oriented activities; primarily providing front line representation of the District responding to customer complaints and inquiries on the phone and customers visiting the District including front desk operations and reception. Provides internal administrative/clerical support. • Provides reception at front desk. Greet customers, answer and routes phone calls. • Responds to customer inquiries/complaints; documents conversations, generates service orders to the field crew and provides necessary follow-up to the customer and documentation. • Provides customers with assistance regarding billing and account information, water/sewer availability certificates, scheduling side sewer inspections, move-in/move-out account updates, customer complaints, forms requests and all other inquiries. • Greet customers and assign/track visitor badges. • Maintains a daily balanced cash drawer, processing/posting customer payments. Close out daily transactions and turns over balance receipts and monies to Finance.

7.3 Personnel Certifications

Washington State Law requires that certified water system operators are employed by the system and that they complete not less than three (3) Continuing Education Units (CEU) every three (3) years. Programs sponsored by Washington Environmental Training Resources Center (WETRC), the Washington State Association of Sewer and Water Districts (WASWD), and the American Water Works Association (AWWA) Pacific Northwest Subsection are readily available sources of CEUs for certified operators in Washington State. The District encourages and supports state certification of operations personnel and sponsors attendance of personnel at appropriate safety and technical seminars. Table 7.2 provides a listing of current certifications held by water system personnel.

Besides providing CEUs, operator training is an important component in maintaining a safe and reliable water system. At a minimum, all personnel performing water system related duties receive training in confined space, trenching and shoring, traffic control, Asbestos Cement (AC) pipe safety, Cross Connection Control, and first aid and safety.

Table 7.2 Personnel Certifications as of May 2018

Staff Member/Position	Certifications
Patrick Sorensen, General Manager	MPA, ICMA-CM
Ken McDowell, P.E. District Engineer	PE, WDM IV
Steve Brown	WDM III, CCS, WWC I, RAMW
Tim Cantwell	WDM IV, CCS, BAT
Jeff Grapp	WDS, WDM II, CCS
Brady Hjort	WDM II, CCS, BAT
James Stephens	WDS, WDM II, CCS
Mike Massena	WDM II, WDS
Kurtis Crilly	WDS, WDM
Michael Green	WDS, CCS
Todd Young	WDS, WDM II, CCS
Dean Lotz	CCS, WDM II, WDS
Jack Baker	CCS, WDS
William Pearson	WDS
DeLynn Erickson	WDS
Daniel Amador	CCS, WDM II, WDS
Christian Hoffman	WDM II
Kurt Oakland	WDS

Notes: Information Current as of July 2018.
(1) BAT = Backflow Assembly Tester.
(2) CCS = Cross Connection Control Specialist.
(3) WDM = Water Distribution Manager.
(4) WDS = Water Distribution Specialist.
(5) PE = Registered Professional Engineer, State of Washington.

7.4 System Operation and Control

Routine operations require the analysis, formulation, and implementation of procedures to ensure that the facilities are functioning efficiently and meeting pressure requirements and other demands of the system. The District's comprehensive operational procedures ensure a prompt response time, ensuring that customers receive high level of quality water services without interruption. The following paragraphs provide an overview of routine operations of the water system.

7.4.1 Supply

Under normal operations, the District strives to maintain a relatively constant flow from the SPU supply system. The storage tanks are operated as full as possible, while preventing closure of the altitude valve that controls flow into those tanks. Each day, the District establishes a setpoint on each Tolt Tap (TT). During the peak water demand period (June 1 to September 1), this setpoint is typically adjusted daily based on water demand, reservoir levels, and weather conditions. During the low water demand period (September 1 to June 1), the flow control setpoint is adjusted as needed.

The District has a total of ten (10) active taps to the Tolt River supply, eight (8) to the Tolt Pipeline Number 1 (TPL1) and two (2) to the Tolt Eastside Supply Line. Two of these taps (76 and 77) are connected and metered, but only come on-line in the case of an emergency. All taps are equipped with source meters and detailed information on each is provided in Section 3 of this Plan. Source meters are located in the same vaults as the source flow control valves. Flow at the source meters is monitored through the SCADA system. The flow control valve setpoints are remotely controlled from the District headquarters through the SCADA system.

7.4.2 Supervisory Control and Data Acquisition

The existing SCADA system allows for continuous monitoring and control of the system from District Headquarters. The system assists with optimization of system operations and monitoring data is utilized for a variety of analytical and record keeping purposes. Primary monitoring, control, and reporting are provided by the system:

Monitoring:

- Pump Stations - Cumulative and instantaneous flow.
- Reservoirs - Flow and reservoir levels.
- Source Meters - Cumulative and instantaneous flow.
- Tolt Taps - Hydraulic gradient at TT-76, TT-77, TT-78, TT-79, TT-80, TT-167, and TT-195.
- Alarm status.
- Video feeds at remote sites.
- Chlorine residual.

Control:

- Pump Stations - Pumps controlled remotely through SCADA system.
- Reservoirs - Control of altitude valves, where applicable.
- Source Meters Locations - Control of flow control valves.
- Alarms - Auto dialer goes to computer modem using WIN 911 software. WIN 911 has a separate modem and a dedicated phone line.

Reporting:

- Daily, monthly, and annual reports.
- Alarm history.
- Historical trends over a 1 year period.

7.4.3 Reservoirs

As presented in Section 3, the District owns and operates eight separate water reservoirs to provide equalizing, fire and standby storage in accordance with the Washington State Department of Health (DOH) criteria. The control of each storage facility is summarized in Table 7.3. In general, reservoirs are operated as full as possible while preventing closure of the altitude valve that controls flow into each tank. At the same time, circulation of water through reservoirs is critical to maintaining chlorine residuals and preventing stagnation of water impounded in reservoirs. Balancing these two parameters of reservoir operation is critical to water quality control and recent implementation of disinfection by-product monitoring will assist in striking the appropriate balance seasonally.

Table 7.3 Reservoir Controls

Reservoir	Operation Levels (Height in Feet)		Seismic Protect.	Control System
	On	Off		
Hollywood	18	26	Yes	Reservoir is fed directly from TT-80. Seismic valve is located inside a vault at the Hollywood Pump Station.
Brookside	14	16.6	No	Fed by TT-125. Floats on the 420 Central Zone.
Sammamish	26	31.1	Yes	Fed by TT-167. A combination flow control valve/altitude valve controls reservoir flow. Equipped with Seismic Control Valve.
James Bard Memorial	17	19.4	Yes	Fed through the 670 East Zone. Reservoir is operated full and cycled manually once per month to maintain water quality. Equipped with Seismic Control Valve.
Kingsgate	86	95.3	Yes	Fed by TT-195. The Kingsgate Pump Station allows the full volume of the tank to be used. Equipped with Seismic Control Valve.
South Hollywood	80	85.9	Yes	Fed by TT-57. Currently, the South Hollywood Pump Station allows the full volume of the tank to be used for maintaining sufficient pressure in the 570 Central Zone. Equipped with Seismic Control Valve.
Wellington	72	78.3	Yes	Reservoir floats on the 570 Central Zone. Equipped with Seismic Control Valve.
Aspenwood	97	115	Yes	Fed by Ringhill Pump Station during high demands and by gravity during low demands. No altitude control valve. The Ringhill Pump Station gravity feed has a PRV set to 67 psi. Equipped with Seismic Control Valve.

Notes:
(1) Altitude valve setpoints were measured in feet starting from the bottom of the reservoir (2/2/07).
(2) Tanks with seismic protection contain Seismic Valves located in a control valve vault, unless otherwise noted.
(3) psi: pounds per square inch.

7.4.4 Pump Stations

The District has seven (7) pump stations, two of which have been deactivated. Table 3.5 in Section 3 summarizes pump station specifications, capacity, and other data. The five (5) active pump stations have various control features, as listed in Table 7.4: Pump Station Controls, below. There is a diesel-fueled generator at each pump station that can provide from 7 to 14 days of standby power.

Table 7.4 Pump Station Controls

Pump Station	Control Features
Hollywood	Pumps from the Hollywood Reservoir to the 650 Central Zone. Pumps operate when system pressures in 650 Central are low. Low pressure in the system generally occurs when: - Pressure on the TT-80 drops below 55 psi or - Demand is too high for gravity to maintain 50 psi. TT-80 fills the reservoir and provides water to the zone through a gravity fed 3 inch PRV when Tolt HGL is high and system demands are low.
South Hollywood	TT-57 fills the reservoir and the pump station pumps to the 570 Central Zone. When the pressure drops to 31 psi, the controller refers to FM2 to identify which pumps are called on. When the South Hollywood Reservoir level rises above level 565 feet (32 psi @ PT1) all pumps are shut off. When the tank level falls below 558 feet, the controller operates pumps in a predetermined sequence.
Ringhill	Pumps from TT-78 to the 670 East Zone. The Ringhill pumps have variable frequency drives. Flow control valves automatically modulate to meet the pressure and flow demand in the system. The pump station is also equipped with a local pressure transmitter located on the pump discharge header to enable automatic, backup operation in the event of a remote sensor failure or communications failure at the Aspenwood Reservoir.
Ringhill East	Pumps from the 670 East Zone to 770 East Zone to serve 25 developed lots in the Lake of the Woods East development area. Two (2) hydropneumatic tanks and two (2) jockey pumps regulate constant pressure in the 770 East Zone. As demand increases and pressure in the system decreases, an additional fire pump in the station is activated. The pumps have the following pressure setpoints: - Jockey Pump #1 - 72 psi. - Jockey Pump #2 - 68 psi. - Fire Pump - 45 psi.
Kingsgate	Pumps from the Kingsgate Reservoir to the 510 West Zone. Pumps operate when system pressures in the 510 West Zone are low. TT-195 fills the reservoir and provides supply to the zone through a gravity PRV, much like the Hollywood booster pump station.

Notes:
(1) Reintree and Cottage Glen pump stations have been decommissioned.
(2) HGL: Hydraulic Grade Lines.

7.4.5 Pressure Reducing Valves

There are currently 45 active PRVs in the District's system to control flow from the Tolt Pipeline and between pressure zones. Information on the PRVs is detailed in Section 3, Table 3.6.

7.5 Preventative Maintenance Program

The District's preventative maintenance program has been developed to ensure reliable operation of the system components. The Utility Supervisor tracks and schedules the preventive maintenance program through a formal workload management plan. A summary of the preventative Maintenance schedule is provided in Table 7.5 below.

Table 7.5 Preventative Maintenance Schedule

Frequency	Task
Storage Facilities	
Daily (M,W,F)	Check security and inspect facilities for proper operation.
Annually	Clean and check interior condition, vents, hatches, etc.
As Needed	Repaint interior and exterior of storage tanks (estimated 15 to 25 year frequency).
Water Mains	
Annually, or As Needed	Flush dead end mains (or as needed due to water quality complaints or known problem areas). Leak detection survey performed as determined necessary.
Supply and Pump Stations	
Weekly	Observe and record motor current draw (three phases); check packing; log and record volume delivered and pump motor hours; check motor oil level; measure and record discharge pressure; check motor noise, temperature, vibration. Check for sufficient fuel in the generators if they have been activated since previous inspection.
Weekly	Check security.
Annually	Change motor oil.
As Needed	Calibrate flow meter; maintain electrical and mechanical equipment; paint structures and piping.
Pressure Reducing Stations and Emergency Interties	
Annually	Flush and check all valves and screens; check pressure settings.
As Needed	Rebuild and paint every seven (7) years or as necessary.
Isolation Valves	
Annually	Operate full open/closed; uncover where buried; clean out valve boxes and repair as necessary.
Hydrants	
Annually	Operate, test and flush; check drain rate; lubricate as necessary; measure pressure; paint as necessary.
Meters	
2-10 Year Intervals	Time and measure volume of meter-delivered flow; dismantle, clean, and inspect all parts, replace worn or defective parts; retest meter for accuracy. Frequency varies based on meter size.

Table 7.5 Preventative Maintenance Schedule (continued)

Frequency	Tasks
Air and Vacuum Release Valve and Blow-off Assemblies	
Annually	Flush and inspect.
Telemetry and Control System	
Daily	Check master and remote terminal units (RTUs) for proper operation; repair as necessary.
Annually	Upgrade software if possible.
As Needed	Software maintenance and system backups.
Equipment/Rolling Stock	
Weekly	Check all fluid levels and brakes.
As Needed	Replace fluids and filters in accordance with manufacturer's recommendations (or more frequently depending on type of use).
Tools	
As Needed	Clean after each use; lubricate and maintain as necessary.

7.6 Equipment and Supplies Inventory

The District maintains an inventory of spare parts for valves, telemetry, circuit boards, repair sleeves, and couplings for all pipes in the system. In addition, there are two fully equipped service trucks for the water system, one for PRV maintenance, and one for main repair. A list of service representatives used by the District for major water system components is provided in Table 7.6.

Table 7.6 Supply & Equipment Contacts

Equipment	Company	Address	Phone Number
Electrical and Power	Puget Sound Energy	18150 NE Fall City Hwy. Redmond, WA 98052	(425) 885-7599
Special Service Lines	Frontier Phone	P.O. Box 740407	(800) 921-8102
	Frontier ISP		(877) 600-1511
	Comcast Corp. Internet	P.O. Box 34744	(800) 934-6489
	Allstream Phone	P.O. Box 2966	(800) 360-4467
Natural Gas	Puget Sound Energy	805 - 156th NE Bellevue, WA 98004	(425) 447-0700
Telemetry	Technical Systems, Inc. (TSI)	2303 - 196th SW, Suite B Lynnwood, WA 98036	(425) 775-5696
Pumps	Cascade Machinery	4600 E. Marginal Way S. Seattle, WA 98134	(206) 762-0500
Control Valves	G.C. Systems, Inc.	13107 NE 20th, No. 6 Bellevue, WA 98007	(425) 882-2198
Miscellaneous Repair Fittings	H.B. Jaeger	1830 16th St, Snohomish, WA 98290	(360) 568-5958
Emergency Field Repair	The District currently uses MRSC Rosters for professional services and small works rosters for emergency field repair work.		

7.7 Water Quality

The DOH has adopted federal regulations that specify minimum monitoring requirements for water systems. Sampling requirements are governed by the population served, source type, and source treatment that is provided. Specific sampling requirements are contained in the Washington Administrative Code (WAC) 246-290-300. The District is responsible for maintaining water quality standards, specifically within the confines of its transmission, storage, and distribution system. Water quality is ensured by testing in accordance with all current federal and state requirements, as adhered to by a schedule agreed upon between the District and DOH. Water Quality sampling requirements are summarized in Table 7.7.

Because the District purchases all of its source water directly from SPU, responsibilities for water quality monitoring are shared by SPU and the District. This reduces regional water quality monitoring costs and maintains a regional water quality perspective to determine effectiveness of current treatment at the regional level. This information is presented to District customers annually in accordance with the U.S. Environmental Protection Agency (EPA) requirements under the Clean Water Act. Public notification of water quality data is provided annually by the District in Consumer Confidence Reports (CCR). A copy of the most recent CCR is included in Appendix I.

Table 7.7 Tolt River Supply Water Quality Testing

Regulation	Location	Test	Last Tested	Schedule	Comments
Revised Total Coliform Rule	Distribution System	Routine Coliform	On-going	SPU draws 50 samples per month by agreement with DOH. 50 samples are normally required for a population of between 41,001 and 50,000. The samples are collected from 12 sample stands throughout the distribution system.	SPU does initial routine coliform sample collection; follow-up repeat coliform samples are collected by WWD.
Surface Water Treatment Rule	Distribution System	Daily Chlorine Residuals	On-going	SPU draws samples each month at the same time and place that Coliform Sampling is performed. The District also collects daily samples at representative locations throughout the system.	A detectable residual in 95% of the samples taken each calendar month is required for compliance.
N/A	Distribution System	Fluoride	On-going	Tested Annually.	WWD is not required to sample Fluoride.
National Primary and Secondary Drinking Water Standards	Distribution System	Asbestos	2010	Every 9 years, next one will be conducted in 2019.	If asbestos pipe is less than 10% of total inventory, a waiver can be granted.
Lead and Copper Rule	Customer's taps	Lead and Copper	2016	11 samples every 3 years. The most recent sample was conducted in Summer 2017.	Source: Corrosion of household plumbing systems.
Stage 1 and 2 Disinfection Byproducts Rule	Distribution System	Disinfection-by-products (TTHM, HAA5 and bromate)	N/A	SPU collects samples for TTHMs and HAA5s from sample stands in the District's distribution system every 90 days.	WWD completed the IDSE Standard Monitoring Plan in 2008. Compliance is based on running annual average at each DBP sample location (LRAA). SPU collects treated water bromate samples at the Tolt Treatment Facility.
National Primary and Secondary Drinking Water Standards	Raw Water	Total Organic Carbon (TOC)	On-going	Raw water sample each month.	Naturally present in environment.

7.7.1 Coliform Monitoring

The Revised Total Coliform Rule requires the District to perform routine (monthly) coliform sampling at a frequency proportional to the population served. SPU currently performs all routine coliform sampling throughout the District's distribution system. A total of 50 samples are taken each month at 12 sample stations. A further discussion of the water quality monitoring program is contained in the District's Coliform Monitoring Plan located in Appendix I.

The District is in full compliance with the Revised Total Coliform Rule.

7.7.2 Chlorine Residual Monitoring

SPU draws chlorine residual samples each month at the same time and place that coliform sampling is performed from 12 sample stands. The District also collects chlorine residual samples on a regular basis from four (4) baseline sample sites and twelve (12) sample stations throughout the distribution system.

Detectable chlorine residual must be maintained throughout the distribution system. The District is in compliance, however, during the winter months the District has noticed low free chlorine residuals in some portions of the eastern pressure zones of the District. Likely lower winter demands and the corresponding increased retention time in reservoirs are contributing to loss of chlorine residual. It is recommended the District perform additional water quality monitoring and conduct an evaluation to troubleshoot the low chlorine residual challenge.

7.7.3 Lead and Copper Monitoring

The lead and copper rule is intended to reduce the tap water concentrations that can occur when corrosive source water causes lead and copper to leach from water meters and other plumbing fixtures. The District collects 11 samples every 3 years. The most recent set of customer tap samples were collected summer of 2017.

The District is in full compliance with the Lead and Copper Rule. Recent results are shown in Table 7.8.

Table 7.8 Lead and Copper Monitoring Results

Parameter	MCLG(1)	Action Level	2014 Results(2)		2017 Results(2)	
			Results	# Homes Exceeding Action Level	Results	# Homes Exceeding Action Level
Lead, ppb(1)	0	15	2.9	0 of 11	4	0 of 11
Copper, ppm(1)	1.3	1.3	0.16	0 of 11	0.15	0 of 11

Note:
(1) MCLG: Maximum Contaminant Level Goal ppb: parts per billion ppm: parts per million.
(2) 90th Percentile.

7.7.4 Disinfection Byproducts Rule

The Stage 1 and Stage 2 Disinfection By-products Rules (DBPR) require testing to monitor the presence of disinfection by-products within the water system. These by-products are formed as water ages, and chlorine dissipates from the drinking water supply. The District completed an initial distribution system evaluation (ISDE) and submitted a Disinfection By-products (DBP) monitoring plan to the EPA, which are included in Appendix I. SPU monitors DBPs for the District.

The District is in full compliance with the Stage 1 and 2 DBPR. 2017 monitoring results are shown in Table 7.9.

Table 7.9 2017 LRAA DBPR Monitoring Results by Sample Site

Parameter	MCL[1]	104-1	104-6	104-10	104-4
Total Trihalomethanes, ppb	80	29	31	41	23
Haloacetic Acids, ppb	60	24	27	24	23

Note:
(1) MCL: Maximum Contaminant Level.

7.7.5 Potential Future Regulatory Requirements

Long-term revisions to the Lead and Copper Rule are anticipated. In January, 2018 the EPA held a consultation with state and local governments on their upcoming revision to the Lead and Copper Rule. Items subject to revision may be tier criteria, service line replacement, corrosion controls, and water quality parameters. It is unknown when these revisions will be finalized.

The District does not anticipate any issues with meeting future lead and copper requirements based on the information available. The District will revisit the proposed rule when specific requirements are published.

7.8 Cross Connection Control

The District has adopted a cross connection control program to comply with WAC 246-290-490 pertaining to contamination of potable water due to cross connections. Backflow prevention devices are required at service connections where a potential for contamination exists. In March 2001, the District submitted a copy of their Cross Connection Control Plan (CCCP) to DOH. The Plan remains as submitted with no changes at this time. The District complies with the ten (10) minimum elements specified in WAC 246-290-490(3). To demonstrate compliance with the current Cross Connection Control requirements, the minimum elements are described below:

Element 1: Establish Legal Authority. On October 5, 1999, the District adopted Resolution No. 3320 that established legal authority to implement a cross connection control program. This resolution was updated April 5, 2016 with Resolution 3841 and contains policies and enforcement to ensure that consumer's comply with the CCCP. A copy of this resolution is located in Appendix G. The District also has a written agreement with the City of Woodinville and King County to make sure that the CCCP is being applied in these areas.

Element 2: Procedures/Schedules for Hazard Evaluations. The District evaluates new and existing service connections to make sure the connection does not pose a danger to the distribution system. The District requires premise isolation with a Reduced-Pressure Backflow assembly (RPBA) to be installed on all commercial connections. All new connections are protected at the time of installation, existing connections are protected when an upgrade in plumbing occurs or when the District requires a re-evaluation of the devices. Resolution No. 3841 states that "all commercial and high hazard services RPBAs are tested, at a minimum, annually at the property owner's expense." The owner provides the annual reports required by the CCCP to the CCS. Re-evaluations of service schedules and procedures for notification to the consumer and the local administrative agency are located in the approved CCCP on file with DOH.

Element 3: Procedures/Schedules to Eliminate/Control Cross Connections. The resolution and the CCCP require that approved RPBAs be installed to protect the public water supply. At a minimum, annual testing of the backflow devices at the owner's expense is required in accordance with the District's CCCP.

Element 4: Provide Qualified Personnel. The District has hired a fulltime Water Quality – CCS. Several of the District's staff are certified CCS, as indicated previously in Table 7.2.

Element 5: Procedures/Schedules for Backflow Preventer Inspection and Testing. At a minimum, the District requires annual testing of the backflow devices at the owner's expense in accordance with the District's CCCP.

Element 6: Assembly Testing Quality Assurance/Quality Control (QA/QC). The District ensures that results from backflow prevention assembly inspections and tests are documented and reported in an acceptable manner. The District monitors tester certifications and test kit calibrations. The District requires test reports to be filled out completely and to be submitted in a timely manner.

Element 7: Backflow Incident Response Plan. The District has procedures for responding to a backflow incident and implementing enforcement (when appropriate) in accordance with Resolution 3320, CCCP, and WAC 246-290-490.

Element 8: Public Education. The District provides cross connection educational material for customers that include pamphlets, periodic bill inserts, and the District's newsletter. This educational material reports on the CCCP, its purpose, and rationale.

Element 9: Establish/Maintain Cross-Connection Control Records. The District, through their CCS, has developed and maintained cross connection control records in WAC 246-290-490(3)(j) and (8). The District maintains a data base that tracks all relevant information including master list of service connections, inventory information, backflow incidents, and annual summary reports.

Element 10: Meet Additional Reclaimed Water Requirements. The Brightwater Treatment Plant located north of the District's retail water service area (RWSA) produces reclaimed water that is wheeled through the District's RWSA to customers located south of the District's RWSA boundary. There is a possibility that customers within the District's RWSA could be served by Brightwater reclaimed water in the future.

7.9 Mapping and As-Built Drawing Records

Drawing and map maintenance is essential to system maintenance crews, planners, engineers, developers, and anyone else needing to know how the water system is laid out throughout the District. As-builts and other drafting records are stored digitally and in mylar format, and are maintained by the Engineering Department. A GIS-based master drawing of the water system is also maintained by the IT & GIS Department to provide an accurate water system map for use by all District personnel. The drawing is created from as-built records and contains water main information such as pipe size, material, and year installed.

The District is currently upgrading the GIS to a server based platform and will be providing digital tablets and laptops for use in the field. The ArcServer platform will also provide the ability for customers to utilize interactive mapping to find information related to their property and District facilities.

7.9.1 Location of Records

The following identifies the location where the District stores records:

- Bacteriological Analysis, Chemical Analysis: Water Quality Office.
- Daily Source Meter Reading: SCADA system.
- Project Reports, As-Builts, Construction Drawings: Archives in Building "A."
- Comprehensive Water Plan: District Library.
- Other Water Related Records: Archives in Building "A", Finance.

7.10 Safety Procedures and Equipment

Safety is the concern and responsibility of all water system O&M staff. Staff regularly participates in safety and training programs to keep abreast of the latest changes in the water industry and to ensure smooth and safe operation of the water system.

To maintain the highest level of safety, the District has taken steps toward educating staff and providing resources to ensure a safe working environment. The District strives to improve its safety program on an on-going basis. The AWWA publishes a manual entitled Safety Practices for Water Utilities (M3), which describes safety programs and provides guidelines for safe work practices and techniques for a variety of water utility work situations. This manual is available to all District personnel. The District has also developed its own safety programs and training that are available to all personnel that identifies safety procedures for the following O&M tasks:

- Safety and health orientation.
- Safety audit.
- Slips, Trips & Falls.
- Safety Responsibility.
- Traffic Control.
- Hearing conservation.
- Fall protection.
- Back injury prevention.
- Medical & First aid.
- Slips, trips, and falls.
- Asbestos awareness.
- Trenching and shoring.
- Respiratory protection.
- Confined spaces entry.
- Motor Vehicle Fleet Safety.
- Lock out Tag out.

Safety training classes in first aid, cardiopulmonary resuscitation (CPR), and traffic safety are required of all District staff. The District utilizes the online Vivid Safety training for all staff. In addition, safety talks are conducted weekly for all operations personnel. The following identifies procedures to be followed for O&M tasks that involve the most common potential work place hazards in the water system.

The District's O&M Department follows all appropriate Occupational and Safety Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) regulations in its day-to-day operations and complies with the following state requirements:

- WAC 296-809-500 to 800: Entry into confined spaces.
- WAC 296-155-650 to 66411 Part N: Shoring of open ditches.
- WAC 296-155-429: Lockout-tag-out for work on energized or de-energized equipment or circuits.
- Chapter 296-155 WAC Part C1: Fall restraint for access to the top of the City's water reservoirs.
- Manual on Uniform Traffic Control Devices: Traffic control for work in the public right-of-way.
- All requirements and training necessary to maintain state certifications.

Use of Chlorine or Chlorine Products: Standard Procedure – Handle with care, provide adequate ventilation, wear safety glasses, rubber gloves, and an appropriate respirator, and follow the all safety data sheets (SDS) and facility Standard Operating Procedures (SOP's).

Working in Confined Spaces: Standard Procedure – Follow state requirements for confined space entry.

Working around Heavy Equipment: Standard Procedure – Obtain proper training and follow all safety procedures. Use noise protection equipment.

Working in Traffic Areas: Standard Procedure – Wear proper clothing and provide adequate signage and flagging for work area. State Certified flaggers are to be used when traffic management requires flagging around a work site.

Working on or Around Water Reservoirs: Standard Procedure – Obtain proper training and follow proper safety harness procedures for working on tall structures. Entry into a reservoir is considered entry into a confined space work area. Follow State regulations and procedures for confined space entry.

Working in or Around Pump Stations: Standard Procedure – Obtain proper training and follow all safety procedures for working on pumps and electrical equipment. Use appropriate noise protection equipment. Use lockout-tag-out safety procedure.

Working on AC Water Main: Standard Procedure – Obtain proper state certified training and follow all safety procedures for working with asbestos materials.

Working on Pressurized Water Main: Standard Procedure – Obtain proper training and follow all safety procedures for working with pressurized water mains.

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

- First aid & Bloodborne Pathogens kits in each vehicle and workshops. Automated external defibrillator (AED) in Buildings, A, B, C and Trucks 54 and 70.
- Safety boots.
- Safety eye glasses and goggles.
- Ear plugs, Ear muffs.
- Retroreflective vests and pants.
- Fall harnesses.
- Fire extinguishers.
- Chemical aprons.
- Gloves.
- Hard hats.
- Respirators.
- Eye wash stations.
- Trench shoring equipment.
- Air tester for confined spaces.
- Confined space blower.
- Traffic safety equipment.
- Construction radios and cell phones.
- Driver training.

7.11 Emergency Operations

The District is well equipped to accommodate short-term system failures and abnormalities. Its capabilities are discussed in the following paragraphs.

7.11.1 Multiple Supply Capability

Should the District lose the operation of its main supply stations, it would not adversely impact its ability to meet normal water demands of its customers. The District has emergency interties with the City of Bothell, City of Redmond, Cross Valley Water District, and the Northshore Utility District that could be used in the event that its main supply is unavailable. The District also has an emergency well with a bladder and dispensing unit to provide water to the public if the Tolt supply is down.

7.11.2 Multiple Reservoirs

Multiple Reservoirs and their associated transmission mains, the Booster and Supply Stations, and pressure reducing valves provide the capability to distribute water throughout the system when one of the reservoirs is out of service.

7.11.3 Distribution System

Water mains are looped wherever possible to improve water circulation and reliability.

7.11.4 Emergency Equipment

The District is equipped with the necessary tools to deal with common and serious emergencies associated with water main failures. If a more serious emergency should develop, such as a major weld rupture or collapse, the District will utilize the MRSC roster to locate an available local contractor for assistance in alleviating the emergency condition.

7.11.4.1 Emergency Telephone

Key or "on-call" personnel can be reached by the Districts internal phone system, Police Department, Fire Departments, and 911.

7.11.4.2 On-Call Personnel

The on-call technician is equipped with a cell phone and service vehicle and is typically able to respond to emergency calls within 30 minutes. A list of emergency telephone numbers is provided to each on-call employee. New employees are not placed on-call until they are familiar with the water system and maintenance procedures.

7.11.4.3 Material Readiness

Some critical repair parts, tools, and equipment are on-hand and kept in fully operational condition. As repair parts are used, they are immediately re-ordered to replenish the parts inventory. Inventory is kept current and is adequate for most common emergencies that are reasonably anticipated. In addition, agreements are in place with certain vendors in case of an unanticipated emergency. The District has access to an inventory of repair parts, including parts required for the repair of every type and size of pipe within the service area.

7.11.5 Cross Training

O&M employees are trained in all areas of the District. By cross training, the District is able to draw from a pool of workers that are qualified to deal with water related issues in the event of an emergency. This places the District in a position of readiness, enabling it to effectively deal with almost any problem that arises.

7.12 Emergency Response Program

The District's Emergency Response Plan, prepared by the District and included in Appendix I, identifies procedures that would be carried out in the event of a serious emergency or disaster situation. The District has also prepared a Vulnerability Assessment Study that identifies the District's vulnerability of the water system and contingency plans for responding to potential emergency conditions. Copies of the Vulnerability Assessment Study are kept on file with the District and are considered confidential under the provisions of the Homeland Security Act.

7.13 Public Notification

The federal Safe Drinking Water Act and WAC 246-290-330 require purveyors to notify their customers if any of the following occurs:

- Failure to comply with a primary MCL described under WAC 246-290-310.
- Failure to comply with a surface water treatment technique.
- Failure to comply with monitoring requirements under WAC 246-2 90.
- Failure to comply with testing requirements.
- Failure to comply with a DOH order.
- Failure to comply with a variance or exemption schedule from DOH.
- If system is identified as a source of waterborne disease outbreak.
- If DOH issues the system a category red operating permit.
- If DOH issues an order.
- If the system is operating under a variance or exemption.

The required content, distribution channels, and time limit requirements of notifications are specified in WAC 246-290-330.

Section 8

CAPITAL IMPROVEMENT PLAN

8.1 Introduction

This chapter combines the various projects that were recommended in previous sections of this Water System Plan (Plan) for the Woodinville Water District's (District's) water system and presents a comprehensive capital improvement plan (CIP). The purpose of the CIP is to provide the District with a guideline for planning and budgeting of its water system. The CIP consists of schedule and cost estimates for each project. Project phasing is described as either short-term (2018 - 2027), or long-term (2028 - 2037). Detailed descriptions of each project that include the cost estimates and implementation timing are included in Appendix K. Appendix K also includes a summary table that shows the CIP costs for each year through 2027.

8.1.1 Capital Project Categories

Capital projects can be categorized by the nature of the infrastructure involved. These include:

- Distribution (D).
- Pressure Zone (PZ).
- Supply (S).
- Storage (ST).
- Pump Station (PS).
- District-Financed (DF).

The above abbreviations were used as the initial letter in the Project Identification and aid in delineating the project category. Distribution projects contain new pipe, pipe upsizing, and pipe repair and replacement (R&R) projects. Supply, pumping, and storage to serve these customers are included in the respective category.

8.1.2 Capital Project Types

Projects can be allocated into three types to support development of rates and standard development charge (SDC) charges:

1. Capacity – Projects that provide additional system capacity to meet future demand growth. These projects are typically funded by connection fees.
2. Repair & Replacement – Non-capacity-related projects that involve replacing or maintaining existing infrastructure without increasing capacity or level-of-service. These projects are typically funded by reserves.
3. Improvement – Projects that increase level-of-service (i.e., redundant pumping, backup power, pipe upsizing, fire flow, system reliability, etc.) of existing infrastructure. These projects are typically funded by rates.

Projects may include elements of multiple capital project types. Each project was defined as one or more of the three project types by assigning a percentage of the total project cost to each project type. The allocations between multiple types were made based on professional judgment.

8.2 Pipeline Risk Evaluation

The District's existing pipelines were evaluated for risk in order to aid in project prioritization. As described in Section 3, a majority of the pipe that is expected to reach the end of its useful life during the 20-year planning period is asbestos cement (AC) pipe. Therefore, only AC pipe was included in this risk evaluation.

The District has a goal to replace all of its AC pipe within the 20-year planning period because it is prone to leakage and poses a risk of health hazards when exposed. The District's water system contains approximately 143,000 feet of AC pipe. In order to replace all of this pipe within the 20-year planning period, the District will need to replace approximately 7,150 LF of AC pipe each year. For the period of 2008 to 2017, the District replaced 57,000 LF of AC main, or an average of 5,700 LF per year.

The CIP does not contain a separate project or category for the District's AC main replacement program. AC pipe replacement segments were combined with nearby pipe capacity upgrade segments to create CIP projects in the Distribution (D) category that are the right size for the District to put out to bid.

Risk of an asset is a measure of the impact of asset failure on the overall system. Risk is calculated as the product of vulnerability and criticality, or:

Risk = Vulnerability x Criticality

Vulnerability represents the likelihood of failure, and criticality represents the consequence of failure.

Due to limited data, for the purpose of this evaluation, a vulnerability score was assigned to each AC pipe based on its remaining useful life. A pipe is more likely to fail if it is reaching the end of its useful life. Vulnerability scores ranged from 1 (low vulnerability) to 4 (high vulnerability) as shown in Table 8.1. A map of the AC pipes color-coded by vulnerability score is included in Figure 8.1.

A criticality score was assigned to each AC pipe segment based on engineering judgment. A criticality score of 1 indicates a small diameter pipe that does not serve very many customers and would not greatly impact the water system if it were to fail. A criticality score of 4 indicates a large diameter pipe that supplies many customers and would greatly impact the system in the event of failure. The range of criticality scores are shown in Table 8.2. Each AC pipe is shown on a map with a color indicating its criticality score in Figure 8.2.

A risk score was then calculated for each AC pipe segment by multiplying its criticality score by its vulnerability score. As shown in the matrix of Table 8.3, risk scores from 1 to 4 were considered low risk, risk scores from 5 to 8 were considered medium risk, and risk scores from 9 to 16 were considered high risk. Figure 8.3 is a map of the District's AC pipe color-coded by risk score. About 57,000 LF of AC main are considered high risk, 79,000 LF are considered medium risk, and 7,000 LF are low risk.

Table 8.1 Vulnerability Scoring

Replacement Period	Vulnerability Score	Vulnerability Category
2018 - 2037	4	High
2038 - 2039	3	Medium high
2040 - 2044	2	Medium low
Beyond 2044	1	Low

Table 8.2 Criticality Scoring

Criticality Score	Criticality Category	Comments
4	High	Large diameter pipe, serving many customers, high consequence of failure
3	Medium high	
2	Medium low	Small diameter pipe, serving few customers, low consequence of failure
1	Low	

Table 8.3 Risk Scoring

		Criticality Score			
		1	2	3	4
Vulnerability Score	1	1	2	3	4
	2	2	4	6	8
	3	3	6	9	12
	4	4	8	12	16
Risk		Low	Medium	High	
Linear Feet of AC Main by Risk Score		7,000	79,000	57,000	

8.3 Cost Estimating Assumptions

8.3.1 Cost Estimate Level

The CIP cost estimates presented in this chapter are Class 4 estimates. Class 4 estimates are budget level estimates. Actual costs may vary from these estimates by -15 percent to +30 percent. These costs were determined based on the District's perception of current conditions at the project locations.

All costs are in 2018 dollars. The Engineering New Report (ENR) U.S. 20-City Construction Cost Index for March 2018 is 10959. The estimates are subject to change as the project design matures. Cost of labor, materials, equipment may vary in the future.

8.3.2 Pipeline Unit Costs

Pipeline unit cost assumptions are shown in Table 8.4. These costs were developed from recent construction costs of various water pipelines. To be conservative, these unit costs assume open-trench construction in improved areas. If trenchless construction is possible for some projects, the cost estimates may need to be modified. Costs include pavement cutting, excavation, hauling, shoring, pipe materials and installation, backfill material and installation, and pavement replacement. The unit costs are for "typical" field conditions with construction in stable soil at a depth ranging between 3 to 5 feet. The total project costs included an additional 30 percent for contingency and 20 percent for engineering, legal, administrative, and planning costs. For specific projects that required heavy traffic control, the contingency was increased according to District estimates.

Table 8.4 Pipeline Unit Costs

Pipe Size (Inches)	Pipeline Unit Cost ($/LF)
6	$250
8	$268
10	$298
12	$340
16	$400
18	$415
20	$425
24	$483
30	$580

8.3.3 Pump Station Costs

Pump station costs were estimated by the District and are shown in the project sheets. These costs also include a 30 percent contingency and 20 percent engineering, legal, administrative, and planning costs.

8.3.4 Supply Costs

New supply project costs were developed by the District and are shown in the project sheets in Appendix K. Contingencies were assumed to already be included in the costs provided by the District.

8.3.5 Storage Costs

New storage project costs were developed based on typical costs from past projects. Conceptual costs for reservoirs vary by type: ground, standpipe, and elevated. Costs are estimates based on reservoir volume in gallons (gal), as presented in Table 8.5. Storage costs are sensitive to site-specific geotechnical and seismic considerations; therefore, it is recommended that a reservoir siting study that addresses these issues be conducted at the initiation of a new storage project. The total project costs also include an additional 30 percent contingency and 20 percent for engineering, legal, administrative, and planning costs.

Table 8.5 Reservoir Unit Costs

Reservoir Type	Cost per gallon ($/gal)
Ground	$1
Standpipe	$2
Elevated	$4

Note:
(1) Reservoir unit costs are for construction only.

8.3.6 Additional Costs

Other costs for the CIP included; pressure reducing valve (PRV) station, chlorine station, and easement acquisition. Conceptual costs were estimated based on past projects and District cost estimates, as presented in Table 8.6

Table 8.6 Additional Costs

Type	Unit Cost
PRV Station	$100,000/each
Chlorine Station	$20,000/each
Easement Acquisition(1)	$45/LF

Note:
(1) Easement acquisition per District and adjusted for planning purposes; using percentage of the cost per square foot of the assessed value of property (w/out improvements) and multiplied by the area of the easement.

8.4 CIP Project Sheets and Cost Summary

CIP projects were identified based on the analyses presented in previous sections. The CIP projects summarized in Table 8.7 are in 2018 dollars and have not been escalated. The table presents the costs for the short-, and long-term planning horizons. Additionally, it allocates projects between the capital project types (i.e., Capacity, R&R, and Improvements). The table provides a total cost and average annual cost for all CIP items.

An individual project sheet was generated for each CIP project and includes project identifier, description, costs, project type, timeline, and comments to aid in future implementation. To aid in finding individual projects, project sheets have been separated by project category. The project sheets are included in Appendix K. A summary of costs by project category and type is presented at the end of this section.

8.4.1 Distribution Project Sheets

Most of the distribution projects were identified in Section 5 – Water System Analysis, as shown in Figure 8.4. Distribution (D) projects also include the AC main replacement program. The AC main replacement program is not a separate CIP project. Rather, as seen on Figure 8.4, AC main replacement segments and capacity upsize pipe segments located in the same area were combined to form CIP projects that are the right size for the District to execute as one project.

General notes on the distribution system projects include:

- Projects are generally numbered by location, beginning in the northwest of the District and moving toward the southeast. Projects are prioritized by the following designations: low, medium-low, medium-high, and high and based on the risk evaluation, results from the system analysis, and from District input. The projects are shaded in Figure 8.4 to indicate the prioritization.
- D-1 consists of 11 pipe segments that require private easements before installation. This project provides the funds to initially acquire the easements and is scheduled to be completed by 2026. D-1 pipe segments are anticipated to be installed in the long-term planning horizon.
- R&R (including AC main replacement) components of the D projects were discussed with District staff and combined with projects that were in the same approximate location in order to create right-sized projects for contracting out.

Table 8.7 CIP Project Summary

Capital Improvements Program Summary																			
Project		Total CIP Cost Estimate	CIP Phasing													Project Type			
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Short-term (2018-2027)	Long-term (2028-2037)		Capacity	Repair & Replacement	Improvements
Distribution System		$ 69,103,000	$ 266,000	$ 4,358,000	$ 2,709,000	$ 1,328,000	$ 2,720,000	$ 1,994,000	$ 3,408,000	$ 2,519,000	$ 1,132,000	$ 1,895,000	$ 22,329,000	$ 46,774,000				
D-1	Easements - Unincorporated KC; New Pipe	$ 2,489,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 328,000	$ -	$ 328,000	$ 2,161,000		0%	0%	100%
D-2	205th Ave NE R&R	$ 260,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 260,000		0%	100%	0%
D-3	NE 184th Place, NE 192nd Place Pipe Upsize; 132nd Avenue NE Pipe Replacement	$ 3,311,000	$ -	$ -	$ -	$ -	$ -	$ 331,000	$ 2,493,000	$ 487,000	$ -	$ -	$ 3,311,000	$ -		0%	70%	30%
D-4	NE 178th Street R&R	$ 914,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 914,000		0%	100%	0%
D-5	NE 177th Place R&R	$ 598,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 598,000		0%	100%	0%
D-6	135th Ave NE R&R	$ 311,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 311,000		0%	100%	0%
D-7	NE 165th St Pipe Upsize and New Pipe	$ 312,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 31,000	$ 281,000	$ -	$ 312,000	$ -		0%	0%	100%
D-8	305 West Zone Investigation.	$ 75,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 75,000		0%	0%	100%
D-9	NE 145th Place Pipe Upsize; Leak Row Service Lines; R&R Pipe	$ 483,000	$ -	$ 483,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 483,000	$ -		0%	61%	39%
D-10	NE 140th St R&R	$ 926,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 926,000		0%	100%	0%
D-11	NE 132nd St R&R	$ 5,098,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,098,000		0%	100%	0%
D-12	NE 200th Street, 144th Avenue NE, 142nd Avenue NE	$ 2,812,000	$ -	$ -	$ -	$ 200,000	$ 1,999,000	$ 613,000	$ -	$ -	$ -	$ -	$ 2,812,000	$ -		0%	14%	86%
D-13	N. Woodinville Way Pipe Upsize; 148th Ave NE New	$ 1,178,000	$ -	$ -	$ 118,000	$ 1,060,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,178,000	$ -		0%	23%	77%
D-14	141st Ave NE New Pipe; NE 190th Place R&R	$ 2,150,000	$ -	$ -	$ -	$ -	$ -	$ 19,000	$ 169,000	$ -	$ -	$ -	$ 188,000	$ 1,962,000		0%	100%	0%
D-15	NE 171st Street, R&R	$ 1,081,000	$ -	$ -	$ -	$ -	$ 108,000	$ 973,000	$ -	$ -	$ -	$ -	$ 1,081,000	$ -		0%	61%	39%
D-16	140th Avenue NE Pipe Replacement; 142nd Ave NE	$ 582,000	$ -	$ -	$ -	$ -	$ -	$ 58,000	$ 524,000	$ -	$ -	$ -	$ 582,000	$ -		0%	80%	20%
D-17	154th Court NE Pipe Upsize, NE 177th Drive and NE	$ 370,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 370,000		0%	100%	0%
D-18	173rd St NE Pipe Upsize; 148th Avenue NE New Pipe	$ 681,000	$ -	$ -	$ -	$ 68,000	$ 613,000	$ -	$ -	$ -	$ -	$ -	$ 681,000	$ -		0%	0%	100%
D-19	Dead-End at 168th St New Pipe; R&R Pipe	$ 2,106,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 211,000	$ 1,895,000	$ 2,106,000	$ -		0%	100%	0%
D-20	156th Ave NE; NE 195th St. R&R	$ 2,428,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,428,000		0%	100%	0%
D-21	NE 180th Street at Lake Leota R&R	$ 1,441,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,441,000		0%	100%	0%
D-22	NE 175th Street Pipe Upsize; R&R Pipe	$ 2,195,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,195,000		0%	77%	23%
D-23	NE 160th St R&R	$ 1,406,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,406,000		0%	100%	0%
D-24	168th Ave NE, NE 145th St R&R	$ 1,551,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,551,000		0%	100%	0%
D-25	162nd Ave NE R&R	$ 1,898,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,898,000		0%	100%	0%
D-26	NE 195th Street R&R	$ 2,699,000	$ 151,000	$ 2,548,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,699,000	$ -		0%	100%	0%
D-27	NE Woodinville Duvall Rd R&R	$ 3,725,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,725,000		0%	100%	0%
D-28	174th Ave NE R&R	$ 1,380,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,380,000		0%	100%	0%
D-29	NE 160th Pl R&R	$ 3,433,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,433,000		0%	100%	0%
D-30	NE 160th Street Pipe Upsize; R&R Pipe	$ 2,703,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,703,000		0%	78%	22%
D-31	NE 146th Street Pipe Upsize	$ 226,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 226,000		0%	0%	100%
D-32	Dead-end NE 129th Way	$ 1,110,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,110,000		0%	0%	100%
D-33	Avondale Road NE, NE 176st Street Pipe Upsizes, R&R	$ 1,796,000	$ -	$ 180,000	$ 1,616,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,796,000	$ -		0%	43%	57%
D-34	NE 165th Place R&R	$ 3,668,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,668,000		0%	100%	0%
D-35	NE 161st PL and NE 172nd Street Pipe Upsize; R&R	$ 2,223,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 222,000	$ 2,001,000	$ -	$ -	$ 2,223,000	$ -		0%	84%	16%
D-36	NE 161st PL and NE 172nd Street Pipe Upsize; R&R Pip	$ 3,120,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 312,000	$ -	$ 312,000	$ 2,808,000		0%	86%	14%
D-37	Mink Road R&R	$ 2,427,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,427,000		0%	100%	0%
D-38	NE 164th Street Pipe Upsize, Dead End Connection at N	$ 1,700,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,700,000		0%	71%	29%
D-39	223rd Avenue NE, Dead end at NE 166th Street	$ 1,083,000	$ -	$ 108,000	$ 975,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,083,000	$ -		0%	0%	100%
D-40	NE 133rd Street Pipe Upsize; NE 133rd Street New	$ 1,154,000	$ 115,000	$ 1,039,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,154,000	$ -		0%	0%	100%

Table 8.7 CIP Project Summary (continued)

Capital Improvements Program Summary																			
Project		Total CIP Cost Estimate	CIP Phasing												Project Type				
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Short-term (2018-2027)	Long-term (2028-2037)	Capacity	Repair & Replacement	Improvements		
Pressure Zone		$ 1,946,000	$ -	$ 122,000	$ 425,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 967,000	$ 979,000					
PZ-1	New PRV Station	$ 475,000	$ -	$ 50,000	$ 425,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 475,000	$ -	0%	0%	100%		
PZ-2	Zone 670 Study	$ 72,000	$ -	$ 72,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 72,000	$ -	0%	0%	100%		
PZ-3	Zone 420 Central Fire Flow Deficiency	$ 10,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,000	0%	0%	100%		
PZ-4	PRV Station Rehabs	$ 1,020,000	$ -	$ -	$ -	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 420,000	$ 600,000	0%	0%	100%		
PZ-5	PRV and Pipe Replacement along 178th St.	$ 359,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 359,000	0%	0%	100%		
PZ-6	Zone 420 Central (NE) Fire Flow Deficiency	$ 10,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,000	0%	0%	100%		
Supply		$ 725,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 440,000	$ 15,000	$ 15,000	$ 575,000	$ 150,000					
S-1	SRRWA Annual Funding	$ 300,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 150,000	$ 150,000	0%	0%	100%		
S-2	East Service Area 2nd Tap to SPU Tolt River Line	$ 425,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 425,000	$ -	$ -	$ 425,000	$ -	0%	0%	100%		
Storage		$ 19,581,000	$ 2,199,000	$ 336,000	$ 1,898,000	$ 1,949,000	$ 2,406,000	$ 2,108,000	$ 158,000	$ 1,651,000	$ 2,395,000	$ 3,281,000	$ 18,381,000	$ 1,200,000					
ST-1	Zone 670 East Storage	$ 1,200,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,200,000	0%	0%	100%		
ST-2	Hollywood Reservoir - Upgrade Improvements	$ 1,899,000	$ -	$ 150,000	$ 1,749,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,899,000	$ -	0%	0%	100%		
ST-3	James Bard Reservoior -Upgrade Improvements	$ 1,800,000	$ -	$ -	$ 149,000	$ 1,651,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,800,000	$ -	0%	50%	50%		
ST-4	Aspenwood Standpipe - Upgrade	$ 1,583,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 158,000	$ 1,425,000	$ -	$ -	$ 1,583,000	$ -	0%	50%	50%		
ST-5	Sammamish Reservoir Upgrade	$ 2,256,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 226,000	$ 2,030,000	$ -	$ 2,256,000	$ -	0%	50%	50%		
ST-6	Wellington Reservoir Upgrade	$ 1,838,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 184,000	$ 1,654,000	$ 1,838,000	$ -	0%	50%	50%		
ST-7	S. Hollywood Reservoir Upgrades	$ 1,808,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 181,000	$ 1,627,000	$ 1,808,000	$ -	0%	50%	50%		
ST-8	Kingsgate Standpipe - Construction	$ 4,812,000	$ -	$ -	$ -	$ 298,000	$ 2,406,000	$ 2,108,000	$ -	$ -	$ -	$ -	$ 4,812,000	$ -	50%	0%	50%		
ST-9	Brookside Reservoir Upgrade Improvements	$ 2,385,000	$ 2,199,000	$ 186,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,385,000	$ -	0%	0%	100%		
Pump Station		$ 6,495,000	$ 750,000	$ 165,000	$ 299,000	$ 1,476,000	$ 475,000	$ -	$ -	$ -	$ -	$ -	$ 3,165,000	$ 3,330,000					
PS-1	Aspenwood Pump Station	$ 2,250,000	$ -	$ -	$ 299,000	$ 1,476,000	$ 475,000	$ -	$ -	$ -	$ -	$ -	$ 2,250,000	$ -	0%	0%	100%		
PS-2	Ringhill East Pump Station Upgrade	$ 300,000	$ 300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 300,000	$ -	0%	0%	100%		
PS-3	Emergency BPS in 650 Central Zone	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 750,000	0%	0%	100%		
PS-4	Low Pressure Program	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%	0%	100%		
PS-5	Replace Hollywood Pumps	$ 200,000	$ 200,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 200,000	$ -	0%	100%	0%		
PS-6	Replace Ringhill Pumps	$ 250,000	$ 250,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 250,000	$ -	0%	100%	0%		
PS-7	Wellington Booster Pump Station	$ 1,080,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,080,000	100%	0%	0%		
PS-8	New Generator for Ringhill BPS	$ 165,000	$ -	$ 165,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 165,000	$ -	0%	100%	0%		
PS-9	Hollywood Pump Station Replacement	$ 1,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,500,000	0%	100%	0%		
District-Financed		$ 5,873,000	$ 707,000	$ 1,006,000	$ 695,000	$ 195,000	$ 195,000	$ 195,000	$ 195,000	$ 195,000	$ 195,000	$ 195,000	$ 3,773,000	$ 2,100,000					
DF-1	2016 Water System Plan Update	$ 138,000	$ 138,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 138,000	$ -	33%	33%	34%		
DF-2	Dead End Main Program	$ 500,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 500,000	$ -	0%	0%	100%		
DF-3	Little Dead End	$ 350,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 350,000	0%	0%	100%		
DF-4	2016 PRV Rehabilitation	$ 500,000	$ -	$ -	$ 500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 500,000	$ -	0%	100%	0%		
DF-5	KC 218th Ave NE Drainage Imp	$ 188,000	$ -	$ 188,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 188,000	$ -	0%	100%	0%		
DF-6	KC NE 133rd St/NE 128th St Rd Imp.	$ 563,000	$ -	$ 563,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 563,000	$ -	0%	100%	0%		
DF-7	Chlorine Stations	$ 150,000	$ 90,000	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ -	0%	0%	100%		
DF-8	Certification of Emergency Well	$ 150,000	$ 150,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 150,000	$ -	0%	0%	100%		
DF-9	Water Seismic Resilience Plan	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%	100%	0%		
DF-10	2028 Water System Plan Update	$ 300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 300,000	33%	33%	34%		
DF-11	Bulk Water Station	$ 62,000	$ 62,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 62,000	$ -	0%	0%	100%		
DF-12	COW Sammamish River Bridge AC Replacement	$ 42,000	$ 42,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 42,000	$ -	0%	100%	0%		
DF-13	WSDOT Lt. Bear Creek/SR-202 Culvert Replacement	$ 30,000	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ -	0%	100%	0%		
DF-14	Misc. COW and KC Projects	$ 400,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 200,000	$ 200,000	0%	0%	100%		
DF-15	ESA Removals	$ 500,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 250,000	$ 250,000	0%	0%	100%		
DF-16	District Participation in DE Projects	$ 2,000,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 1,000,000	$ 1,000,000	0%	0%	100%		
CIP Total		$ 103,723,000	$ 3,937,000	$ 6,002,000	$ 6,041,000	$ 5,023,000	$ 5,871,000	$ 4,372,000	$ 3,836,000	$ 4,865,000	$ 3,797,000	$ 5,446,000	$ 49,190,000	$ 54,533,000	$ 3,630,540	$ 61,752,256	$ 38,340,204		
Annual Cost		$ 5,186,000	$ 3,937,000	$ 6,002,000	$ 6,041,000	$ 5,023,000	$ 5,871,000	$ 4,372,000	$ 3,836,000	$ 4,865,000	$ 3,797,000	$ 5,446,000	$ 4,919,000	$ 5,453,000	$ 182,000	$ 3,088,000	$ 1,917,000		

8.4.2 Pressure Zone Project Sheets

Pressure zone projects were identified by the system analysis found in Section 5 – Water System Analysis. Projects are spread throughout the system as shown on Figure 8.4:

- PZ-1: New PRV Station.
- PZ-2: Zone 670 Study.
- PZ-3: Zone 420 Central Fire Flow Deficiency.
- PZ-4: PRV Station Rehabilitation.
- PZ-5: PRV and Pipe Replacement along 178th Street.
- PZ-6: Zone 420 Central (NE) Fire Flow Deficiency.

8.4.3 Supply Project Sheets

Supply projects were identified by the District and are described in detail in the individual project sheets.

8.4.4 Storage Project Sheets

Storage projects needed to maintain pressure zone hydraulic grade line and provide adequate emergency storage were identified in Section 5 – Water System Analysis. The District provided input on storage facility maintenance needs. The projects are spread throughout the system as shown on Figure 8.4:

- ST-1: Zone 670 East Storage.
- ST-2: Hollywood Reservoir - Upgrade Improvements.
- ST-3: James Bard Reservoir -Upgrade Improvements.
- ST-4: Aspenwood Standpipe - Upgrade.
- ST-5: Sammamish Reservoir Upgrade.
- ST-6: Wellington Reservoir Upgrade.
- ST-7: South Hollywood Reservoir Upgrades.
- ST-8: Kingsgate Standpipe - Construction.
- ST-9: Brookside Reservoir Upgrade Improvements.

Further detailed descriptions can be found on the individual project sheets provided in Appendix K.

8.4.5 Pump Station Project Sheets

Pump Station projects to resolve system deficiencies and meet future growth were identified in Section 5 – Water System Analysis. PS maintenance projects were identified by the District:

- PS-1: Aspenwood Pump Station.
- PS-2: Ringhill East Pump Station Upgrade.
- PS-3: Emergency BPS in 650 Central Zone.
- PS-4: Low Pressure Program.
- PS-5: Replace Hollywood Pumps.
- PS-6: Replace Ringhill Pumps.
- PS-7: Wellington Booster Pump Station.
- PS-8: New Generator for Ringhill BPS.
- PS-9: Hollywood Pump Station Replacement.

General notes on the PS projects include:

- Cost estimates were provided by previous projects and District input.
- PS-4 is a program for the District to improve pressure to high elevation customers. Some areas in the District's system experience pressures below 30 psi during peak hour demand.

8.4.6 District-Financed Project Sheets

District-Financed projects were identified by the District and represent various projects that are not specifically allocated in the previous project types.

- DF-1: 2028 Water System Plan Update.
- DF-2: Dead End Main Program.
- DF-3: Little Dead End.
- DF-4: Replace East Gate at Campus.
- DF-5: King County (KC) 218th Avenue Northeast Drainage Improvements.
- DF-6: KC Northeast 133rd Street/ Northeast 128th Street Road Improvements.
- DF-7: Chlorine Stations.
- DF-8: Snohomish River Regional Water Authority (SRRWA) Annual Funding.
- DF-9: Water Seismic Resilience Plan.
- DF-10: 2016 Water System Plan Update.
- DF-11: Bulk Water Station.
- DF-12: City of Woodinville (COW) Sammamish River Bridge AC Replacement.
- DF-13: Washington State Department of Transportation (WSDOT) Lt. Bear Creek/SR 202 Culvert Replacement.
- DF-14: Miscellaneous COW and KC Projects.
- DF-15: Extended Service Agreement (ESA) Removals.
- DF-16: District Participation in Developer Extension (DE) Projects.

8.4.7 Cost Summary

CIP projects were summarized by project category and type in Tables 8.8 and 8.9, respectively. The total Water CIP cost over the next 20 years is approximately $103.7 million, which equates to approximately $5.2 million annually. Of the total cost, $49.2 million is budgeted for the short-term phase and approximately $54.5 million is budgeted for the long-term phase.

When considering CIP costs by project category, as shown in Table 8.9, the majority of CIP costs (67 percent) occur from distribution projects. The other high cost category is storage, at 19.0 percent of the CIP.

When considering CIP costs by project type, approximately 60 percent of the CIP costs are repair and replacement projects, and the majority of those projects are anticipated to be completed in the long-term. Improvement projects make up approximately 36 percent of the CIP costs, with a majority of these projects expected to be completed in the short-term planning horizon. Capacity projects make up only about 4 percent of the CIP costs, with the majority being completed in the short-term. Not many projects were categorized as capacity because the District's demands are not anticipated to increase very much over the planning period.

Table 8.8 CIP Summary by Project Type

Project Type	Total CIP Cost Estimate	CIP Phasing	
		Short-term (2018 – 2027)	Long-term (2028 – 2036)
Total Cost	**$ 103,723,000**	**$ 49,191,000**	**$ 54,533,000**
Capacity	$ 3,631,000	$ 2,452,000	$ 1,179,000
Repair & Replacement	$ 61,752,000	$ 18,936,000	$ 42,817,000
Improvements	$ 38,340,000	$ 27,803,000	$ 10,537,000
Annual Cost	**$ 5,186,000**	**$ 4,919,000**	**$ 5,453,000**

Table 8.9 CIP Summary by Project Category

Project Category	Total CIP	Percentage
Distribution System	$ 69,103,000	66.6%
Pressure Zone	$ 1,946,000	1.9%
Supply	$ 725,000	0.7%
Storage	$ 19,581,000	18.9%
Pump Station	$ 6,495,000	6.3%
District Funded	$ 5,873,000	5.7%
Total	**$ 103,723,000**	**100%**

Section 9

FINANCING AND IMPLEMENTATION

9.1 Introduction

This section summarizes the financial status of Woodinville Water District (District) and provides a cursory evaluation of the ability of the District to finance necessary capital improvements identified in the Capital Improvement Plan (CIP) as outlined in Section 8. Financial status of the water utility, funding required to finance the scheduled improvements, potential funding sources and the impact of water system improvements on water rates are presented.

9.2 Historical Financial Performance Summary

9.2.1 Current Water Rates, Fees, and Charges

The District has the following rate categories for their water system customers:

- Residential.
- Non-Residential.
- Irrigation.
- Fire Service.
- Public School Irrigation.

9.2.1.1 Monthly Meter Charge

The monthly charge for customers is based on meter size, regardless of customer type, as shown in Table 9.1. Residential and non-residential customers with a fire sprinkler meter also pay a monthly fire service charge of $3.10 and $21.30, respectively.

Table 9.1 2018 Monthly Meter Charge

Meter Size (inches)	Monthly Charge
3/4	$21.30
1	$53.55
1.5	$107.75
2	$172.00
3	$343.80
4	$538.70
6	$1,077.10
8	$1,718.75
10	$2,474.95

Note:
(1) Source: District 2018 Rate Schedule, adopted 12/6/2016.

9.2.1.2 Consumption Charge

In addition to the monthly charge, customers also pay a usage charge for the water consumed. Table 9.2 shows the District's consumption charges based on customer types. Residential customers have a winter and summer rate and are charged per hundred cubic feet (CCF) once they consume more than two (2) CCF (1,496 gallons) per month.

Table 9.2 2018 Consumption Charges

Customer Type	Consumption Charge (per CCF)
Residential (Winter)	$4.93
Residential (Summer)	$6.15
Non-Residential	$4.56
Irrigation	$8.68
Fire (Residential)	$10.40
Fire (Non-Residential)	$10.40
Public School Irrigation(2)	$4.56

Note:
(1) Source: WWD 2018 Rate Schedule, adopted 12/6/2016.
(2) Based on bi-monthly winter average usage for preceding October-April.

9.2.1.3 Excess Capacity Charges

The District charges residential customers an Excess Capacity Charge of $2.53 per CCF for any consumption greater than 25 CCF per the two-month billing cycle. Public School Irrigation customers have an excess capacity charge of $5.00 per CCF for consumption in excess of the customer's average winter bi-monthly use.

9.2.2 Wholesale Water Supply Costs

Wholesale water costs associated with purchasing water from the Seattle regional supply system represent a substantial portion of the District's annual operating expenses. These expenses represent the largest single item in the Water operating budget. In 2004, the District entered into a new, 60-year wholesale water supply agreement with Seattle, a copy of which is included in Appendix D. The terms of this contract did not change the configuration of how the District receives its water supply from Seattle. Changes associated with the new contract are primarily related to the "old water" philosophy. Under the new contract, the District will still be limited to volumes defined by their former old water allowance but the "interim growth charge" rate for water use over the old water allowance is limited to $0.60 per CCF and that charge was eliminated on December 31, 2011. The growth charge, coupled with a "Seattle Facilities Charge" collected directly from properties connecting to the water system under the new supply contract, provides a mechanism for growth to pay for additional regional infrastructure needed to service new water system connections.

9.2.3 System Development Charges

System Development Charges (SDCs) are one-time charges paid by new development to reimburse existing utility customers for costs previously paid to construct current system capacity or to help finance planned future growth-related capacity improvements. The charges help ensure that all customers connecting to the system bear an equitable share of costs that have been or will be invested to provide capacity needed to serve them and any further growth-related expansion. SDC revenues are deposited in the Utility's capital fund and are used to help support current and future capital expenditures.

Water SDC rates are traditionally recalculated following the update of the Comprehensive Water System Plan to reflect historical capital investments through that date and capital expenditures outlined in the Comprehensive Plan that are needed to support future growth. Current Water SDC rates are based on Resolution No. 3856 and effective January 1, 2017. These charges include a Woodinville SDC and a Seattle Facilities charge and are based on meter size. For a 3/4-inch meter the total SDC would be $5,755.00. The Resolution is attached in Appendix L.

9.2.4 Historical Financial Operations

The District's operating revenues for the years 2013 to 2018 are summarized in Table 9.3. Years 2013 through 2016 were provided through the District's financial statements and years 2017 and 2018 are budgeted revenues through the District's 2016 financial rate model. Water sales increased in 2015 and 2016 due to increases in irrigation.

Table 9.4 shows a summary of the District's operating expenses from 2013 to 2018. The District's purchase of water is the largest single expense, with a 2018 budget of approximately $3.2 million. Operating expenses include financial categories General and Administration, Finance, Water Operations, Information Technology (IT), and Engineering. Debt service payments are also included and explained in Section 9.2.5.

9.2.5 Outstanding Debt

The District has the following outstanding loans:

- 2012 Revenue Bond – 20-year principal and interest payment of approximately $612,000 per year, ending in 2032.
- Sewer Interfund Loan – 10-year principal and interest payment of $105,582 per year, ending in 2025.
- Public Works Trust Fund (PWTF) Loan – For multiple pipe replacement projects, varying in payments until 2021.

The District's Debt Service Coverage ratio (DSCR) is calculated by dividing the District's net income (revenues less expenses) by the annual debt service payment. The District has a target DSCR for planning purposes of 1.30. The District currently has a calculated DSCR of 4.14.

Table 9.3 Historical Operating Revenue

Operating Revenue	2013	2014	2015	2016	2017 Budget	2018 Budget
Water Sales	$11,929,165	$12,708,902	$13,483,933	$13,437,003	$12,595,672	$12,943,342
Other Revenue	174,260	166,989	169,787	184,128	266,496	267,682
Total	**$12,103,425**	**$12,875,891**	**$13,653,720**	**$13,621,131**	**$12,862,168**	**$13,211,024**

Note:
(1) Source: WWD 2016 Water Rate Model 10.14.16.xlsm and District's Financial Statements.
(2) 2017 and 2018 water sales include proposed rate increases.
(3) Years ended December 31st.

Table 9.4 Historical Operating Expenses

Operating Expenses	2013	2014	2015	2016	2017 Budget	2018 Budget
Wholesale Water Purchases	$3,595,615	$3,614,886	$3,519,852	$3,151,829	$3,151,829	$3,208,814
Operating Expenses	5,339,513	5,355,102	6,255,177	6,329,809	6,733,139	6,608,200
Debt Service Payments	$983,367	$934,992	$934,650	$1,008,171	$1,035,806	$1,035,064
Total	**$9,918,495**	**$9,904,980**	**$10,709,679**	**$10,489,809**	**$10,920,774**	**$10,852,078**

Note:
(1) Source: WWD 2016 Water Rate Model 10.14.16.xlsm and District's Financial Statements.
(2) Operating expenses include General Admin, Finance, Water Operations, IT, and Engineering expenses. Does not include depreciation.
(3) Years ended December 31st.

9.3 Financial Policies

The District's adopted financial policies and guidelines, found in Appendix L, were updated in the 2017-2018 Budget and discuss the following in detail:

- Financial Reporting Policies.
- Financial Planning Policies.
- Revenue Policies.
- Expenditure Policies.
- Rate Setting Policies.
- Collection of Billing Data.

9.4 Financial Forecast

9.4.1 Projected Operating Revenues and Expenditures

Using the District's forecast factors and assumptions presented in their 2016 water rate model, operating revenues and expenditures were projected to 2027, as summarized in Tables 9.5 and 9.6, respectively. The rate model currently forecasts through 2024. For consistency purposes, years 2025 through 2027 were assumed to have the same percent increases in expenditures as for 2023 and 2024.

9.4.1.1 Rate Increases

The projected water sales shown in Table 9.5 include an "across the board" rate revenue increase, which assumes the revenue collected from the metered water sales the previous year will increase by a certain percentage, and not calculated by each customer category. For budgeted years 2017 and 2018, it was assumed a 2.0 percent rate increase would be applied to the water sales, which is consistent with the District's 2016 Water Rate Model. A three (3) percent rate increase is assumed from 2019 to 2020 and a 2.5 percent increase from 2021 to 2037 in order to keep the District's minimum requirement of operating reserves at 60 days while funding the proposed capital improvement projects.

9.4.1.2 Reserves

The District has the following reserves, which are summarized in Section 4.2 of the District's Financial Policies and Guidelines, found in Appendix L:

- Operating Reserve.
- Capital Reserves.
- Vehicle Replacement Reserve.
- Bond Reserves.
- Rate Stabilization Reserve.

9.4.1.3 Cash Flow

Table 9.7 shows the ten-year projected operating cash flow for the water utility, which subtracts the total operation and maintenance expenses and any issued debt from the total operating revenues, as shown in the previous tables. The result is that the District's net revenue increases over the projected years. This is the projected cash flow with no grants or loans issued during this period.

Based on the current water utility status, the projected capital improvement projects detailed in Section 8, the assumptions provided by the District's rate model, and increasing the water rate revenue as indicated, the District will have an adequate amount of funds to cover the projected operating expenditures and capital projects through the long-term planning horizon.

Table 9.5 Projected Operating Revenue

Operating Revenue	2017 Budget	2018 Budget	2019	2020	2021	2022	2023	2024	2025	2026	2027
Water Sales	$12,595,670	$12,943,340	$13,430,270	$13,936,080	$14,390,480	$14,859,720	$15,346,220	$15,845,480	$16,362,290	$16,895,960	$17,447,030
Other Revenue	266,500	267,680	268,480	269,280	270,080	270,880	271,680	272,580	273,480	274,380	275,280
Total	**$12,862,170**	**$13,211,020**	**$13,698,750**	**$14,205,360**	**$14,660,560**	**$15,130,600**	**$15,617,900**	**$16,118,060**	**$16,635,770**	**$17,170,340**	**$17,722,310**

Note:
(1) Source: WWD 2016 Water Rate Model 10.14.16.xlsm.
(2) Water sales include proposed rate increases.
(3) Years ended December 31st.

Table 9.6 Projected Operating Expenditures

Operating Expenses	2017 Budget	2018 Budget	2019	2020	2021	2022	2023	2024	2025	2026	2027
Operating Expenses	$6,733,140	$6,608,200	$6,910,100	$7,225,850	$7,556,090	$7,901,470	$8,262,710	$8,640,520	$9,037,980	$9,453,730	$9,888,602
Wholesale Water Purchases	3,151,830	3,208,810	3,266,830	3,325,890	3,386,030	3,447,250	3,474,830	3,502,620	3,565,900	3,630,400	3,696,000
Total	**$9,884,970**	**$9,817,010**	**$10,176,930**	**$10,551,740**	**$10,942,120**	**$11,348,720**	**$11,737,540**	**$12,143,140**	**$12,603,880**	**$13,084,130**	**$13,584,602**

Note:
(1) 2017 to 2024 Source: WWD 2016 Water Rate Model 10.14.16.xlsm.
(2) Expenses and water purchases rounded.
(3) 2025 - 2027 water purchases and operating expenses increased by 0.8 percent and 4.6 percent, respectively, per District assumptions.
(4) Years ended December 31st.

9.4.2 Projected Capital Improvement Projects

Table 9.8 presents the water CIP based on the short-term (2018 to 2027) projects listed in Section 8. For the purpose of this analysis, the projects were designated by project categories and then allocated to certain years within the 2018-2027 period. These designations are assumptions and can be shifted as the utility determines a more detailed schedule. The financial model shows that the utility will have to use reserves in order to pay for the projected capital projects. By the end of the 10-year planning period, the reserves will be depleted by approximately $7 million, assuming the projected rate increases would be implemented with no additional debt to finance the CIP and approximately $5.6 million remaining in the fund balance. Long-term (2028-2037) projects are discussed in Section 8 and are included in the long-term financial forecast, as shown in Figure 9.1.

9.4.3 Financial Forecast Scenario – Water Rate Increases, No Additional Debt

Figure 9.1 shows the District's projected financial performance through 2037. This scenario assumes no additional debt is added to fund capital improvement projects, and instead rate increases would be applied. The stacked bar lines represent the District's operational expenses, CIP, and existing debt. The District's revenues are shown in the solid red line and include the proposed rate increases labeled. The District's ending fund balance is also shown in the solid blue line. The balance is projected to decrease from $12.7 million in 2018 to approximately $4.1 million by 2023 as the District will use its reserves to fund the proposed CIP, as detailed in Section 8.

The dashed red line in Figure 9.1 represents the District's minimum operating reserve requirement of 60 days operating expenses. Rate increases were adjusted to meet this requirement.

Table 9.7 Summary Projected Cash Flow (short-term)

	2017 Budget	2018 Budget	2019	2020	2021	2022	2023	2024	2025	2026	2027
(+)Total Operating Revenues	$12,862,170	$13,211,020	$13,698,750	$14,205,360	$14,660,560	$15,130,600	$15,617,900	$16,118,060	$16,635,770	$17,170,340	$17,722,310
(-)Total Operating Expenses	9,884,970	9,817,010	10,176,930	10,551,740	10,942,120	11,348,720	11,737,540	12,143,140	12,603,880	13,084,130	13,584,602
(-)Total Debt	$1,035,806	$1,035,064	$1,001,491	$1,000,564	$912,051	$716,038	$716,438	$716,638	$716,638	$610,856	$610,456
Total	$1,941,394	$2,358,946	$2,520,329	$2,653,056	$2,806,389	$3,065,842	$3,163,922	$3,258,282	$3,315,252	$3,475,354	$3,527,252

Note:
(1) Years ended December 31st.
(2) Does not include capital improvement projects.

Table 9.8 Projected Capital Improvement Projects (short-term)

Project Category	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total
Distribution Projects	$266,000	$4,358,000	$2,709,000	$1,328,000	$2,720,000	$1,994,000	$3,408,000	$2,519,000	$1,132,000	$1,895,000	$22,329,000
Pressure Zone Projects	0	122,000	425,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	967,000
Supply Projects	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$440,000	$15,000	$15,000	$575,000
Storage Projects	2,199,000	336,000	1,898,000	1,949,000	2,406,000	2,108,000	158,000	1,651,000	2,395,000	3,281,000	18,381,000
Pump Station Projects	$750,000	$165,000	$299,000	$1,476,000	$475,000	$0	$0	$0	$0	$0	$3,165,000
District-Financed Projects	707,000	1,006,000	695,000	195,000	195,000	195,000	195,000	195,000	195,000	195,000	3,773,000
Total	**$3,937,000**	**$6,002,000**	**$6,041,000**	**$5,023,000**	**$5,871,000**	**$4,372,000**	**$3,836,000**	**$4,865,000**	**$3,797,000**	**$5,446,000**	**$49,190,000**

Note:
(1) See Section 8 for detailed project information.

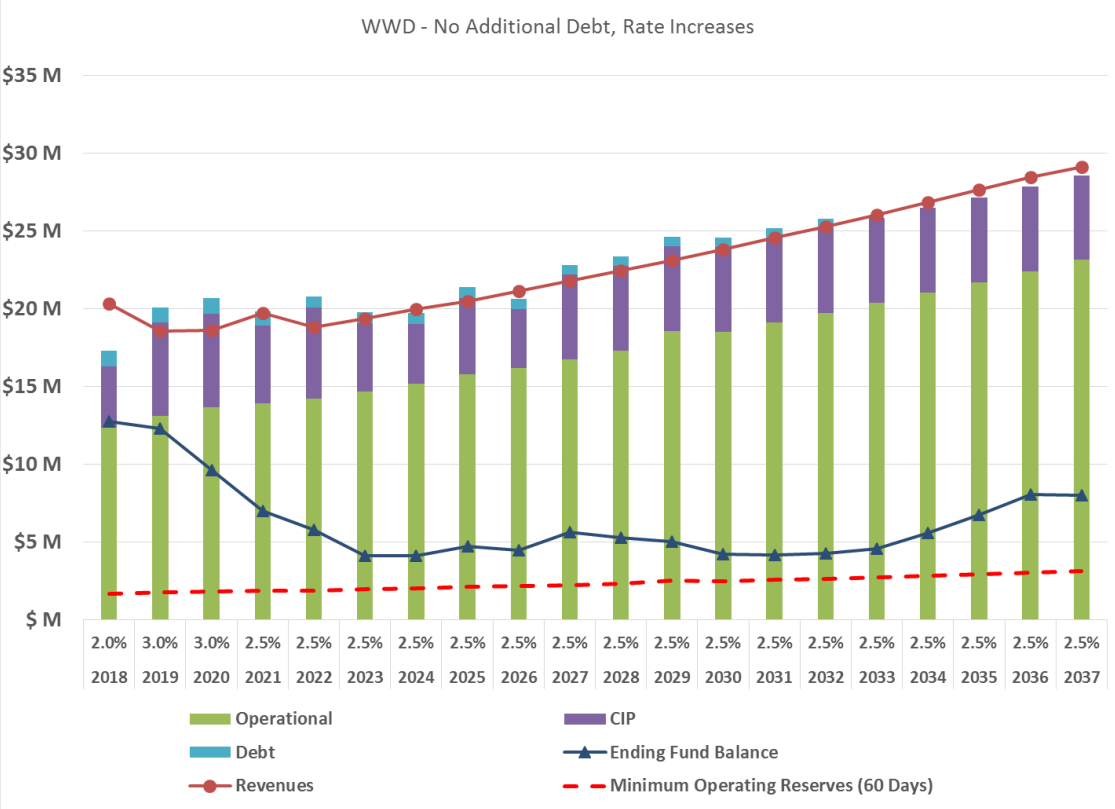

Figure 9.1 Financial Forecast

9.5 Available Funding Assistance and Financing Resources

The ten-year planning period shows the District's reserves will be adequate to fund the anticipated short- and long-term projects shown in the capital improvement plan with moderate rate increases. However, it is important for the District to understand what funding assistance and financing resources are available to help fund the CIP should reserves fall to a level that would not fund the CIP. The following is a summary of the District's resources.

9.5.1 Grants and Low Cost Loans

The Infrastructure Assistance Coordinating Council (IACC) is a non-profit organization that helps improve the delivery of infrastructure assistance, both financial and technical, to local governments and tribes in Washington State. The IACC has put together a list of funding opportunities that are currently available for drinking water and wastewater projects, broken down by the following:

- **Type of program:** (planning, pre-construction only, construction and design/construction, and emergency).
- **Eligible Projects**: the type of project (water, wastewater, stormwater, etc.).
- **Eligible Applicants:** the type of municipality or district, meeting certain requirements.
- **Funding Available:** whether the source is a grant or a loan, providing the maximum amount, and financial information if necessary.

- **How to apply:** providing the date to submit, website resources, and contact information.

The types of funding sources vary, but the main assistance programs are:

- **Public Works Trust Fund (PWTF):** loans for eligible projects including repair, replacement, and construction of infrastructure for domestic water projects that improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance.
- **Drinking Water State Revolving Fund (DWSRF):** This funding was established by the 1996 amendments to the Safe Drinking Water Act (SDWA) and is a partnership between the U.S. Environmental Protection Agency (EPA) and the states. According to the Washington State Department of Health (DOH) website, the DWSRF makes funds available to drinking water systems to pay for infrastructure improvements. The loan program is funded through federal and state money and subject to state laws and additional federal regulations. Loan repayments can range from 6 to 20 years.

9.5.2 Bond Financing

Bond financing is obtained by issuing general obligation or revenue bonds. Revenue bonds do not require voter approval and may be repaid with revenues from rates, miscellaneous fees or connection charges. The District has sold several revenue bond issues in the past to help finance system-wide improvements but presently only has a 2012 revenue bond outstanding, and will be paid in full by 2032.

9.5.3 Utility Local Improvement District (ULID) Financing

As noted from the District's previous Water System Plan, Utility Local Improvement Districts (ULIDs) are a mechanism that allows improvements to be financed by property owners who directly benefit from the improvements. A majority of benefited property owners must support formation of the ULID which may be initiated either by petition or by District resolution. ULID financing is generally used for local facility improvements in areas not previously served or where existing facilities are not adequate to support the type of development proposed for an area, when there are multiple property owners, instead of one developer who can assume responsibility for constructing necessary improvements. Financing is typically through bond sales or loans with the cost of improvements typically allocated to and assessed against benefited properties within the ULID area. Revenue from rates, however, can also be used to repay bonds issued to construct improvements under a ULID, allowing for District-wide participation in portions of the projects. While ULID's were used in the past to finance a good portion of the District's original water system, those assessments have all been paid in full and there are no utility customers with outstanding ULID balances at this time.

9.6 Summary

Upon analysis of the financial status of the water utility, the District has adequate revenues from water rates and system facility charges to meet the expected operating costs of the water system through 2027. Capital projects are projected to average approximately $4.9 million annually in the next ten (10) years, which will require the utility to use reserves to fund these projects. If the District chooses not to issue any debt, water rates are anticipated to increase 3.0 percent per year from 2019 to 2020 and then continuing at 2.5 percent through 2037. This would decrease the ending fund balance to approximately $4 million by 2023, which is still above the District's financial requirement of 60 days of operating expenses. The ending fund balance would remain above the minimum operating reserves through 2033 and begin to increase as current debt service would be ending. The District has the option to issue debt, apply for qualifying grants, or conduct a rate study to determine if rate increases would help cover the costs of the projected capital projects.